# Bachelor of Commerce

**Programme Code**: 110

**Programme Summary**

Duration: 3 years

**Eligibility**

10+2 in any discipline with minimum 40% marks in aggregate.

**Program outcomes:**

- To demonstrate an advanced, specialized and well-rounded knowledge of the chosen academic discipline.
- To develop aptitude for formulating research problem and data collection and statistical planning.
- To acquire knowledge about Corporate accounting and Financial Accounting.
- To develop analytic thinking skills and sound oral and written communication skills so as to be able to communicate ideas effectively.
- Ability to compute taxable income of Individual.
- Ability to analyze financial data for managerial decision-making.
- Knowledge of business laws like contract Act, Sale of Goods Act ,Partnership Act , Negotiable Act.
- Knowledge of emerging field E-commerce and its working pattern.
- To be trained in recombinant in on-line filing return.
- Knowledge about GST and Cost Accounting procedure and technique.
- To gain knowledge of auditing and marketing.
- Understand the concepts of Indian economy & principle of micro economics.
- To integrate an advanced knowledge of ICT practices so as to make the best possible use of electronic sources for academic purposes.
- To develop creativity, sound judgment skills, autonomy, ethical maturity and academic integrity with regards to their chosen disciplines.
- To develop basic computer skills required for study and employment.
- Adapt to recent changes in Marketing, Human Resource, Taxation, Environment and in investment of securities

**Course outcome:**

| S. | Course code | Course name | Credits | Course outcomes |
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| **1st Semester** | | | | |
| 1 | BC-101 | Environmental Studies | 2 | To understand appropriate sociological and technological measures in environment management.<br>To focus on ecosystem services and human well being and livelihoods.<br>To learn basis of problems and solutions in natural resource management<br>To find solutions towards more sustainable societies around the globe.<br>To learn strategies for waste reduction and disposal<br>To contribute meaningfully for analysis of environmental systems planning and management with both a local and global perspective<br>To understand the concept of sustainable development<br>To be able to cope with the impacts of climate change by adopting adaptation and mitigation measures<br>To prepare the students for national and global employability |
| 2 | BC-102 | Financial Accounting | 6 | To provide knowledge on the fundamental of financial accounting.<br>To expose the student to various financial transaction and its current application.<br>Prepare ledger accounts using double entry book keeping and record journal entries accordingly<br>To familiarize the concept of Branch account and its system<br>To introduce the system of Hire Purchasing<br>To provide knowledge on the fundamental of financial accounting.<br>To familiarize the concept of Consignment and joint venture accounting<br>To make the students to learn the various aspects of dissolutions methods<br>Demonstrate the concepts of Tally ERP.9 Software, to create company, journal entries, and financial statement. |
| 3 | BC-103 | Business Organization and Management | 6 | To enlighten with nature and scope of Business Organisation<br>To familiarize the students about various sources of finance<br>To provide knowledge about stock exchange<br>To enable them with office equipments and system.<br>To study about the organizations structures<br>Processes underlying diversity within an organization . |

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| 4 | BC-104 | English Language | 6 | We frequently hear the fashionable phase "good communication skills" widely bandid about these days. The greater the skills in speaking and writing,the grater the chances of success in many aspects of life ranging from friendships to business dealings.<br>Students on completion of this course will be able to enhance their already learnt concepts in grammar like -parts of speech, uses of frequently confused articles , prepositions, common mistakes in writing.<br>They will also become aware of how to write business letters , report writing, paragraphs writing, precis writing and comprehensions. |
| **2nd Semester** | | | | |
| 5 | BC-201 | English Language | 2 | On completion of this course students will reach to the threshold of proficiency in English communication skills. It will not only enable them to pass their examination exeditably but will also help them learn a subject that holds the key to their success in future.<br><br>The significance of clear and effective communication in present age of globalization is self evident.<br>Student at the end of this course will find a difference in their personal and professional interaction.<br>They will become aware of the writing style of business letter ,note making, report writing, job application, cover letter, resume bio data, c.v. |
| 6 | BC-202 | Business Law | 6 | To understand the concepts of business law and its importance.<br>To understand the procedure of application of the business law in various aspects<br>To understand basic knowledge about Indian Contract Act 1872.<br>To know about Partnership act 1932 and LLP act 2008.<br>To know about the basic knowledge of sale of goods act 1930.<br>To know about the basic knowledge of Negotiable Instrument Act 1881 |
| 7 | BC-203 | Business Statistics | 6 | Understand Meaning and concepts of Statistics and different methods of presentation of Statistical data.<br>Classification of different measures of central tendency and variations.<br>Computation of simple correlation and regression which is comparing more than one set of data.<br>Analysis the causes of variations in Time series.<br>Application of statistics in business and economics. |
| 8 | BC-204 | Modern Hindi Language | 6 | **आधुनिक भारतीय भाषाः हिन्दी गद्य का उद्भव और विकास**<br>इस पाठ्यक्रम की समाप्ति पर छात्र हिन्दी गद्य साहित्य के बारे मे सामान्य जानकारी प्राप्त कर सकेंगे।<br>हिन्दी गद्य साहित्य का विभिन्न कालक्रमानुसाार विकास को परिभाषित कर सकेंगे।<br><br>छात्र हिन्दी गद्य की विभिन्न विद्याओं से परिचित हो सकेंगे। |

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| | | | | छात्र हिन्दी गद्य साहित्य के मूर्धन्य साहित्याकार<br>जैसे मुंशी प्रेमचन्द, यशपाल, कृष्णा सोबती, बालमुकुन्द गुप्त, भारतुन्दु हिरशचन्द, हरिशंकर परसाई एवं महादेवी वर्मा तथा इनके कृतियों से परिचित हो सकेंगे। |
| **3rd Semester** | | | | |
| 9 | BC-301 | Company Law | 6 | Classification of different types of Joint Stock Companies.<br>Understanding memorandum of association, Articles of association and Prospectus.<br>Knowledge on share capital, borrowing powers of companies.<br>Awareness about directors, meeting and resolutions passed.<br>Understand winding up of the company. |
| 10 | BC-302 | Income Tax Law and Practice | 6 | To introduce the basic concept of Income Tax.<br>In order to familiarize the different know-how and heads of income with its components.<br>It helps to build an idea about income from house property as a concept.<br>It give more idea about the income from business or profession. |
| 11 | BC-303 | Modern Hindi Language | 6 | **आधुनिक भारतीय भाषाः हिन्दी – हिन्दी**<br>इस पाठ्यक्रम के पूर्ण होने के उपरान्त छात्र<br>आधुनिक भारतीय भाषा (संविधान की आठवीं अनुसूचि में वर्णित 22 भाषा) का सामान्य परिचय दें सकेंगे।<br>हिन्दी साहित्य के आदिकाल, मध्यकाल एवं आधुनिक काल को उनकी प्रवृत्ति के आधार पर परिभाषित कर सकेंगे।<br>भक्तिकालीन प्रमुख कवियों एवं उनकी रचनाओं से परिचित हो सकेंगे।<br>रीतिकाल एवं आधुनिक काल के प्रमुख हिन्दी कवियों, उनकी प्रमुख रचनाओं एवं काल विशेष की प्रमुख प्रवृत्तियों की जानकारी प्राप्त कर सकेंगे। |
| 12 | BC-304 | Computer Applications in Business | 2 | To introduce the students about basics of MS-Office.<br>To provide practical knowledge exposure to MS-Word.<br>To provide practical knowledge exposure MS-Excel<br>To provide practical knowledge exposure MS-Power Point<br>Develop the competence of database management<br>To make them aware about information system concepts and features<br>To provide knowledge about Hardware and Software<br>Enable the students with data processing and modern electronic medium<br>Develop the students about application of information system<br>Create an awareness about security , threats and its protective measures |
| | | Computer Applications in | 2 | Provide basic knowledge about handling the computer |

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| | | Business (Practical) | | Provide knowledge of MSWord, MS Excel And MS PowerPoint<br>Surfing of internet<br>Knowledge about accounting package |
| **4th Semester** | | | | |
| 13 | BC-401 | Business Communication | 6 | To develop Communication skills and overall personality development of the students.<br>To acquire skills in reading ,writing ,comprehension and communication ,as also to use electronic media for Business Communication .<br>The effective use of various types of communication.<br>Develop communication skills for the workplace<br>Techniques to improving your presentation skills. |
| 14 | BC-402 | Corporate Accounting | 6 | Enabling the students to understand the features of Shares and Debentures<br>Develop an understanding about redemption of Shares and Debenture and its types<br>To give an exposure to the company final accounts<br>To provide knowledge on Valuation of Goodwill & Shares<br>Enable the students to understand about amalgamation , absorption and external reconstruction<br>Students can get an idea about internal reconstruction<br>To introduce and develop knowledge of holding companies accounts<br>To make them aware about accounts of banking companies<br>Keep them aware about CashFlow Statement |
| 15 | BC-403 | Cost Accounting | 6 | Aimed to familiarize the concept of cost accounting<br>Helps to gather knowledge on preparation of cost sheet in its practical point of view<br>To facilitate the idea and meaning of material control with pricing methods<br>Develop the knowledge about remuneration and incentives<br>To introduce the concept of overhead cost. |
| 16 | BC-404 | E-Commerce | 3 | Understand the concept of E-Commerce and Describe the opportunities and challenges offered by E-Commerce<br>Able to handle electronic payment technology and requirements for internet based payments<br>Understand the categories of E-Commerceand understand |

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| | | | | the different applications of E<br>-Commerce<br>To understand and identify<br>security issues of E-Commerce<br>Understand the concept of WEB Based BusinessUnderstand the M-Commerce applications. |
| | | E-Commerce (Practical) | 1 | Provide knowledge of Website Development<br>Provide knowledge of online Transactions through E-Commerce sites |
| **5th Semester** | | | | |
| 17 | BC-501 | Principles of Marketing | 6 | To provide understanding of Marketing and the Market driven enterprise to differentiate market.<br>Identify the basic approaches to formulate. Marketing strategy.<br>Identify stages of the Market planning process.<br>To know the overview of Management.<br>To study planning procedure. |
| 18 | BC-502 | Goods and Service Tax (GST) | 6 | It provides Knowledge to students regarding the laws and principal of taxation and custom laws<br>It enhances there capabilities to understand the taxation prevailing in the current economic system<br>It enhance there knowledge of taxation accounting of GST which is necessary for the current market system.<br>Identify the characters of customs duty.<br>Understand about tax Computation. |
| 19 | BC-503 | Principles Of Micro Economics | 6 | Students able to think critically and formulate independent and well considered conclusion about economic issues and policies.<br>Make rational decisions based on rudimentary marginal analysis.<br>Understand market structures and Market power .<br>Understand the demand analysis<br>Students able to understand cost analysis.<br>Students will able to understand knowledge of law of supply and demand. |
| 20 | BC-504 | Entrepreneurship | 4 | Inculcate innovative ideas for their new initiatives.<br>Manage their own/family business in skillful manner with new idea coping with fast changing requirements of the society.<br>Work together collaboratively for the startup of their new business instead of waiting for white collar job.<br>Communicate skillfully with government officials and financial institutes with full confidence. |

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| | | | | Ready their project for new venture after completion of their study. |
| **6th Semester** | | | | |
| 21 | BC-601 | Auditing And Corporate Governace | 6 | This paper gives the knowledge of examines the principles and practices of internal and external auditing<br>The students is capable in understanding the auditing as a component of recurrent and strategic activities, risk assessment, internal control, systems evaluation, forensic accountability, and contemporary audit issues and challenges.<br>Described about the concept of auditing, types and methods of auditing.<br>Acquired knowledge about vouching of cash & credit transaction, verification of assets and liabilities |
| 22 | BC-602 | Consumer Protection | 6 | Students will have a comprehensive understanding about the existing law on Consumer Protection in India.<br>Students will be conversant with major International Instrument on Consumer Protection.<br>Students will be aware of the basic procedure for handling consumer dispute.<br>Students will be able to appreciate the emerging questions and policy issues in consumer law for future research<br>Students able to know the rights of consumer .<br>Should able to know about the Ombudsman. |
| 23 | BC-603 | Indian Economy | 6 | To impart the knowledge about objectives and economic planning in India.<br>Mixes Economy and economic planning, development strategy in India, liberalisation, privatization and Globalisation.<br>Providing exposure to basis of Indian Economy.<br>To create student's ability to suggest of the various economic problems.<br>To know the development process in India after independence.<br>Should able to understand structures of economy.<br>Importance causes and impact of population growth. |
| 24 | BC-604 | Seminar and Comprehensive Viva Voce | 4 | To gain the experience of a interview before they go out seeking jobs in industry.<br>To develop confidence in a face to face interaction in a formal setting. |

## B.Sc. Forestry

**Programme Code: 103**

**Programme Summary**

Duration: 4 years

**Eligibility**

10+2 with at least 45% marks in PCB/PCM.

**Program outcomes:**

- To get acquainted with basics & principles of Plant Biochemistry, Biotechnology, Physiology, Botany, Cytology-genetics, Computers, Statistics and English.
- To understand the fundamentals of Hydrology, Geology and Soil science like chemistry and fertility of Forest soils, Sericulture, Environmental Science and Horticulture.
- To learn the ethnobotany along with medicinal and aromatic Plants and their uses and impacts on the tribal communities and remote villages using extension education concepts.
- To understand the effect of meteorology on crops production and weather forecasting models to cope up with the uncertainty of Indian weather conditions.
- To gain the preliminary knowledge on geographical distribution of grasslands, forests and their classification in the India and in the world. Critical examination of the world forest sources, productivity potential and increment of world forests.
- To learn the principles and practices of Silviculture, silvicultural and dendrological knowledge i.e. origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, tending operations and economic importance of important conifer and broad leaved tree species of India & also the nursery techniques of these tree species.
- To learn the Forest management skills for best growth of any forest and also to get acquainted with the Forest policies and the laws.
- To develop the skills to take-up forest mensuration exercises and ecological studies in the forested areas.
- To explore the anatomical studies of tree/woody perennials including monocot and dicot.
- The skills on tree-seed collection, seed storage, seed testing for purity, viability, moisture, germination etc will be developed in this program.
- To learn the principles & techniques of tree improvement i.e. selecting superior trees in natural stands and plantation, controlled crossing techniques, Vegetative propagation techniques, Pollen viability determination.
- It provides in depth information on logging operations in the forests, develop basic knowledge on chemical, physical, mechanical, electrical as well as sound related properties of timber, various treatments like seasoning of wood, preservation of wood and the utilization of the timber/wood collected in various industries.
- It imparts general idea about the use of wood as an engineering material for bridges, roads and building material.
- It also provides basic knowledge on the role and use of Remote Sensing in Forestry.
- To develop knowledge on methods of collection, extraction, classification, storage, uses, management and importance of Non-Timber Forest Products (NTFP) viz.- Fodder (grasses and tree leaves), canes and bamboos, essential Oils, non-essential oils, Gums and resins, Tans and dyes.

- To gain the knowledge on traditional & well designed Agroforestry systems, techniques, management and their advantages over sole cropping landuse systems.
- To develop the skills to identify and cure the diseases, insects, pests of the Forest trees.
- To explore about the wildlife and its management including habit & habitat of different wildlife, scientific names, behavior and adaptations of important wild species.
- To know about the basic concept of entrepreneurship and its development in forestry. Project planning, evaluation, Swot analysis.
- To become familiar with basic economic and business principles and how they can be applied to forestry. Utilize economic principles to address private and public policy issues related to allocating natural resources and environmental amenities.
- To develop skills to conduct various field based activities of forestry aspects.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.
- To provide hands-on-trainings or Forestry work experience on Socio-economic surveys in villages, Forest Department attachments, Forest-based-Industrial attachment and Production and marketing of quality planting material.

## Course outcomes:

| S.no. | Course code | Course name | Credits | Course outcomes |
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| | | | | **1st Semester** |
| 1 | SOA/FC101T | Fundamentals of Geology & Soil science | 2 | To explore about Composition of earth's crust, soil as a natural body major components by volume pedologyrocks types Igneous sedimentary and metamorphic classification soil forming minerals. Definition classification – silicates, oxides, carbonates, sulphides, phosphates occurrence. Weathering of rocks and minerals, weathering factors: physical, chemical, biological agents involved, weathering indices, factors of soil formation, land forms parent, material climate organism, relief time soil forming processes eluviations and illuviation formation of various soils.<br>To study about problem soils: salted soils, permeable, flooded, sandy soils properties. Physical parameters texture definition methods of textural analysis textural classes, absolute specific gravity definition apparent specific gravity/bulk density factors influencing field bulk density. Relation between BD. Pore space definition, factors affecting capillary and noncapillary porosity, soil colour definition, its significance, colour variable hue, value, chroma, Munsell colour chart, factors influencing parent material soil moisture organic matter, soil structure, types of structure, factors influencing genesis of soil structure. Soil air-air composition, amount of air space, soil air renewal, soil temperature sources and distribution of heat, chemical properties humus inorganic secondary silicate clay hydrous oxides.<br>To Acquire knowledge about Soil organic matter decomposition, pH nutrient availability, soil buffering capacity, soil water forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity, energy concepts, pF scale measurement-gravimetric, electric and tensiometer methods. Soil water movement, saturated and unsaturated infiltration and percolation. Soils of different eco-systems and their properties. |
| 2 | SOA/FC101P | Fundamentals of Geology & Soil science-Practical | 1 | To have a knowledge about Identification of rocks and minerals; Collection and preparation of soil samples; Soil analyses for moisture, color, bulk density, organic matter, pH, EC; textural analysis; study of soil profile I & II.<br>To have field experience by excursions/ tours for identification of rocks and minerals and profile studies; practical introduction to tensiometer, pressure plate and neutron probe etc. |
| 3 | SOA/FC102T | Plant Biochemistry and Biotechnology | 2 | To understand the significance of Biochemistry.<br>Describe the chemistry of carbohydrates, lipids, proteins and amino acids.<br>Describe the classification and structural organization of proteins.<br>Describe the mechanism of enzyme action and identify the classes of enzymes and factors affecting action.<br>Describe the catabolic reactions of carbohydrates, lipids and amino acids.<br>Understand Concepts, principles and processes in plant biotechnology.<br>Identify the class and functions of secondary metabolites |

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| 4 | SOA/FC102P | Plant Biochemistry and Biotechnology- Practical | 1 | Students will be able to assay the compound qualitatively or quantitatively<br>Determination of unknown compound.<br>Develop skills for application of tissue culture techniques in tree improvement.<br>To get knowledge about the plant tissue culture. |
| 5 | SOA/FC103T | Principles of Plant Physiology | 2 | To know about the metabolic activity and life, cycle of the plant from germination through growth and development.<br>To know importance and scope of plant physiology.<br>To understand the plants and plant cells in relation to water-osmosis, imbibitions, diffusion and water potential and the movement of sap and absorption of water in plant body, structure and function of stomata, opening and closing of stomata, different types of stresses- water, cold, heat, plant nutrition and essentiality and mechanism of absorption.<br>To understand the process of photosynthesis particular light and dark reaction, respiration particular emphasis on aerobic and anaerobic respiration, photo-hormones. |
| 6 | SOA/FC103P | Principles of Plant Physiology- Practical | 1 | To learn about measurement of water potential by osmosis and plasmolysis method.<br>To demonstrate the rate of transpiration by using Potometer.<br>To learn demonstrate the importance of photosynthesis by the help of wilmonnt bubbler and inverted funnel exp.<br>To study plant movement by the help of clinostat.<br>To study separation of leaf pigments by paper strip chromatography.<br>To study structure of stomata and role of stomata in transpiration by using four leaves exp. |
| 7 | SOA/FC104T | Statistics & Computer Application | 2 | Statistics: Basic Statistical concept.<br>Average and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, for raw and grouped data.<br>Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data.<br>Probability concepts.<br>Correlation & Regression.<br>Test of significance.<br>Computer Application:<br>Introduction to computers and personal computers given.<br>Basic concepts of hardware and software discussed.<br>Input and output devices demonstrated.<br>Operating system and its importance elaborated.<br>Exposure to MS Office , MS word, MS PowerPoint and MS Excel have been provided. |
| 8 | SOA/FC104P | Statistics & Computer Application-Practical | 1 | As per the SOA/FC104T<br>Practical case studies on MS Office practiced. |
| 9 | SOA/FAECC101T | Structural Grammer and Spoken English | 1 | Introduction to word classes; structure of the verb in English.<br>Uses of tenses. Study of voice. Use of conjunctions and prepositions.<br>Sentence patterns in English.<br>Spoken English: conversations of different situations in everyday life. The concept of |

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| | | | | stress, stress shift in words and sentences. |
| 10 | SOA/FAECC101P | Structural Grammar and Spoken English- Practical | 1 | As per the SOA/FC101T |
| 11 | SOA/FE101T | Chemistry & fertility of Forest Soils | 1 | To explore the knowledge of Chemistry & fertility of Forest Soils and their importance.<br>Scope, opportunities and constraints of soil and its chemistry.<br>Introduction to Forest soils and cultivated soils. Properties of soils under different forest ecosystems. And also know the Essential nutrient elements-occurrence, availability and their functions. |
| 12 | SOA/FE101P | Chemistry & fertility of Forest Soils- Practical | 1 | To identify and study forest soil profile and Determination of available N, P & K content of soil. |
| 13 | SOA/FE103T | Introductory Botany | 1 | Introduction to Botany and general classification of plants.<br>Structure and types of plant tissues.<br>Internal Structure of Dicot and Monocot Stems, roots and leaf.<br>Significance of life cycle with special reference to alternation of generations in *Chlamydomonas, Rhizopus, Funaria, Adiantum, Pinus* and a flowering plant. |
| 14 | SOA/FE103P | Introductory Botany- Practical | 1 | Studies of permanent slides of anatomy of stem root and leaf.<br>Study of various plant parts.<br>Survey to local area to study local vegetation. |
| 15 | SOA/FE104T | Sericulture | 1 | It provides exposure to the history of sericulture development and future scopes.<br>Detailed study of mulberry and its cultivation practices in different climatic zones of country. |
| 16 | SOA/FE104P | Sericulture- Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE104T. |
| **2nd Semester** | | | | |
| 17 | SOA/FC105T | Principles of Hydrology,Soil- Water Conservation and wasteland | 2 | Students know basic terms used in hydrology.<br>Students comprehend the hydrologic cycle and related major water quantity and quality challenges and their relevance to human health and well-being, ecosystems, and the food supply.<br>Students understand the role of hydrology, water resources management.<br>Students understand the principle of water flow in the nature.<br>Students understand the structure and activities of various types of aquifers.<br>Students know basic methods for measuring and analysing hydrologic parameters.<br>Students understand the importance of water sources and know how to adequately protect them.<br>Students understand the importance of soil and know how to conserve that.<br>Students understand the concept of Wasteland and reclamation of wasteland. |
| 18 | SOA/FC105P | Principles of Hydrology, Soil- Water Conservation and | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC105T. |

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| | | wasteland- Practical | | |
| 19 | SOA/FC106T | Principles of Cytology and Genetics | 2 | History of genetics and hypothesis-theories.<br>Physical basis of heredity, cell reproduction mitosis-meiosis and their significance.<br>Gametogenesis and syngamy in plants.<br>Mendel's principles of heredity, deviation from Mendelian inhritance, Chromosome theory of inheritance, gene interaction: modification of monohybrid and dihybrid ratios. Multiple alleles, quantitative inheritance, linkage and crossing over, sex determination - theories, sex linked inheritance and characters.<br>Cytoplasmic inheritance and maternal effects. Chemical basis of heredity:<br>Structure of DNA and its replication. Evidences to prove DNA as genetic material.<br>Mutation and its classification.<br>Chromosomal aberrations: Changes in chromosome structure and number |
| 20 | SOA/FC106P | Principles of Cytology and Genetics-Practical | 1 | As per the SOA/FC106T |
| 21 | SOA/FC107T | Ethnobotany | 2 | Traditional ecological knowledge of wild plant to the society.<br>To communicate and describes the healing uses of local plants.<br>To experience the cultural contact of the healing and food local food production process.<br>To describes and observe the use and role and importance of psycho active plant within their traditional contact.<br>To identify local plants and scientific names and mythology of syllabus related families.<br>Bring out the relevance of ethnobotany in the present context.<br>Know about the major and minor ethnic groups or Tribal's of India, and their lifestyles.<br>Learn about the methodology of Ethnobotanical studies.<br>Gain knowledge on the role of role of ethnobotany in modern medicine.<br>Get awareness on the conservation practices of medicinal plants. |
| 22 | SOA/FC107P | Ethnobotany-Practical | 1 | To learn about traditional local plants used as traditional medicine, as food, as fodder, as fiber etc. by local people.<br>To visit various local places to collect information regarding traditional uses of plants.<br>To study about identification of plants associated with mentioned families in syllabus.<br>To study mythology of some common local plants. |
| 23 | SOA/FC108T | Medicinal and Aromatic Plants | 2 | To excel the knowledge of Medicinal and aromatic plants and their importance. Scope, opportunities and constraints of medicinal and aromatic plants. Origin, importance, distribution, production, climate, soil, water, plant protection, harvesting and use of important medicinal and aromatic plants. Endangered medicinal and aromatic plants of India and their conservation. |
| 24 | SOA/FC108P | Medicinal and Aromatic Plants- Practical | 1 | To identify different types of plants including tree, shrub and herbs in surrounding forest areas. Different processing methods of medicinal and aromatic plant products through industrial/ institute visits. |
| 25 | SOA/FC109P | Technique / field tour | 1 | Field tours to study the forestry field techniques. |
| 26 | SOA/FAECC102T | Environmental Science | 1 | Environment: introduction, definition and importance. |

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| | | | | Components of environment -interactions with organisms. Global and Indian environment - past and present status.<br>Environmental pollution and pollutants.<br>Smog, acid rain, global warming, ozone hole, eutrophication, sewage and hazardous waste management.<br>Impact of different pollutions on humans, organisms and environment.<br>Introduction to biological magnification of toxins.<br>Deforestation - forms and causes relation to environment.<br>Prevention and control of pollution - technological and sociological measures and solutions - Indian and global efforts.<br>India, international and voluntary agencies for environmental conservation - mandates and activities.<br>International conventions and summits - major achievements.<br>Environmental policy and legislation in India.<br>Introduction to environmental impact assessment. Causes of environmental degradation - socio-economic factors.<br>Human population growth and lifestyle. |
| 27 | SOA/FAECC102P | Environmental Science-Practical | 1 | As per paper SOA/FAECC102P |
| 28 | SOA/FE105T | Fundamental of Extension Education | 1 | To explore about of extension forestry can be expressions of the end towards which our efforts are directed. And also with the help of extension education is the development of the rural people, and also to improve all aspects rural people lives within the framework of the national development policies and people's need for development. |
| 29 | SOA/FE105P | Fundamental of Extension | 1 | To learn about the structure, functions, linkages and extension programmes of ICFRE institutes/voluntary organizations/ Mahila Mandal, Village Panchayat, State Dept. of Forests/All India Radio (AIR). |
| 30 | SOA/FE106T | Fundamentals of Horticulture | 1 | To study the Economic importance and classification of horticultural crops.<br>To learn about the nutritive value of fruits and vegetables.<br>To learn about the area and production of horticultural crops.<br>To understand about the exports and imports of horticultural crops.<br>To learn about fruit and vegetable zones of India and of different states.<br>To understand the nursery management practices, soil and climate.<br>To gain knowledge about vegetable gardens, nutrition and kitchen garden and other types of gardens.<br>To understand the principles, planning and layout.<br>To learn about the management of orchards.<br>To understand the planting systems and planting densities.<br>To gain knowledge about production and practices for fruit, vegetables and floriculture crops.<br>To gain knowledge about nursery techniques and their management. |

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| | | | | To understand the principles and methods of pruning and training of fruit crops.<br>To learn about the types and use of growth regulators in horticulture.<br>To learn about water management, weed management and fertility management in horticultural crops.<br>To study about bearing habit and factors influencing fruitfulness and unfruitfulness.<br>To learn about the rejuvenation of old orchards, top working, frame working.<br>To understand about the principles of organic farming |
| 31 | SOA/FE106P | Fundamentals of Horticulture-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC106T |
| 32 | SOA/FE107T | Agrometeorology | 1 | Students understand the role of meteorology for crop production.<br>Students understand concepts of Weather & Climate and their significance for atmosphere.<br>Students get the knowledge of different type of clouds.<br>Students understand the science behind formation of cyclones and anticyclones.<br>Students comprehend effect of Solar radiation on plant growth.<br>Students know the concept of agroclimatic zones.<br>Students get to know about global warming and impact on climate change.<br>Students get to know the use of remote sensing in Agrometeorology. |
| 33 | SOA/FE107P | Agrometeorology-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC107T |
| **3rd Semester** | | | | |
| 34 | SOA/FC110T | Logging and Ergonomics | 2 | To learn about and scope of logging, study of logging plan and execution.<br>Study of Location and demarcation of the area for logging and estimation of produce available for extraction.<br>Study of Implements used in logging operation- traditional and improved tools.<br>Study of Felling rules and methods. Conversion.<br>Study about various means of transport of timber- carts, dragging, skidding, overhead transport, ropeways, and skylines.<br>Transport by road and railways. Transport by water- floating, rafting and concept of booms.<br>Study of Grading and Storage of timber in the depots for display and disposal. Timber Depots- types, lay out and management.<br>Study of Systems of disposal of timber.<br>Study of Ergonomics, components and provision of energy.<br>Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition.<br>Study of Personal protective equipments, safety helmets, ear and eye protections.<br>Accidents: causes, safety rules and first aids. |
| 35 | SOA/FC110P | Logging and Ergonomics-Practical | 1 | Field study of Survey and demarcation of area intended for logging and listing of permanent boundary marks; Marking of trees for logging operation and preparation of marking list. |

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| | | | | Study of Equipments and tools used in logging operations and their uses.<br>Study of Planning and execution of different logging operation in a phase wise manner;<br>Study of Application of felling rules in the forests for felling of standing trees at different localities.<br>Study of Instructions regarding maintenance of various records and registers in logging operations.<br>Study of Conversion of felled trees into logs, poles, firewood, pulpwood etc.<br>Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers.<br>Minor and other types of transport practicable at felling sites;<br>Study of Final transport, information regarding transit permits for various types of forest produce;<br>Visit to local dumping yard (timber depot) to trace the logs delivered from different forest sites;<br>Study of Sorting of logs, poles and firewood in the depots according to species, quality, length and girth classes; Study of Stacking and stock checking of different logs, poles and firewood in the depots so as to confirm that all the converted materials in the forests have reached their destination.<br>Study of Recording of the lots for auction sale. Final disposal of the material; Visit during the auction sale in the government timber depots;<br>Study of Preparation of ergonomic check lists. |
| 36 | SOA/FC111T | Soil Survey, Remote Sensing | 2 | Scope and objective; soil survey, sampling methods; planning, inventory, permanent sample plots; sample size allocation, landuse classes and planning.<br>Soil survey – classification–aerial photography–satellite–their interpretation, land-capability-classification.<br>Aerial photography and remote sensing-definition, meaning, scope, merits and brief history.<br>Electromagnetic spectrum; radiations, differential reflections by surfaces, active and passive remote sensing, earth observation satellites. Equipment and materials-aerial bases, cameras, filters, stereoscopes, computers, radars.<br>Photogrammetry: Vertical and oblique photography. Photographs and images, scales, resolution, photo interpretation, photogrammetry, image analysis, mapping.<br>Agencies involved in remote sensing and acquiring information from them.<br>Remote sensing; principles, uses in forestry, vegetation / cover classification and mapping, species identification, height and volume – estimation. Identification of tree species and their form stand delineation.<br>Interpretation of land forms and soils; use of micro-level survey of farm forests, large scale photos in forest inventory, site selection. Imagery and image analysis – video satellite, computer and radars. Geographic Information systems- Computer softwares used. |
| 37 | SOA/FC111P | Soil Survey, Remote Sensing -Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC111T |
| 38 | SOA/FC112T | Forest Mensuration | 2 | To understand different techniques to calculate parameters of tree like diameter, girth, age |

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| | | | | etc;<br>Understanding and use of instruments used in forest mensuration.<br>To prepare volume table concept of forest inventory and sampling techniques.<br>Application of Remote Sensing |
| 39 | SOA/FC112P | Forest Mensuration-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC112T |
| 40 | SOA/FC113T | Forest Engineering & Survey | 2 | Basic knowledge of types of survey and related instruments.<br>Concept and design of forest roads and building materials.<br>Design of bridges. |
| 41 | SOA/FC113P | Forest Engineering & Survey-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC113T |
| 42 | SOA/FC114P | Technique / field tour | 1 | Field tours to study the forestry field techniques. |
| 43 | SOA/FSEC101T | Tree Seed Technology | 1 | To learn about Seed and its importance. Study of Role of seed technology in nursery stock production.<br>Study of Production of quality seed, identification of seed collection areas-seed orchards – maintenance of genetic purity-isolation and rouging, seed study of source (provenance and stands). Study of Selection of seed tree (genotypic and phenotypic selection), plus tree (pure stands, elite seed tree, isolated tree and their location).<br>Study of Seed Collection – Planning and Organization, Collection methods, Factors affecting seed collection,<br>Study of Seed maturity and tests. Seed Study of processing – Seed extraction, drying, blending, cleaning, grading, treating, bagging, labeling and storage. Study of seed Storage – orthodox, intermediate and recalcitrant<br>seeds, precautions of handling of recalcitrant seeds, natural longevity of tree seeds, factors affecting longevity.<br>Study of Seed testing (sampling, mixing and dividing, determination of genuineness, germination, moisture, purity, vigour, viability). Seed Study of seed dormancy, classification and breaking of seed dormancy.<br>Study of Different viability and vigour tests, seed pelleting, seed health. Classes of tree seeds, study of seed certification and procedures of tree seeds certification. |
| 44 | SOA/FSEC101P | Tree Seed Technology-Practical | 1 | Identification of seeds of tree species; Seed<br>Study of maturity tests; Physical purity analysis;<br>Determination of seed moisture; Seed germination test; Hydrogen peroxide test;<br>Study of Tetrazolium test for viability; Seed vigour and its measurements; Identification of seed dormancy and methods of breaking dormancy in tree seeds; Testing membrane permeability;<br>Study of seed collection and equipments; Study of Planning of seed collection; Seed collection; Seed extraction;<br>Visit to seed production area and seed orchard; |

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| | | | | Visit to seed processing unit/testing laboratory;<br>Study of seed sampling equipments. |
| 45 | SOA/FE109T | Wood Anatomy | 1 | To explore the anatomical studies of tree including monocot and dicot. Plant cell and tissue and types. Stem root and leaf anatomical studies. Mechanism of secondary growth and its importance. Early wood and late wood formation. Sapwood and heart wood and abnormal secondary growth in plants. Micro- and macro properties of wood. |
| 46 | SOA/FE109P | Wood Anatomy-Practical | 1 | To learn Microscopic studies of meristem, simple and complex tissue. Anatomical features of stem root and leaf. |
| 47 | SOA/FE110T | Tree Physiology | 1 | To learn about tree structure, growth, development, differentiation and reproduction. Plant growth functions and growth kinetics, will increase their identification skill.<br>To explore about Physiological functions and processes in trees. To study the role of environmental effects on growth and development.<br>To highlight the students about light use efficiency in forest species, canopy structure, plant phyllotaxis and its importance in translocation. Plant light relationship. LAI, Photosynthetic efficiency and respiratory losses, source sink relationship, Factors affecting photosynthesis. Radiation interception. The content will definitely help the forestry students to know the forest environment and conducive conditions for the same.<br>To study transport processes with special reference to long distance transport in trees and its impact on plant water relations and photosynthesis. Biocides and growth regulators in forest ecosystems. Senescence and abscission. Role of trees in pollution control. |
| 48 | SOA/FE110P | Tree Physiology-Practical | 1 | To study about various physiological process of tree like growth, translocation of food, source and sink, effect of growth hormones and senescence in trees. |
| 49 | SOA/FE111T | Introductory Forest Economics | 2 | The students will be able to understand Nature and scope of economics and also its relationship with other sciences.<br>The students will be able to state the various theories related to consumer behavior such as equi-marginal utility, indifference curve, diminishing marginal utility.<br>The students will be able to define law of demand and understand the concept of price, income and cross elasticity's.<br>The students will be able to explain factors of production i.e. land, labour, capital and enterprise.<br>The students will be able to describe Law of diminishing marginal returns.<br>The students will be able to explain the Law of supply.<br>The students will be able to explain the theories of rent, wage, interest and profit.<br>The students will be able to understand the concepts of Price determination and forecasting under various market structures.<br>The students will be able to understand the concepts of National Income.<br>The students will be able to describe the concept and types of inflation. |
| **4th Semester** | | | | |
| 50 | SOA/FC115T | Principles and Practices of Silviculture | 2 | To learn about forestry and silviculture by studying definition of forest and forestry. Classification of forest and forestry, branches of forestry and their relationships. |

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| | | | | Definition, objectives and scope of Silviculture.<br>Status of forests in India and their role.<br>History of forestry development in India.<br>Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of these factors and their influence on Forest Production.<br>Impacts of controlled burning and grazing. Influence of forests on environment.<br>To acquire knowledge about Trees and their distinguishing features. Growth and development. Forest reproduction - flowering, fruiting and seeding behaviour. Natural, artificial and mixed regeneration. Natural regeneration - seed production, seed dispersal, germination and establishment. Requirement for natural regeneration.<br>Dieback in seedling with examples.<br>Plant succession, competition and tolerance.<br>Forest types of India and their distribution. |
| 51 | SOA/FC115P | Principles and Practices of Silviculture-Practical | 1 | To learn about forest composition, phenotypic characters of the trees, growth rings and forest succession in different forest types of Dehradun. |
| 52 | SOA/FC116T | Wood Science and Technology | 2 | To study kinds of wood and its properties as a raw material.<br>To get knowledge of physical, strength, electrical, acoustic and thermal properties.<br>To understand the relation between use of wood and the properties of wood.<br>To study wood-water relationship.<br>Detailed study of the treatments can be given to wood to increase its life for different uses.<br>To study the timber classification on the basis of durability and refractory nature.<br>To study the processing defects and its effect in woods utilization. |
| 53 | SOA/FC116P | Wood Science and Technology- Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC116T |
| 54 | SOA/FC117T | Silviculture of Indian Trees | 2 | Study of Origin, distribution, general description, phenology, silvicultural characters, regeneration<br>methods, silvicultural systems and economic importance of the following conifer and broad leaved<br>tree species of India. Conifers: *Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii,Pinus wallichiana, P. gerardiana and Juniperus spp. Broad leaved species: Tectona grandis, Shorea robusta, Acacia spp., Dalbergia sissoo, D.latifolia, Quercus spp. Robinia pseudoacacia, Alnus spp.,Anogeissus spp., Populus spp., Eucalyptus spp., Casuarina equisetifolia, Terminalia spp., Santalum album, Swietenia mahagony, Albizzia spp, Prosopis spp., Pterocarpus santalinus, Azardirachta indica, Diospyros melanoxylon, Madhuca indica, Leucaena leucocephala* and Bamboos. |
| 55 | SOA/FC117P | Silviculture of Indian Trees-Practical | 1 | Study of species composition in surrounding areas.<br>Study of morphology and phenology of tree species growing in the area.<br>Study of artificial regeneration of Pines, Bamboo, Oak, *Dalbergia sisoo*<br>and *Acacia catechu*, etc.<br>Practicing thinning in Bamboo clumps. Study on tree responses to the abiotic and biotic |

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| | | | | factors viz., light, fire, drought, frost, root suckering, coppicing and pollarding, etc.<br>To study quality characters of nursery planting stock. |
| 56 | SOA/FC118T | Forest Pathology | 2 | History and importance of forest pathology in India and the world.<br>Relation of plant pathology with forest pathology and other sciences, classification of tree diseases.<br>Role of microbes and fungi in a natural forest ecosystem.<br>Broad classification of different pathogens causing tree diseases. General characteristics of fungi, bacteria, viruses, mycoplasma and phanerogames.<br>Important characters of ascomycetes and basidiomycetes.<br>Growth and reproduction of plant pathogens, infection and factors influencing disease development.<br>Dissemination and survival of plant pathogens.<br>Distribution, economic importance, symptoms, etiology and management of the following.<br>Diseases of important tree species like teak, *Dalbergia* spp., *Acacia* spp., neem, *Cassia*, sal, *Albizia, Terminalia*, mango, jack, pines, deodar, eucalyptus, bamboo, casuarina, rubber, sandal wood, medicinal and aromatic plants grown in different Agroforestry systems.<br>Biodegradation of wood in use. Types of wood decay, gross characters of decay, sapstain, different types of rots in hardwoods, softwoods and their prevention.<br>Graveyard test and decay resistant woods.<br>Principles, definition and scope of forest disease management in forestry. Importance of disease cycle and economic threshold in disease management. Principles of disease management.<br>Nature of disease resistance. Nursery diseases of important forest species.<br>Fungicides and their use in nurseries and plantations. Integration of cultural, chemical, biological and host resistance in disease management. |
| 57 | SOA/FC118P | Forest Pathology-Practical | 1 | To impart practical knowledge as per the course SOA/FC118T |
| 58 | SOA/FC119P | Technique/ Field tour | 1 | Field tours to study the forestry field techniques. |
| 59 | SOA/FSEC102T | Nursery Management & Commercial Forestry | 1 | To explore about the nursery site, its selection and layout. Different types of nurseries and the intercultural operation. Macro and micro propagation. Plant protection measures in nursery. Important tree species and their nursery practices. |
| 60 | SOA/FSEC102P | Nursery Management & Commercial Forestry-Practical | 1 | To explore about the nursery site, preparation of beds, sowing methods, treatment of seeds, intermediate operations for management of nursery. Study of vegetative propagation methods. |
| 61 | SOA/FE112T | Forest Ecology | 1 | To impart knowledge about ecology and the components of ecology, energy flow in ecology and parameters of population and community. |
| 62 | SOA/FE112P | Forest Ecology-Practical | 1 | To learn about the methods of studying the ecology at population and community levels by visiting different ecosystem. |
| 63 | SOA/FE113T | Fundamentals of Wild | 1 | To explore about the wildlife and its management. Different habitat type of wildlife. |

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| | | Life | | Biological basis of wildlife. Different agencies involved in wildlife sector. Wildlife ecology. Basic requirements of wildlife. Importance of wildlife in existing biodiversity globally and in India. |
| 64 | SOA/FE113P | Fundamentals of Wild Life-Practical | 1 | To learn about the habit of different wildlife regarding to their food and habitat. Scientific names of important wild species. Wildlife behavior and adaptations. |
| 65 | SOA/FE114T | Wood Products & Utilization | 1 | To explore the knowledge of paper industry, pulp and paper making, different types of papers, types of paper boards and plywood industry to study the manufacturing processes. To learn about the wood based industries, wood distillation unit. |
| 66 | SOA/FE114P | Wood Products & Utilization-Practical | 1 | Visits to various wood based industries to demonstrate various wood products manufacturing process. |
| **5th Semester** | | | | |
| 67 | SOA/FC120T | Rangeland Management | 2 | To explore about the Key management components seek to optimize such goods and services through the protection and enhancement of soils, riparian zones, watersheds, and vegetation complexes, sustainably improving outputs of consumable range products such as red meat, wildlife, water, wood, fiber, leather, energy resource extraction, |
| 68 | SOA/FC120P | Rangeland Management-Practical | 1 | To learn about identification of grasses, forbs and legumes and fodder trees; Rangeland inventory – ground cover, plant height, relative dominance, etc.; Assessing nutrient; Estimating range condition from plant composition; Determine range utilization, carrying capacity of rangelands; |
| 69 | SOA/FC121T | Silvicultural Systems | 2 | To understand scope/need of silvicultural systems<br>Detailed study of creation and management of various silvicultural systems. |
| 70 | SOA/FC122T | Experimental techniques in Forestry | 2 | Introduction to scientific methodology.<br>Measurement and scaling techniques.<br>Measures of central tendency and dispersion, introduction to distributions.<br>Tests of Significance -'z' test,'t' test and 'F' test.<br>Principles of field experimentation.<br>Comparison between field and forestry experimentation.<br>Design and analysis: Completely randomized design, Randomized complete block design, Latin square design and split-plot design, normalization of data. Concept of factorial experiments.<br>Sampling - Concept of population and sample, advantages of sampling and methods of sampling.<br>Models in Agroforestry research. Site selection, size, layout and shape of the plot, arrangement of blocks in traditional forestry and Agroforestry. Instrumentation in forestry research (for soil analyses, plant analyses). Development of a research plan. Research planning in Forestry in India. Scientific literature search / retrieval and scientific writing. |
| 71 | SOA/FC122P | Experimental techniques in Forestry-Practical | 1 | As per the Paper SOA/FC122T |

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| 72 | SOA/FC123T | Dendrology | 2 | Introduction – importance and scope of dendrology.<br>Classification of plants-Bentham and Hooker's, Engler and Prantles, and Hutchinson's Systems.<br>Plant Nomenclature – objectives, principles and International Code of Botanical Nomenclature.<br>Herbarium techniques, collection, processing and preservation of plant material. General study of herbarium, arboretum and Xylarium.<br>Description of the plant in scientific terms, study of sport characteristics of plants, naming and classifying based on adopted system.<br>Study of families, as survey of forest resources: Magnoliaceae, Rhizophoraceae, Ebenaceae, Sapotaceae, Fabaceae, Santalaceae, Elaeagnaceae, Meliaceae, Salicaceae, Apocynaceae, Betulaceae, Verbenaceae, Fagaceae, Asteraceae, Moraceae, Poaceae, Tiliaceae, Liliaceae, Euphorbiaceae, Myrtaceae, Glusiaceae, Dipterocarpaceae, Cupressaceae, Guttiferae, Taxaceae, Pinaceae and Combretaceae.<br>Geographical distribution of important Indian trees, native trees, exotic trees, endemism. |
| 73 | SOA/FC123P | Dendrology-Practical | 1 | Study of woody flora of families mentioned in theory. |
| 74 | SOA/FC124T | Wild life Management | 2 | To extend the view of wildlife regarding to management and wildlife survey. Wildlife population dynamics. Prey predators relationships. Management of basic requirements. Conservation of biodiversity at national and international level. Political role |
| 75 | SOA/FC124P | Wild life Management-Practical | 1 | To exercise of wildlife study in captivity and nature. Visit learning at different protected areas. |
| 76 | SOA/FSEC103T | Plantation Forestry | 1 | To explore about the plantation needs and its significance. Preparation of plantation site, tools used for different preparation of plantation area. Different methods of planting practices. Industrial plantation. Wastelands and their reclamation. |
| 77 | SOA/FSEC103P | Plantation Forestry-Practical | 1 | To study of tools used for preparation of plantation. Layout of plantation sites. Protection measures for established plantation. Planting design. |
| 78 | SOA/FE115T | Fundamental Forest Business Managements | 1 | Farm management-scope and approaches discussed.<br>Cost-concept, principles and functions its relevance to business demonstrated.<br>Basic laws of production explained.<br>Principles involved in farm management decision making decision as to what, how, when and how much to produce described.<br>Factor- factor-product and product-product relationships displayed.<br>Cost of cultivation and production calculated.<br>Break-even analysis discussed.<br>How to do decision making under risk and uncertainty discussed.<br>Farm business efficiency measures elaborated.<br>Economic order quality and ABC analysis done.<br>Management of resources-<br>land, labour, capital and machinery described. |

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| 79 | SOA/FE115P | Fundamental Forest Business Managements-Practical | 1 | To study:<br>Principles involved in farm management decision making decision as to what, how,when and how much to produce.<br>Factor- factor-product and product-product relationships.<br>Cost of cultivation and production.<br>Break-even analysis.<br>Principles involved in farm management decision making decision as to what, how, when and how much to produce. Factor- factor-product and product-product relationships.<br>Cost of cultivation and production.<br>Break-even analysis. |
| 80 | SOA/FE116T | World Forestry Systems | 2 | To study about Geographical distribution of forests and their classification.<br>Critical examination of the world forest sources, productivity potential and increment of world forests.<br>To learn about Forest resources and forestry practices in different regions of the world – North and South America, Europe, Africa, China, Japan, Russia, South-East Asia and Australia.<br>To study about Forest development and economy – forest based industries of the world.<br>To learn about Recent trends in forestry development in the world.<br>To study about International forestry organizations. |
| 81 | SOA/FE117T | Forest Entomology & Nematology | 1 | To understand classification, biology, natural history and diversity of insects affecting forest ecosystems.<br>To identify insects common to forests and recognize their damage.<br>To appreciate insect sampling in forest ecosystems, with particular attention paid to monitoring, forecasting and assessing the risk of insect outbreaks.<br>To illustrate the importance of silvicultural practices and management of natural enemies in preventing insect outbreaks.<br>To recognize the importance of cultural, physical, biological, and chemical strategies for preventing, controlling and managing forest pests.<br>To foster an appreciation for the significance of research on insect pests of forests.<br>To understand the morphology of nematodes as it relates to their taxonomic position, their ability to cause diseases of plants and the principles of controlling nematode diseases of plants. |
| 82 | SOA/FE117P | Forest Entomology & Nematology-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE117T |
| **6th Semester** | | | | |
| 83 | SOA/FC125T | Forest Management, Policy and Legislation | 2 | To study about the management aspects of forestry, yield regulations, rotation,legal aspects related to forestry and working plan. Sustained yield and normality in forestry. |
| 84 | SOA/FC125P | Forest Management, | 1 | To acquire knowledge by visiting forest departments and learning about the records they |

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| | | Policy and Legislation-Practical | | maintain in the department, formation of working plan and legal aspects they use |
| 85 | SOA/FC126T | Principles and Methods of Tree Improvement | 2 | Introductory study about forest genetics, tree breeding and improvement,<br>Study of history of tree improvement, justification for tree improvement programme, its relation with other disciplines of forest management; activities, advantage and limitation of tree improvement.<br>To learn about Forest reproduction and natural variation: sexual and asexual reproduction and their consequences.<br>Study about Causes and kinds of variability, variation in natural stands, concepts, evolutionary forces that force variations and level of genetic variation; conservation and utilization of forest tree genetic resources- principle & strategies.<br>Learn about quantitative genetics and importance of statistical methods in it, study about selection procedures and techniques in tree improvement, species and provenance selection, Plus tree selection and progeny trials. Study about Introduction to exotic forestry. Learn about seed production areas and seed orchards.<br>Study about Hybrid in tree improvement; mutation and polyploidy breeding. Study about recent techniques in tree improvement, Learn about vegetative propagation and tree improvement. |
| 86 | SOA/FC126P | Principles and Methods of Tree Improvement-Practical | 1 | Study about Seed collection and handling of forest seeds.<br>Learn about Techniques of selecting superior trees in natural stands and plantation. Floral biology and controlled crossing techniques.<br>Study about Vegetative propagation techniques.<br>Learn about Pollen viability determination. Visit to seed production areas and seed orchards.<br>Study about Numerical exercises and statistical analysis. |
| 87 | SOA/FC127T | Utilization of Non-timber Forest Products | 2 | Learn about various methods of collection, management and importance of Non-Timber Forest<br>Products (NTFP) viz.- Fodder (grasses and tree leaves), canes and bamboos. Essential Oils - methods of extraction, classification, storage and uses. Non-essential oils – nature, occurrence, methods of extraction, classification and uses. Important fixed oil yielding trees. Gums and resins –definition, classification, sources, collection and uses. Factors affecting gum formation. Important gum yielding plants. Resins and Oleoresins, their formation in plants and classification of resins. Tans-nature, classification, uses and important tannin yielding plants. Dyes – classification and sources of dyes. Beedi leaves – sources, collection and processing. Fibers and flosses. Katha and Cutch –sources, extraction and uses. Drugs, wild fruits, spices, poisons and bio-pesticides. |
| 88 | SOA/FC127P | Utilization of Non-timber Forest Products-Practical | 1 | Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and tree leaves. Study of canes and bamboos and their sources. Study of essential oils and their sources.<br>Study of non-essential oils and their sources. Study of gums and resins and their collection. |

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| | | | | Study of tans and dyes and their sources. Study of fibers, flosses and their collection from nearby forests.<br>Visit to Herbal Gardens and herbaria to study medicinal plants. Study of plants yielding drugs, spices, wild fruits, poisons and bio-pesticides and their collection from nearby forests. Visit to nearby extraction units. |
| 89 | SOA/FC128T | Agroforestry Systems and Management | 2 | Introduction and classification of Agroforestry system.<br>To learn about various traditional as well as modern agroforestry systems.<br>To know the characteristic and role of various components of agroforestry systems.<br>Impact of argoforestry practices in society, industries and environment. |
| 90 | SOA/FC128P | Agroforestry Systems and Management-Practical | 1 | To conduct the Agroforestry surveys.<br>To identify various Agroforestry systems.<br>To measure volume, biomass, tree dimensions of Agroforestry interest.<br>To do soil analysis. |
| 91 | SOA/FC129P | Technique / field tour | 1 | Field tours to study the forestry field techniques. |
| 92 | SOA/FSEC104T | Entrepreneurship Development and Communication Skills | 1 | Assessing overall business environment in the Indian and managerial economy done.<br>Concept of entrepreneurship and entrepreneurial characteristics discussed.<br>Managing an enterprise and its skills displayed.<br>Motivation and its types.<br>Importance of planning, monitoring, evaluation and follow up discussed.<br>Managing competition is an art and discussed how?<br>Entrepreneurship development programs conducted.<br>SWOT analysis explained.<br>Government schemes and incentives for promotion of entrepreneurship discussed.<br>Government policy on Small and Medium Enterprises (SMEs) / SSIs displayed.<br>Export and Import Policies relevant to forestry sector and its case studies discussed. |
| 93 | SOA/FSEC104P | Entrepreneurship Development and Communication Skills-Practical | 1 | Field surveys.<br>Market case studies.<br>Interviews. |
| 94 | SOA/FE118T | Principles of Forest Economics, Project Planning and Evaluation | 1 | To become familiar with *economics* and business principles and how they can be applied to *forestry.*<br>Utilize economic principles to address private and public policy issues related to allocating natural resources and environmental amenities. |
| 95 | SOA/FE118P | Principles of Forest Economics, project Planning and Evaluation-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE118T |
| 96 | SOA/FE119T | Marketing and Trade of Forest Produce | 1 | Demonstrate a basic knowledge of the role of markets and market failure with regards to the allocation of natural resources and environmental amenities. |

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| | | | | To familiar with the role of market channels for distribution of forest resources.<br>To understand the concept of different types of market<br>Students get to know about WTO & IPR. |
| 97 | SOA/FE119P | Marketing and Trade of Forest Produce-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE119T |
| 98 | SOA/FE120T | Biodiversity & Conservation | 1 | To explore about the biodiversity and its conservation at local as well as global level. Basic terms about biodiversity and its conservation. Diversity and its analytical features, different life forms under diversity. Conservation biology and its principles. Methods of conservation. Conservation efforts by India and worldwide. |
| 99 | SOA/FE120P | Biodiversity & Conservation-Practical | 1 | To exercise of diversity indices computation , visit of protected areas, case study regarding conservation. |
| **7th Semester** | | | | |
| 100 | SOA/FC130P | Socio-economic surveys -village Attachment (28 working days) | 4 | To prepare survey questionnaire for socio-economic survey.<br>To conduct the socio-economic surveys for data collection of relevance. |
| 101 | SOA/FC131P | Attachment with State Forest Department (70 working days) | 10 | To understand the construction of modern forest nurseries, herbal gardens and watersheds.<br>To see and understand the procedure of the felling and logging operations, timber lots and important industrial products extraction with the use of Forestry equipments/ instruments.<br>To see the working plan document of variuos Forest divisions and get to know enumeration, volume and yield calculation & compartment history<br>To study the 'CAT' (Catchment Area Treatment Plan) and FDA (Forest Development Agencies)<br>To study the regeneration and management of important forestry tree species.<br>To conduct layout studies, stump analysis, preparation of local volume table. |
| 102 | SOA/FC132P | Industrial Placement (28 working days) | 4 | To get acquinted with the nature, working environment, production and management process and Marketing & financial management various of wood-based industries. |
| 103 | SOA/FSEC105T | Report Writing and Presentation of FWE (14 Working days) | 2 | To learn the compilation of the workdone/skills gained.<br>To learn the data processing/ analysis.<br>To develop the skill of Presentation of the report. |
| **8th Semester** | | | | |
| 104 | SOA/FC133P | Project Development (2 weeks) | 2 | To develop the skill of project development to carry out any research activity. |
| 105 | SOA/FC134P | Collection, Handling, Processing and Storage of planting material (3 weeks) | 2 | To identify the superior seed sources.<br>To use various seed collection methods for different species on field.<br>To put seeds under various seed treatments to document their quality and regeneration potential.<br>To understand the methods of storage of collected planting materials. |
| 106 | SOA/FC135P | Vegetative Propagation under controlled and | 3 | To apply vegetative propagation methods like cutting, grafting for propagation of forest trees, medicinal plants and fruit trees. |

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| | | ambient conditions (3weeks) | | Production of bare root and containerized seedlings. |
| 107 | SOA/FC136P | Nursery Management (11 Weeks) | 9 | Practical application of the nursery management practices like seedbed preparation, sowing, planting, irrigation, polyhouse management, various intercultural operation. |
| | SOA/FSEC106P | Marketing of seeds and seedlings (2weeks) | 2 | To understand the marketing channels and links.<br>To grade the planting stocks on the basis of quality and do pricing for them |
| 108 | SOA/FSEC107P | Cost Benefit analysis, Project Report & Presentation (1 week) | 2 | To get acquainted with the economic analysis of projects.<br>To sharpen the skills of documentation of the field studies.<br>To sharpen the skill of Presentation of research projects. |

**Programme: B.Sc. Agriculture**
**Programme Code**: 102
**Course Summary**
Duration: 4 years
**Eligibility**
10+2 with minimum 45% marks in aggregate with PCB/ PCM/Agriculture.

**Programme Outcomes:**

- To get acquaintance with basics and principles of Elementary Statistics, Computer, English, Rural Sociology & Educational Psychology, Elementary Agriculture, Plant Biochemistry, Microbiology.
- To understand the fundamentals of Principles of Agronomy, Soil Science, e.g. Chemistry, soil fertility and nutrient management, Environmental Science, Horticulture.
- To learn the Control of Weed Management in different agricultural and horticultural crops.
- To understand the effect of meteorology on crops production and weather forecasting models which are helpful for prediction of Indian weather conditions?
- To gain the preliminary knowledge of genetic principles and thereby implementing for breeding of field crops.
- To learn the basic concepts of plant pathology for best growth of crops against the prevalent crop diseases of particular crop-zones.
- To develop the Principles and skills of vegetable production, fruit production, ornamental plants and medicinal & aromatics plants.
- To learn principles and techniques of field crops (Kharif & Rabi) production in diverse agroclimatic conditions of India.
- To learn the different methods of irrigating field crops, horticultural crops and managing water as precious element of crop production and increasing water use efficiency.
- To develop skills to conduct various field based activities related to agricultural aspects.
- It imparts the general ideas for the allied aspects of agriculture like Mushroom production, Beekeeping, Sericulture and Lac cultivation.
- To understand and gain the preliminary knowledge for plant biotechnology, establishment of tissue culture lab., generation of transgenic plants.
- To learn the basic concepts of agriculture co-operation, finance and business management related to agriculture products, it gives knowledge for availing different types of agriculture credits by Institutional and non-institutional sources.
- To learn the basic principles and techniques for control of insects, pests on cereals, sugar crops, fruit crops, vegetable crops, plantation crops, stored grain and house hold pests.
- It provides the in-depth knowledge for breeding and nutritional aspects for increasing the production of livestock products like milk, meat, egg, and its by-products and controlling livestock, poultry diseases.
- To learn the in-depth information of crop physiology for augmenting crop productivity. Physiology of growth and development, growth regulators which influence productivity of major cereals, pulses and oilseed crops.
- It provides general idea about the farm machinery which includes sources of farm power, tillage equipments, plant protection equipments, harvesting and threshing machineries, different types of tractors etc.

- To gain the knowledge of extension education different extension and rural development related programmes to understand extension training centres etc.
- To gain the knowledge and applying the principles and practices for different processing techniques for fruits and vegetables after their harvest and increasing their shelf life.
- To learn the principles and practices of farming systems and sustainable agriculture by using LEISA and HEISA. Using different conservation and management practices for soil & water resources.
- It provides basic knowledge for soil survey, soil taxonomy and the role of remote sensing in agriculture.
- The skills for seed production, seed storage, seed testing for purity, viability, moisture and germination related to field crops.
- After learning and imbibing the technical and articulated aspects of agriculture production students' undergoe Rural Agriculture Work Experience (RAWE) of any four components of their choice wherein students gets exposure in real field experience.

## Course outcomes of B.Sc. Agriculture programmes:

| Sr.No. | Course name | Credits | Course outcome |
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| | | | **1st Semester** |
| **1** | Elementary Statistics | 1+1 | To learn about Introduction to statistics, arithmetic mean, median, mode and partition values range, interquartile range, quartile deviation, mean deviation, variances, standard deviation, coefficient of variation, moments, skewness, Kurtosis and its measure.<br><br>To gain knowledge of Simple problems based on probability theory; Definition of correlation; Scatter diagram; Karl pearson's coefficient of correlation; Linear regression equations; introduction to test of significance, one sample and two sample test for mean. |
| **2** | Agriculture Meteorology | 1+1 | To understand the basic concepts of Earth atmosphere its composition, extent and structure; Atmospheric weather variables: Atmospheric pressure, its variation with height; Daily and seasonal variation of wind speed and direction. Cyclones and anticyclones, air masses and fronts.<br><br>To receive knowledge about Agriculture and weather relations: Modification of crop microclimate, use of weather data for irrigation scheduling, pesticides sprays, fertilizer application, climatic normals for crop production. Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave and thermal radiation, net radiation, albedo, atmospheric temperature – temperature inversion, daily and seasonal variation of temperature balance of earth;<br><br>To understand the concept of atmospheric humidity;sssss saturation, vapour process of condensation, formation of dew, fog, mist, frost, snow rain and hail: precipitation cloud formation and movement. |
| **3** | Computer Application | 1+1 | To learn Introduction to personal computer, peripherals, operating systems (Dos & Windows) and high-level language- Interaction with software pack-ages (Lotus, Foxpro, Statistical, packages) and its execution for applications in relation to solution of simultaneous equations, plotting of graph and diagrams. Simple agricultural statistics computations. Database file; creation and Query. |
| **4** | Str. & Spoken English | 1+1 | To understand the structural patterns of communicative grammar; modern usages; functional language disorder and common structural errors in part of speech-noun, pronoun, verb, adjective, adverb, preposition, conjunction; articles; word-formation and vocabulary building-affixes, prefixes, suffixes, synonyms, antonyms, substitutions and foreign words; prepositions; phrases idioms; gerunds; participles; infinitives; time and tense; modal verbs, conditional parities; synthesis; transformation controlled writing; paragraph writing;<br><br>To learn and make use of modern technical prose; listening and reading skills; comprehension; phonetic and scientific systems of spoken English – speech mechanism; symbols and sounds; stress and intonation. |
| **5** | Elementary Agriculture | 2+1 | To learn about the basic concepts of Indian agriculture its scope and resources; crop plants-their significance as source of food, feed, fuel and raw material for various industries. Crop seasons and classification of crops according to seasons.<br><br>To understand the basic concepts of Soils-their formation, classification, physical and chemical properties and |

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| | | | manures and fertilizers-essential plant nutrients, uptake of N,P & K by important crops, methods of manure & fertilizer application, composition of bulky organic manures, concentrated organic manures, green manures and various types of inorganic fertilizers,<br><br>To learn about Irrigation and drainage-importance of water, quality of irrigation water; sources methods and measurement of irrigation water, disadvantages of excessive soil moisture necessity and methods of drainage.<br><br>The students will be able to understand cultivation of important crops in the state such as wheat, rice cotton, sorghum, maize, groundnut, rape seed & mustard, chickpea, pigeonpea, tobacco, berseem, potato and sugarcane. Acquaintance with horticultural crops such as cabbage, cauliflower, onion, garlic, cucurbits, root crops, peas, tomato, brinjal, banana, apple, mango, litchi, citrus, guava.<br><br>The students will be able to understand the concepts of introductory economics-Factors of production, exchange, different types of markets; pricing, bank and credits, law of diminishing returns, elementary rural sociology, place of agriculture in five year plans, statistics relating to agricultural production.<br><br>The students will be able to explain of main breeds of animals such as cows, buffaloes, goats, sheep and poultry. Elementary physiology and anatomy of cow and buffaloes. Characteristics of milch cattles. Care of animal, poultry management, principles of nutrition, common medicines.<br><br>The students will be able to learn types of iron and steel used in agricultural implements; different types of plough, mechanical devices, their management and cost. Water lifting devices, tillage, different methods of ploughing. Power transmission through belts, pullies, gears, chaff, cutter, cane crusher. Necessity for drainage, damage to soil due to excess moisture, land development, prevention and formation of acidic and alkali soils. |
| **6** | Principles of Agronomy | 2+1 | The students will be able to understand the Principles of agronomy as a science and its scope.<br>The students will be able to quantify and explain the plant growth and development, environmental effects on growth, ideal plant type, tillage, seed quality, sowing, crop density and spatial arrangement, crop nutrition, organic manures and fertilizers, irrigation and drainage, The students will be able to understand weed management, distribution of crops, cropping systems, selection of crops and varieties for multiple cropping, crop yield contributing characters;<br><br>The students will be able to understand the organic farming-concept, practice and scope in India. Crop production in dry lands, salt affected, acidic, flood affected, waterlogged and eroded areas. |
| **7** | Rural Sociology & Educational Psychology | 2+1 | The students will be able to explain the concepts, methods, tools, characteristics of rural society and people; rural – urban continuum and differences, Rural social structure: interaction, processes, institutions groups.<br><br>The students will be able to understand rural social stratification: status, roles, class, castes etc. Panchyati Raj and Block Development Organizations as rural peoples participative agencies for planned development, Specific, programs for rural area upliftment/ employment: JRY, IAT, EAS, MWS, IRDP, GKY, DWCRA, TRYSEM, DPAP, DDP, NSAP, Land reforms, etc. Council for Advancement of peoples Action and Rural Technology |

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| | | | (CAPART). National Fund for Rural Development (NFRD), NGOs/Voluntary Sector.<br><br>The students will learn about Conceptual /Clarifications on educational psychology, Psychology of individual differences; MA & IQ; the gifted, Slow Learner and Socially disadvantaged child. Learning and motivation, mental hygiene and adjustment, guidance and counselling. |
| **2nd Semester** | | | |
| **8** | Fundamentals of Soil Science | 2+1 | The students will be able to understand soil as a natural body and medium for plant growth; soil compounds and soil plants relationship; soil forming rocks and minerals; weathering and processes of soil formation;<br><br>The students will be able to explain physical properties of soils – texture, structure, density and porosity, soil colour, consistence and plasticity, soil reaction pH and its measurement, soil acidity and alkalinity, buffering, effect of pH on nutrient availability, soil colloids – inorganic and organic; silicate clays: constitution and properties; humic substances nature and properties; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and influence on soil properties, transformation of organic and inorganic constituents of soil; biological nitrogen fixation; recycling of organic wastes in soils – Urban and industrial wastes.<br><br>Students will be able to describe Soil water retention, dynamics and availability; soil air composition and dynamics; source, amount and flow of heat in soils; soil temperature and plant growth; soil survey and classification, soils of India.<br><br>Students will be able to describe soil pollution – behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution. |
| **9** | Fundamentals of Horticulture | 2+1 | To learn about fundamentals of horticulture: its definition and branches; importance and scope; horticultural and botanical classification; climate, soil and distribution of fruit crops.<br>Students will be able to learn the techniques of propagation and nursery raising; principles of orchard establishment and management. flower bud differentiation and pollination; causes of unfruitfulness, pollinizers and pollinators.<br><br>Students will be able to explain environmental and soil factors affecting vegetable production, kitchen gardening; garden types and parts; care and maintenance of ornamental plants; lawn. making; knowledge of landscaping of rural and urban areas; exposure to important medicinal aromatic plants, spices and condiments, use of plant bio-regulators in horticulture, Post Harvest Technology-Principles and Practices. |
| **10** | Elementary Plant Biochemistry | 2+1 | Students will be able to understand recapitulation of basic chemistry and biology, water, pH and buffer, Cellular constituents: Structure and function – amino acids and protein, carbohydrates, lipids and biomembrances and nucleic acids;<br><br>Students will be able to explain enzymes-function, properties and mechanism, metabolism of cellular |

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| | | | constituents: Central Metabolic Pathways: Degradative path ways – glycolysis, hexose monophosphate pathway, degradation of starch, sucrose, other sugars, fatty acids and acylglycerols, proteins and amino acids; Biosynthetic pathways – photosynthesis, formation of sucrose and starch, Kreb's cycle and electron transport chain;<br><br>To learn Nitrogen and sulphur cycles; Nitrogen fixation, assimilation of ammonia; Synthesis of DNA, RNA and proteins; Secondary metabolites – structure, function and metabolism |
| **11** | Weed Management | 1+1 | Student will learn weed control, costs to society from weeds, classification of weeds. Ecology of weeds: Reproduction (seed production, seeds essmination, seeds germination, vegetative reproduction), geopraphics, distribution, factors influencing weed distribution, weed succession of uncultivated sites, competition between crops and weeds. Concepts of prevention, eradication and control.<br><br>Students will be able to manage weeds by controlling different methods: Physical, cultural, biological, chemical, integrated weed management.<br>Students will get exposure to herbicides: basic concepts, polar vs. Non-polar, Esters, Salts, acids, etc. surfactant chemistry. Factors influencing foliage active herbicides: reaching the target plant, spray retention, absorption into leaf, translocation, factors influencing soil applied herbicides: microbiological effect, soil absorption, photo-decomposition and volatilization, spray of herbicides. |
| **12** | Element of Genetics | 2+1 | Students will get exposure to the historical aspects of Pre mendelian and post-Mandelian concepts of heredity, mendelian principles of heredity, Probability and chi-square.<br><br>Students will learn concepts of *Cell* plant cell and animal cell, chromosome structure. Cell division mitosis, meiosis, variation in chromosomes polytene chromosome, Lampbrush chromosomes. Dominance relationship gene interaction. Multiple alleles, plelotropism and pseudoalleles. Sex determination and sex linkage, sex limited and sex influenced traits. Linkage, Crossing over mechanism, Chromosomes mapping, structural changes in chromosomes: Deletion and Duplication, Translocation and diversion, "Numerical changes in chromosomes, chemical basis of heredity".<br><br>Students will learn the gene concept made of replication of genetic material, transcription and translational mechanism of genetic material. Gene regulation and operon concept. Mutations: chemical and physical mutagens, mode of action of mutagens. Extranculear inheritance. Polygene and quantitative inheritance. Introduction to plant tissue culture. |
| **13** | Introductory Entomology | 2+1 | Students will be able to understand the scope of Entomology, brief history of entomology in India, insects as Arthropods and its relationship with phylum Annelida and other classes of Arthropoda, origin in insects major points related to dominance of insects in Animal Kingdom.<br><br>Students will learn external morphology and anatomy of grass hopper; body segmentation, integument, thorax and abdomen, antennae, legs and wings and their modifications, generalized mouth parts and their modifications, Alimentary, Circulatory, Excretory, Respiratory, Reproductive and nervous systems, major sensory organs like simple and compound eyes chemoreceptors, endocrine glands; basic embryology and post embryonic development, basic groups of present day insects with special emphasis to orders and families of agricultural |

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| | | | importance like Orthoptera; Tetigonidae, Gryllidae, Gryllotalpidae, Acrididae, Dictyoptera; Mantidae, Blattidae; Isoptera; Hemiptera; Pentatomidae; Coreidae; Cimicidae, Cicadellidae, Delphacidae, Lophophidae, Aleurodidae; Aphididae; Coccidae; Thysanoptera, Coleoptera. Carabidae, Meloidae, Coccinellidae, Bruchidae, Chrysomelidae, Curculionidae, Cerambycidae; Diptera; Culicidae Cephritidae, Agromyzidae, Muscidae; Lepidoptera, Pleridae; Papilionidae, Hespirlidae, Sphingidae, Noctuidae, Artilidae, Pyralidae, Saturnidae, Bombycidae; Hymonoptera. Tenthredinidae, Braconidae, Chalcididae, Trichogrammatidae. |
| | Introductory Plant Pathology | 2+1 | Students will be able to understand the importance of plant diseases, scope and objectives of plant pathology concept of plant disease, of cause of plant disease, inanimate causes and plant viruses.<br>Students will be able to explain classification of plant diseases. Definition and terms, parasites, pathogens biotropls, heribiotrphs, necrotraph, pathogenicity, pathogene is virulence, infection primary infection, inoculum, invasion and colonization, inoculation potential, symptoms, incubation period, disease cycle, disease syndrome, single cycle disease, multiple cycle, single cycle period, multiple cycle disease, alternate host collateral host, predisposition, biotype, symbiosis, mutualism, antagonism.<br><br>Students will be able to explain history of plant pathology with special reference to Indian work. Pathogenesis and parasitism, Koch's postulate. Effect of pathogenesis on the plants, morphological changes, physiological changes, symptom of plant diseases. Development of identies. Principles and methods of plant disease management.<br><br>Students will be able to understand the basic concepts of avoidance, exclusion, eradication, disease resistance and therapy. Methods of plant disease management. Genera morphology, characters of fungi and somatic structure, reproduction of various structure.<br><br>Students will learn Basic and different methods of classification of fungi, taxonomy and nomenclature. Study of selected genera, *Plasmodiophora, spongospora (myconycota), Synchitrum, Thyseoderma, pythiym phytophothora, albugo selerophthora, periosdocrospora and percnosi on (Mastigomyccinal); Taplirina, Erisyphe, Claviceps, Sclerotinia (Ascomycocina), Puccinia Melarapsora, Uromyces, Ustillgo, Tilletia, Neovosain, Splacelothera, Telyposporium (Besidicmycotina); Collectotrichum Alternate Cercospora, Fusarium, Helmilthosporium, Pyricularia, Seletorian. Rhizoctonia, Phyllostica, Phoma (Deuteromycotina*). General morphological and cultural characters of prokaryotes (bacteria), basic methods of classification taxonomy and nomenclature. Nutrition and effects of physiochemical factor on growth, reproduction and life cycle genetics and variability.<br><br>Students will be able to understand the importance and general original characters of morcoplasns, spiroplasma and fastidions bacteria. Reproduction nomenclature and classification physical architecture and chemical composition of viruses and viroids, nomenclature and criteria for identification, multiplication, transmission and infective nature. General morphological characters, life cycle and reproduction of nematodes, behaviour in soil and nematodes as vectors for other plant pathogens. Classification and general identifying characters of phanerogamic plant parasite reproduction and life-cycle. |
| **15** | Microbiology | 1+1 | The student will learn microbial world history- History of microbiology prokaryotic and eukaryotic microbes, |

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| | | | their cell structure, genetics distribution in nature and importance in agriculture, microorganisms in soil fertility and crop production; carbon, nitrogen, phophorus and sulphur cycles, plant microbes association symbiotic associative and a symbiotic nitrogen fixation, Azolla and mycorrhiza iodegradation of agricultural chemicals pesticides, herbicicks and agricultural organic wastes.<br><br>The students will learn microbiology of milk and milk products, rural microbiology and silage production; Microbes in human welfare biofertilizers, biopesticides, waste treatment and recycling; composting, ethanol production, antibiotic production, Human and plant pathogenic microbes |
| **3rd Semester** | | | |
| **16** | Vegetable Production | 2+1 | Students will be able to understand the importance of vegetables in human nutrition and national economy, factors effection vegetable productivity viz. light, temperature, moisture, oxygen, $CO_2$ mineral nutrients, soil reaction, disease and insect pasts; types of vegetable farming; types of classification of vegetable viz, botanical, classification, based on col: mandlness, parts used duration of crop; weed management, use of bioregulation seed production, harvesting and marketing.<br><br>Students will be able be understand the cultivation practices vis. time of sowing nursery management, transplanting, sowing/planning distance, recommended cultivars seed rate, manure and fertilizers doses, harvesting, storage, physiological disorders, diseases and insect pests and their control measure of various vegetable crops namely potato, tomato, onion, garlic, okra, sweet corn pea, beans, cucurbitaceous crops-pumpkin, bottle gourd, sponge gourd, ridge gourd, pointed gourd, bitter gourd, cucumbers etc. |
| **17** | Irrigation Water Management | 2+1 | Students will be able to know the water resources of India, source of irrigation, irrigation water demand, supply and resources development of irrigation, soil moisture and its characteristics soil water potential, retention and movement of soil water. Water intake and infiltration. Importance of water in plants life, plant water status, absorption, transportation and transpiration, moisture sensitive stage, water availability and nutrient up take. Scheduling of irrigation based on soil moisture status. Physiological stages of crop and meteorological parameters, irrigation under limited water supply conditions. Methods of irrigation; surface irrigation, flooding, furrow, border and basin irrigation. Irrigation; drip and sprinkler irrigations.<br><br>Students will be able to explain water stress and plant grows effect of water stress on physio-morphological characteristics and productivity of plant, deficit irrigation and strategy for optimizing yield. Water quality standards and its suitability for irrigation, water use efficiency, agronomic technique to boost water use efficiency, factors affecting water use-efficiency.<br><br>Students will be able to understand irrigation management in soils with low intake rate, saline and alkali soil, soil with shallow ground water table and in poorly declined soil. Water requirement of crops, factor affecting the water requirement of crops, method of determining water requirement, effective rainfall, anti-transpiration and potential evapotranspiration and consumptive use. Irrigation of principal crops critical stages of crops, depth and schedule of irrigation, reducing irrigation requirement of major crops. |
| **18** | Principles of Plant Breeding & Breeding of | 3+1 | The students will get exposure to historical development of plant breeding plant breeding concept, nature and role of plant breeding major achievements and future prospects, genetics in relation of plant breeding, modes of |

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| | Field Crops | | reproduction, self-incompatibility and male sterility. Plant Breeders materials domestication, centres of origin, centres of density acclimatization and components of genetic variation and heritability.<br><br>Student will be able to explain breeding methods in self-pollinated crops: Introduction, selection pure line theory, multilane varieties, hybridization techniques and handling of segregating populations, Hardy-Weinberg law, Methods of breeding cross pollinated crops system of mating heterosis and inbreeding depression development of inbred lines and hybrids and synthetic varieties, breeding methods in asexually propagated crops, clonal selection and hybridization polyploidy in relation to plant breeding, mutation breeding methods, uses nature of gene mutation mutagenic agents, induced mutation in plant breeding, breeding for important biotic and abiotic stresses, and use of biotechnology implant breeding, procedure for release of new varieties.<br><br>The students will learn concepts of crop systematic, species relationship, floral biology and inheritance of economically important characters, breeding objectives development of varieties with desired yield, adaptability, stability, disease and pest resistance and quality (Physical, chemical, nutritional) and marketing Important varieties along with parentage and characteristics, future thrust area in varietals improvement in crops like wheat, rice, make, soybean, field-pea, pigeon pea, urd bean and rapeseed mustard, sunflower, groundnut, sorghum, sugarcane, potato, cotton and tobacco. |
| **19** | Soil Fertility and Nutrient Management | 2+1 | The students will get exposure to the history of plant nutrition and soil fertility, soil fertility and productivity, problems of soil fertility in India, plant growth and development, factors affecting plant growth; essential plant nutrients, their role and deficiency and toxicity symptoms; Ion exchange phenomena in soil and its role in plant nutrient availability; movement of nutrients from soil to plant roots, their uptake and translocation.<br>The students will be able to explain chemistry of soil nitrogen- Nitrogen cycle, mineralization and immobilization, properties and use of inorganic and organic nitrogenous fertilizers in crop production. Chemistry of phosphorus in soil, phosphate fixation and availability chemistry of potassium in soil, potassium fixation and availability; properties and use of phosphorus and potassium fertilizers, chemistry of calcium, magnesium and sulphur in soil, their sources and usage; soil fertility evaluation and fertilizer recommendations; biofertilizers; integrated nutrient management ; methods and time of application of fertilizers, efficient of fertilizers. |
| **20** | Agri. Marketing and International Trade | 2+1 | Students will be able to understand he concepts of marketing, human needs and marketing the marketing mix, the marketing strategy, product planning, promotion Physical distribution and pricing, marketing and different levels of development, function of prices and role of price in economic development, marketing planning and organizational elements of marketing mix, Concept of market segment, market segmentation, basis of market segmentation, Types of markets, classification and characteristics of agricultural market.<br><br>Students will be able to explain demand for farm products; determinants of consumer behaviour, consumers of farm products factors affecting demand and consumption of farm products; supply of farm produces; product decision and strategies, product life cycle and new product development, characteristics of farm firm, farm products and farm production, spatial and temporal distribution of farm products, marketed and marketable surplus, factors affecting supply of marketed surplus and marketable surplus of farm products;<br><br>Students will be able to describe women's role in agricultural produce marketing; pricing and promotion |

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| | | | strategies market structure, determination of price under alternates market structures, price movement overtime seasonal cyclical and trend marketing communication, advertising, publicity, personnel selling and cales promotion; Marketing function, exchange function's buying and rolling physical function storage, transportation and processing; facilitating functions- packaging, branding, financing, market information, grading etc.<br><br>Management of marketing functions, marketing channels; stages of marketing, selection and management of marketing channels for farm products; meaning and components of marketing cost, price spread and market margins, Marketing efficiency, concept and measurements of marketing efficiency;<br><br>Students will be able to understand the role of government in Agricultural marketing, public sector institutions. CACP, FCL, CWC, DMI, Far price shops, Exim Bants etc. The concept and importance of inter-regional and International trade; emerging scenario of international trade in Agricultural commodities; basic theories of international trade; concept of terms of trade and BOP, implications of new GATT agreement (WTO). |
| **21** | Field Crops I (Kharif) | 2+1 | Students will be able to get exposure of origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices yield of kharif crops.<br><br>Students will be able to take information for cereals-rice, maize, sorghum pearl millet and finger millet; pulses – pigeon pea, mungbean and urdbeans oilseeds groundnut, sesame and soybean; fibre crops cotton, jute and sunhemp; and forage crops sorghum, maize, cowpea, cluster bean and napier. |
| **22** | Crop Diseases and their Management | 2+1 | Students will be able to understand and explain wheat disease rusts, loose nut, kernalbunt, powdery mildew, alternaria blight, yellow ear rot, ear cocile, Rice disease blast, brown spot, bacterial blight, sheath blight khaira and tungro; Maize disease stalk rots, downy mildews, leaf spots and Heininthosporium leaf sports; Sorghum disease smuts. Grain mold, anthracites and strgaa; Bajra disease downy mildews and ergot; Sugarcane disease redrot, smut, and with Groundnut disease early and late leaf sports, Sclerotium stem rot, seedling rot and seedling blight; Sunflower disease Sclerotinia stem rot and Alternaria blight; mustard disease. Alterniaria blight, white rust, downy mildew, Sclerotinia stem rot, and bacterial rot; soybean disease Rhizoctonia blight, pod blight, seed rot, bacterial pustule seedling blight and mosatic; pigeonpea diseases Phytophora blight, wilt and sterility mosaic; Gram diseases Wilt, grey mould and Ascochyea blight; Lentil disease rust and wilt; Cotton disease anthocnose; vascular wilt, and black gram; Tobacco diseases damping off early and late blight, black scarf, common scab, bacterial wilt and virus diseases; Tomato diseases damping off, late and early blight, wilts root knot and virus diseases; Brinjal diseases Phomopsis blight, fruit rot, Sclerotimia rot, bacteria wilt and rot knot, Chilies diseases anthracnose and virus diseases, vegetable crucifer diseases damping off, Downey mildew, and black not, vegetable cucurbit diseases powdery mildew and rust, Bean diseases anthracnose, blights, and virus diseases; Mango diseases Mango malformation. Powdery mildew and bacterial blight; Apple diseases scab, colar rot, powdery mildew; fire blight, stem black and brown, pink diseases, Papaya diseases stem and foot rot, leaf curl, and mosaic, Citrus diseases canker, anthracnose, citrus decline and virus disease; Peach and pear disease leaf curl, brown rot, and scab; Guava wilt, anthracrose and stem canker. |
| **4th Semester** | | | |
| **23** | Economic Entomology | 2+1 | Students will be able to explain how insects become pest economic importance of insects, classification of pests, principles and methods of pest control, viz, physical mechanical, cultural, legal, genetical chemical. Biological, |

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| | | | principles and methods of insecticidal applications.<br><br>Students will be able to understand the concepts of apiculture, sericulture and lac cultivation with special reference to equipment used insect pests and diseases, production and marketing. |
| **24** | Introduction to Plant Biotechnology | 1+1 | The students will get exposure to the introduction: History of Plant tissue culture and biotechnology, scope and importance of agricultural biotechnology, Gene technology, Tissue and cell culture: Media, various modes of culture and their application. Organ culture cell suspension culture, Callus culture, Micro-propagation methods.<br><br>Students will be able to explain organogenesis and embryogenesis, their significance, Anther culture; haploid production, diploidization and their significance, Proto plasts isolation, fusion, somatic hybridization and hybrids, Somaclonal variation and its use in crop improvement, Germplasm storage and cryopreservation, Secondary metabolite production, Students will be able to understand introduction to genetic engineering and genetechnology. Gene transfer methods: Physical Chemical and Agrobacterium dependent methods, Generation of transgenic plants and their identification, Molecular markets, RGLP, RAPD, Simple sequence repeats etc, Role of biotechnology in crop improvement. |
| **25** | Field Crops II (Rabi) | 2+1 | Students will be able to get exposure of origin geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rabi crops.<br><br>Students will be able to take information for cereals wheat, barley and triticale; pulses chickpea, lentil, peas, frenchbean; Oil seeds, rapeaseed and mustard, sunflower, safflower and linseed; sugar crops sugarcane and sugarbeet, Regional medicinal and aromatic crops such as mentha, lemon grass, citronella, palma rosa, Isabgol and posts, potato and tobacco, Forage crops berseem, Luceme and Oat. |
| **26** | Agriculture Co-operation, Finance and Busi. Mgt. | 2+1 | Students will be able to understand the concepts of cooperation- Meaning, significance under Indian agricultural conditions, objectives principles of cooperatives.<br>Students will be able to explain agricultural cooperation in India credit marketing consumer and multi- purpose cooperatives, farming cooperatives, processing cooperatives, cooperative warehousing, role of ICA, NCU, NCDC, NAFED etc.<br><br>Students will be able to explain about women cooperatives, Agriculture finance meaning, scope and significance, credit needs of Indian agriculture, economic principles in capital acquisition and use decisions, preparation and analysis of financial statements, balance sheet and income statement, cost of credit, Access for women to agricultural credit facilities. Agricultural credit market- institutional and non-institutional sources of credit, cooperatives credit system.<br><br>Students will be able to describe commercial banks and regional rural banks, NABARD and AFC, problems and issues in institutional agricultural credit system. Business management environment of agricultural business, tasks of a professional manager, management system and processes, types of management decisions, decisions, decision making techniques and processes, organizational culture and management ethics. |
| **27** | Insect Pest and their Management | 2+1 | Students will be able to explain nature and extent of damage, life cycle seasonal history, host range, distribution and management of the major insect pests attacking field drops; Cereals, pulses, oilseeds, fiber, sugar crops, |

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| | | | Horticultural crops; brinjal, okra, potato, tomato, cole crops, leguminous vegetables, cucurbits, chillies sweet potato, leafy vegetables, onion and garlic, colocasia, yarn. Fruit crops (tropical/sub tropical); jack fruit, papaya, coconut and date palm, mango, citrus, litchi, banana, guava, peach, poar, plum, apricot, chestnut, almond. Plantation and garden crops: marcptics, spices and condiments.<br><br>Students will be able to get information of stored grain and household pests; Locust and other major polyphagous insects, Rodents and mites of agricultural importance. |
| **28** | Fruit and Plantation Crops | 2+1 | Students will be able to understand the importance and scope of fruit and plantation crop industries in India Cultivation practices of important fruit and plantation crops with reference to their origin, soil and climatic requirements; botany, important cultivars, plant propagation practices, resources and planting.<br><br>Students will be able to learn care and management in respect of irrigation, nutrition and other cultural operations including training and pruning, nutrient deficiencies of fruit plant and their collection, inter cropping, major cultivation problem and their control measures, harvesting, yield, storage and marketing; application of plant bioregulators; post-harvest and technology of plantation crops.<br><br>Students will be able to describe management of major insect- pests and disease, principles and methods of evaluation of fruit trees, project formulation and evaluation, commercial orchard. |
| **29** | Livestock Production | 2+1 | Students will be able to get exposure to the place of livestock in the national economy, efficient livestock development programme of government of India.<br><br>Students will be able to get information about importance of exotic and Indian breeds of cattle, buffalo, sheep, goat and swine. Measures and factors affecting livestock fertility, reproductive behavior like estrus, parturition, farrowing, milk secretion, milking of animal and factors affection milk yield and composition of milk.<br><br>Students will learn selection and breeding of livestock for higher milk and meat production. Feeding and management of calves, growing of heifers and milch animal and other classes and types of animals. Housing principles, space requirement for different species of livestock. Disease control and measures of measure livestock diseases, sanitation and care. Breeding feeding and production records. |
| **30** | Rainfed Agriculture | 1+1 | The students will get exposure to history of rainfed agriculture, magnitude of its problem and delineating criteria for rainfed and drylands, soil and climatic conditions prevalent in rainfed area.<br>The students will be able to explain water stress in relation to crop productivity, concept of crop productivity and plant type for rainfed farming areas and crop improvement for efficient water use, drought resistance in crop plants.<br><br>Students will be able to understand the concepts of efficient utilization of water through soil and crop management practices; reducing water losses through mulching and use of anti-transpirants, their kinds, mode of action and effect on crop yield. Increasing water storage by reducing run off and increasing infiltration through mechanical and cultural measures, water harvesting techniques, watershed management. Efficient management of rainfed crops; land preparation, seeding and crop density, selection of efficient crops and their varieties, alternate |

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| | | | cropping and land use strategies, soil fertility management and fertilizer use techniques, weed control and interculture operation, mid season correction for mitigating the aberrant weather, agro techniques for hilly tracts. |
| **5th Semester** | | | |
| **31** | Poultry Management | 2+1 | Students will be able to get exposure to important Breed characteristics of poultry, their methods of rearing, breeding, feeding and management. Incubation hatching and breeding, vaccination and prevention of diseases.<br><br>Students will be able to explain about preservation and marketing of eggs, its economics and keeping quality. Broiler production and rearing, hatchery management. |
| **32** | Mushroom Cultivation | 1+1 | Students will be able to get exposure first record of cultivated edible fungi, definition of mushrooms, present scenario of mushroom cultivation uses nutritional and medicinal values of mushrooms, general morphological features and important characters for identification of different edible mushrooms and biological backgrounds for mushroom breeding.<br><br>Students will be able to explain definition of spawn and their types, methods of spawn production raising cultures, preparation of spawn media/master culture/commercial grade spawn, characteristics of good spawn, storage of spawn. Cultivation of Agricus species: Students will be able to understand the concept of compost and it's formulations, preparation of compost using short and long methods of composting, turning schedules, compost microflora and different temperatures zones. Spawning and methods of spawning. Preparation of casing mixture and its sterilization, identification, isolation and management of different diseases, pests and competitors/moulds. Methods of harvesting mushrooms, after care of harvested fruit bodies, after care of beds and crop rooms on rumination of crop. Cultivation of Pleurotus, Volvareilla, Lentinus and Auricularia sp: Types of substrate, substrate preparation and it's sterilization; spawn and methods of spawning, spawn run and cropping, harvesting and packing, processing of mushrooms: Different methods- canning, dehydration, freeze drying and bringing etc. |
| **33** | Elementary Crop Physiology | 2+1 | Students will be able to get exposure to introduction to plant physiology, plant cell an introduction, laws of thermodynamics, diffusion and osmosis.<br><br>Students will be able to understand concept of water potential, cell water relations, absorption of water, transpiration, stomatal physiology, ascent of sap, ion uptake and metabolic utilization of mineral ions, deficiencies of mineral ions in plants, photosynthesis, respiration, fat metabolism, physiology of growth and development, growth regulators, physiological parameters influencing the productivity of major cereal, pulse and oilseed crops. |
| **34** | Farm Machinery and Power | 2+1 | Students will be able to understand the concepts of sources of farm power including non-conventional sources, farm mechanization, tillage, primary and secondary tillage equipment, specialized tillage tools, seeding and fertilizer machinery, specialized sowing and planting machine, inter culture equipment, plant protection equipment, harvesting and threshing machinery, chaff cutter.<br><br>Students will be able to get information for estimation of operating cost of farm equipment. Basic engine types, parts of I.C. engine, working of different engine systems, types of tractors, working of different tractor systems |
| **35** | Farm Mgt. and Natural | 2+1 | Students will be able to understand meaning, concept, objectives, nature and scope of farm management. |

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| | Resource Economics | | Meaning and definition of farm, structure and characteristics of farm business. Students can explain different types of farms and factors determining types and size of farm.<br><br>Students will be able to explain basic principles of farm management factor – factor and product-product relationships, law of equlmarginal returns and law of comparative advantage. Students will understand meaning and concept of cost, types of cost and their importance in farm management decision making. Concepts of farm returns.<br><br>Students will be able to analyse farm business and various measures of efficiency.<br><br>Students will understand importance of farm business records and accounts, inventory balance sheet. Profit and loss accounts of farm.<br><br>Students will be able to explain status of farm inputs land, labour, capital. Farm planning and budgeting meaning and importance of farm plan and farm budget, partial and complete budgeting, formulation of farm plan and budget. Concept, subject matter and importance of natural resources economics.<br><br>Students will be able to Classify natural resources and explain the basic terms ecosystem, biomass, biosphere, reserves, rate of use, environment, pollution etc. and concepts of natural resources of economics-ecology.<br><br>Students will understand natural resources management and conservation, issues in natural resource use of management the benefit cost approach to natural resource problems.<br><br>Students will be able to explain time element in decision making and benefit cost analysis. The basic theory of natural resource economics efficiency in private market economy, externalities in natural resource use and alternative solution thereof,<br><br>The students will understand important issues in economics and management of land, water and forest resources and the environment. Natural resources administration and policy formulation. |
| **36** | Fundamentals of Extension Education and Rural Development | 2+1 | Students will be able to understand meaning, concept and process of extension education, objectives, principles and philosophy of extension.<br><br>Students will be able to explain history of extension work. Education-formal and non-formal. Components of behaviour-knowledge, attitude, skills and motivation.<br><br>Students will understand Principles and steps in teaching learning process, learning situation, Implications of teaching. Concept need and steps in programme planning. Students will be able to use principles of programme planning, programme planning process.<br><br>Students will understand concepts of Panchayati Raj Institute, reorganization and its role in programme planning. |

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| | | | Extension evaluation its meaning, principles, steps, techniques and criteria.<br>Students will be able to analyse Critically various extension programme.<br><br>Students will understand meaning and importance of rural leadership, Types, selection and qualities, training of leadership.<br><br>Students will be able to explain meaning of administration, public administration and extension administration. Coordination and team work. Organization POSDCORB, organization and management of NES and reorganized extension system. Rural development programme: an over view of CD programme before 1952, agricultural/rural development programme ADP, LAAP, CADP, HYVP, SFDA, hill area development programme, integrated tribal development project.<br><br>Students will be able to prepare integrated dryland farming project.<br><br>Students will be able to understnd integrated child development scheme, IRDP, TRYSEM, JRY, DWCRA, *mahila uthan yojana, Sunishchit rojgar yojana.* Role of voluntary organizations in rural development, women in agriculture and rural development. |
| **37** | Post-Harvest Mgt. & Processing of Fruits and Vegetables | 2+1 | To study the importance of Post-harvest management for fruits and vegetable<br>To learn total production and consumption pattern<br>To understand the Post harvest losses in fruits and vegetables<br>To learn about Maturity and ripening process<br>To understand the biochemical changes after harvesting<br>To learn the quality management for fresh marketing and processing<br>To study Storage of fruits and vegetables – ambient, low temperature and controlled atmosphere storage system<br>To learn about Packaging of fresh and processed products<br>To learn about Transportation system, mode of marketing, sorting, grading and handling<br>To study the Pretreatment of fresh produce for marketing and processing<br>To study the general principles and methods of preservation and preparation of jam, marmalade, tomato products, pickles and chutney, drying fruits and vegetables, fruit beverages, juices, squashes, nectars, cordials, by products of fruits and vegetables processing industries such as vinegar, cider<br>To study about Canned fruits and vegetable products, frozen fruits and vegetables<br>To study about government<br>policies, regulation and specifications for fresh and processed products<br>To learn about the export promotion agencies and their role in export of fresh and processed products. |
| **38** | Practical Crops Production – I | 0+2 | Students will be able to understand the complete Practical acquaintance relating to scientific production techniques of major field crops of the season (kharif) including sowing weeding hoeing fertilizer and manure application, harvesting etc. |
| **6th Semester** | | | |
| **39** | Farming System and Sustainable Agriculture | 2+1 | Students will be able to recycle of agricultural and industrial organic wastes; wastelands and their management; reclamation and management of acidic, saline and sodic soils, soil erosion; extent, type and effects; soil |

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| | | | conservation techniques, watershed mgt.; application of remote sensing for assessment of soil and water resources.<br><br>Students will be able to utilise mulching, wind breaks, water harvesting, tied ridging, strip cropping. Permeable contour line barriers and water ponds. |
| **40** | Conservation and Management of soil and water resources | 1+1 | Students will be able to understand different soil resources of India; distribution of waste land problem soils; water resources of India and their utilization in crop production; soil tilth management and relationship with tillage; tilth requirement of different crops; soil impedance layers and their improvement; management of soil water energy state of water in soil and availability to plants; management of soil moisture under different climates; water harvesting techniques, effect of water quality on soil and plants; soil aeration problems and management; soil thermal regimes in relation to crops and their optimization.<br><br>Students will be able to recycling of agricultural and industrial organic wastes; wastelands and their management; reclamation and management of acidic, saline and sodic soils, soil erosion; extent, type and effects; soil conservation techniques, watershed mgt.; application of remote sensing for assessment of soil and water resources. |
| **41** | Ornamental Horticulture | 2+1 | Students will be able to explain importance of ornamental gardening in human life, theory and practice of landscape and formal garden for various places, identification, use of ornamental plants for the beautification of private and public places, styles of gardens, formal, informal etc.<br>Students will be able to understand different concepts of landscape and town planning, ornamental plants for rural and urban areas, indoor gardening, post culture; bonsai, hanging baskets etc.<br><br>Students will be able to understand principles and practices involved in growing ornamental annual and perennial plants, planning and layout of various parts of garden, herbaceous and shrubbery borders, lilly pots, rock gardens etc. cultivation of important ornamental plants, rose, gladiolus, chrysanthemum, tuberose, orchids, authurium, gerbera, dahlia, fern, palms, cycades, cacti etc. Post-harvest technology, project formulation and evaluation. |
| **42** | Environmental Science | 2+1 | **Students will be able to understand Introduction to Environmental Sciences for following heads:**<br>▪ Definition, scope and importance (the multidisciplinary nature of environmental sciences)<br>▪ Need for public awareness on Environment, Role of individual in Environmental protection<br>**Students will be able to explain Natural Resources (Renewable and Non-renewable Resources):**<br>▪ Natural Resource conservation: concepts<br>▪ Freshwater resources: use and over-exploitation of surface and ground water, conflict over water, hydroelectric projects, problems, traditional methods of harvesting of freshwater resources.<br>▪ Mineral resources: use and exploitation, environmental effects of extracting mineral resources, Lime stone quarrying in Uttaranchal<br>▪ Food resources: World food problems, changes caused by agriculture and overgrazing, effect of modern agriculture, fertilizer operated problem, water logging, salinity.<br>▪ Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.<br>▪ Land resources: Land as a resources, land degradation, landslides, soil crosion and desertification. |

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| | | | **Ecosystems:**<br>▪ Concept, structure, and components of an ecosystem.<br>▪ Abiotic and biotic variables.<br>▪ Ecosystem function, trophic levels, energy flow, food chain, food web, Ecosystem, homeostasis.<br>▪ Examples of ecosystems (aquatic: pond, lake, river)<br>▪ Terrestrial ecosystem: Forest, mountain<br>▪ Ecological succession.<br>**Biodiversity and its conservation:**<br>▪ Introduction:- Definition, genetic, species and ecosystem diversity.<br>▪ Bio-geographical classification of India<br>▪ Values of biodiversity: 5 Es (Esthetic (Aesthetic), Economic, Environment, Ethical, Emotional.<br>▪ Biodiversity at global, national and local levels.<br>▪ India as a mega diversity nation, hot spots of biodiversity.<br>▪ Himalayan wildlife: Habital losspoaching of wildlife, man-wildlife conflicts, and conservation.<br>▪ Threatened categories as per IUCN.<br>▪ Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.<br>**Students will be able to understand the concepts of Applied environmental science** Environmental Pollution<br>▪ Definition, causes, effects and measures of Air pollution.<br>▪ Water pollution and thermal pollution.<br>▪ Marine pollution.<br>▪ Noise and radioactive pollution.<br>▪ Solid waste and their management (municipal, industrial (hazardous and non-hazardous), problems of solid waste disposal in Uttaranchal and integrated Solid Waste Management (ISWM).<br>▪ Environmental hazards in Himalayas (floods, river, blockades, cloud burst, landslides, earthquakes).<br><br>Students will be able to explain Environmental problems and Environmental Protection<br>▪ *Anthropogenic* and natural environmental problems.<br>▪ Environmental ethics; issues and possible solutions.<br>▪ Climate change, global warning: causes, effects and mitigation (national and international efforts)<br>▪ Ozone layer depletion: causes, effects and mitigation. (national and international)<br>▪ Environmental Protection Act 1986<br>▪ Air (Prevention and Control of pollution) Act, Water (Prevention and control of Pollution) Act.<br>▪ Wildlife Protection Act 1972<br>▪ Forest Conservation Act 1980<br>▪ The Biological Diversity Act 2002<br>▪ Issues involved in enforcement of environmental legislation, public awareness, Article 48A and 51A<br>▪ Automobile Emission standards (Eco/Bharat), Ecomark<br>**Human Population and the Environment:**<br>▪ Population growth, variation among nations, population explosion Family Welfare Programme.<br>▪ Environment and human health. |

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| | | | ▪ Role of Information Technology in environment and human health.<br>**Sustainable Development:**<br>▪ Definition, concepts and currencies<br>▪ Sustainable development of agro-ecosystem (organic farming)<br>▪ Sericulture, floriculture, bee keeping<br>▪ Sustainable development of hydroenergy in Uttaranchal<br>▪ Traditional Ecological knowledge (TEK) |
| **43** | Silviculture and Agro Forestry | 2+1 | Students will be able to understand Introduction basic terms, concepts and scope, national and global need, growth and development of trees and forest stands growth and developmental stages and growth measurements, factors affecting tree and stand growth, plant succession kinds and causes, natural and artificial regeneration establishment and care of tree nurseries tending operations cleaning, weeding, thinning, pruning.<br><br>Students will be able to explain cultural operation classification, regeneration and crop characteristics of major Silvicultural systems, basic concepts of rotation, sustainable yield management and multiple use, establishment of forest stands/crops and agroforestry-selection and management of tree and crop species i.e. planting density, geometry and Silviculture, comparison among various land uses-mixed farming, multiple cropping and agroforestry, Interactions between components of agroforests for various resources and productivity. Problems, choice and management of agro-forestry systems in various agro-climatic zones. |
| **44** | Seed Production and Processing Technology | 2+1 | Students will be able to understand the concepts of Seed, its importance in green revolution difference between grain and seed, concept of seed quality, steps involved in seed production. Seed technology, its objectives and its role in increasing agriculture production. Seed industry in India.<br>Students will be able to explain development of seed programmes, general principles of seed production. Seed replacement rate, multiplication rate, Breeder's, foundation and certified seed, maintenance of genetic purity, Nucleus and breeders seed production of newly released and established varieties of self-pollinated crops, viz, Rice, Wheat Soybean/chickpea, Pigeonpea, Rapeseed and Mustard etc.<br><br>Students will be able to know maintenance of nucleus and breeder's seed in cross pollinated crop varieties, inbreds and non-inbreds, maintenance of seed of established varieties. Foundation and certified seed production of maize inbreds, single and double cross hybrids. Hybrid seed production of Sunflower, Sorghum, pearlmillet and Rice using male sterility systems. Latest released hybrids of Maize, Sorghum, Bajra and Rice their characteristic feature, seed production of Wheat, Rice, Oats, Soybean, Gram, Urd, Moong, Sunflower, Pigeonpea etc. seed certification, its concepts, roles and goals, seed certification ageneies, certified and truthfully labeled seeds.<br><br>Students will be able to explain seed processing, storage and marketing, Miniumum seed certification standards for self and cross-pollinated crops. Field and seed inspections objectives, general principles and methods, Seed sampling and seed testing for analytical purity, varietal identification through electrophoreses, Grow out test for cultivar purity, seed legislation and seed law enforcement including IPR, PBR in India, Record developments in seed. |
| **45** | Practical Crops | 0+2 | Students will be able to understand the complete Practical acquaintance relating to scientific production technique |

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| | Production – II | | of major field of the season crop(s) including sowing weeding, hoeing, fertilizer and manure application, harvesting etc. |
| **7th Semester** | | | |
| **46** | General Economics | 2+0 | The students will be able to understand Nature and scope and subject matter of economics and also approaches to economic analysis and nature of economic theory.<br>The students will be able to state the basic terms and concepts of economics<br>The students will be able to state the various theories related to consumer behavior such as equi-marginal utility, indifference curve, diminishing marginal utility.<br>The students will be able to define law of demand and understand the concept of price, income and cross elasticities.<br>The students will be able to explain factors of production i.e. land, labour, capital and enterprise and also understand and input-output relationships.<br>The students will be able to describe law of variable proportions and laws of scale.<br>The students will be able to understand the concepts of cost.<br>The students will be able to describe Law of diminishing marginal returns.<br>The students will be able to explain the Law of supply.<br>The students will be able to explain the theories of rent, wage, interest and profit.<br>The students will be able to understand the concepts of various types of markets and also Price determination and forecasting under them.<br>The students will be able to understand the concepts of National Income and also approaches of measuring national income.<br>The students will be able to explain theories of population.<br>The students will be able to describe the concept and types of inflation.<br>The students will be able to understand barter system of exchange and its problems.<br>The students will be able to understand the concept of money and explain quantity theory of money.<br>The students will be able to tell the various types of banks and their function.<br>The students will be able to explain the basic feature of various economic systems,<br>The students will understand the concept of international trade.<br>The students will be able to specify special characteristics of agriculture and its role in economic development.<br>The students will be able to explain the role of women in Indian Agriculture. |
| **47** | Breeding and Improvement of Farm Animals | 1+1 | Students will be able to understand reproductive systems of farm animals. Qualitative and quantitative inheritance and effect of environment on them. Various qualitative and quantitative traits of livestock. Weinberg law, variation, its measures, genetic, phenotypic and environmental variances.<br><br>Students will be able to explain heritability and repeatability, its measurement and uses. Selection its genetic effect, selection for dominant and recessive gene and quantitative traits, selection differential, response to selection, generation interval and annual rate of gain.<br><br>Students will be able to explain Genetic correlation and correlated response. Basic of selection, individual, family, progeny, pedigree and combined selection. Methods of selection for one or more traits random, |

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| | | | independent culling level and selection index. Inbreeding its consequences, inbred lines, line breeding, inbreeding, coefficient and relationship coefficient, out breeding – various types of our crossing and cross-breeding, species hybridization and development of new breeds. |
| **48** | Principles of Animal Nutrition | 2+1 | Students will be able to understand Introduction to expanding field of nutrition, chemical composition of animal and its food, digestive systems and processes of farm animals. Digestion, absorption and metabolism of carbohydrates, lipids and proteins in protein content in various classes of feeds. Concept of essential amino acids for non-ruminants and protein quality of feeds.<br>Students will be able to explain the absorption and metabolism of essential minerals and vitamins; symptoms of their deficiencies; minerals and vitamin content of various classes of feeds. The nutritive evaluation of feeds for energy and protein, digestibility of feeds values of feeds, nutrient requirements of farm animals for maintenance, growth reproduction and lactation. Growth stimulating substances. |
| **49** | Element of Food Technology | 2+1 | Students will be able to understand the scope and importance of food technology in Indian economy. Handling, transportation and storage of food grains, fresh milk, meat, fish and eggs; physical, chemical and nutritional characteristics of food grains – fresh meat, fish, milk and eggs; role of milling and size reduction in food processing;<br><br>Students will be able to explain use of low temperatures in processing and storage of food grains, fresh milk, meat, fish and eggs; Drying and dehydration of food grains and concentration and evaporation of milk; Food fermentations and their application in food processing.<br><br>Students will be able to know the role of food additives in the processing of food grains, milk, meat, fish, eggs and their products; Food irradiation and its application in extending shelf life of food grains, meat, fish, eggs and their products; Food packaging and its functions; By product's utilization and disposal of food industry wastes; quality control, total quality assurance (TQA) and various systems of TQA. |
| **50** | Human Food and Nutrition | 2+1 | Students will be able to understand different trends in food production and consumption in India. Role of agricultural scientists and food technologist in meeting national nutritional requirements. Definition of human nutrition, nutrient, nutritional care, health, nutritional status and good nutrition.<br><br>Students will be able to explain food and its functions and functional classification. Calorific value of foods and its measurement. Digestion and absorption of various nutrients present in foods. Energy and nutrient needs of human body. Recommended dietary allowances for various age groups and classes of individuals.<br><br>Students will be able to know common nutritional problems in India and their causes. Specific nutritional deficiencies and disorders including protein calorie malnutrition, nutritional anaemias, vitamin deficiencies, obesity, atherosclerosis. Clinical symptoms and diagnosis of deficiency disorders. Important food groups and their role in the management of deficiency disorders and diseases. Food habits and their effect on regional balance. Balanced diet and its formulation.<br>Students will be able to understand the food born infections and food hygiene. Effect of processing on the nutritional value of foods. Applied nutritional programme in country, nutritional policies of government. Food fortification, enrichment and restoration, supplementary feeding programmes for vulnerable groups. State, |

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| | | | national and international agencies dealing with nutritional programmes. |
| **51** | Soil Taxonomy, Survey and remote sensing | 2+1 | Students will be able to explain types of soil survey, morphological, physical and chemical properties used in distinguishing and classifying soils.<br><br>Students will be able to understand principles of soil taxonomy, classification system. Soils of India and their classification. Advantages of taxonomic classification of soils. Remote sensing introduction, definition, concept, principles, importance, scope, types, merits and demerits and its application in agriculture and soil classification. |
| **52** | Production Technology of Medicinal and Agromatic Plants | 0+2 | Students will be able to know importance and scope of medicinal and aromatic plants, geographical distribution of species, botanical description, management of nurseries, climate and relation to medicinal and aromatic plants, improved varieties, soil and land preparation, intercultural practices, irrigation and insect-pest management, post-harvest techniques, harvesting processing, storage and herbage/constituent yield.<br><br>Students will be able to know the following medicinal and aromatic plants.<br>*Medicinal Plants:* Sarpagandha, poppy, sadabahar, digitailis, dioscora, solanum, brahmi, isabgol, senna, aloe, neem, cinchona and Ipecac.<br>*Aromatic Plants:* Essential oils: Mints-menthol mint, pepper mint, Spearmint, bergamot mint; Aromatic grasses lemon grass, palmarosa, citronella, vetiver; Ocimum, geranium, pachauli, dill (Sowa), Cinamon, pine, eucalyptus, sandalwood, liquorice<br>*Flower perfume:* lavender, rose, rosemary, jasmine |
| **8th Semester** | | | |
| **53** | Rural Agriculture Work Experience | 0+20 | Students will be able to learn and understand different below mentioned topics each student will have a choice to opt any of the four components given below. He/she will submit his/her work in form of a report and present the results in the seminar.<br>i. Agro-based Industries – Seed processing plants and industries, fruit preservation industries, food processing industries etc.<br>ii. Plant clinics<br>iii. NGO<br>iv. Socio economic studies<br>v. Apiculture<br>vi. Sericulture<br>vii. Mushroom Cultivation<br>viii. Attachment with agriculture Departments<br>ix. Attachment with Agriculture research institutes/organizations/agencies. |

# B.Sc. Biotechnology

**Programme Code**: 140

**Course Summary**

Duration: 3 years

**Eligibility**

10+2 with minimum 45% marks in aggregate with PCB

**Program outcome:**

B.Sc. Biotechnology with CBZ programme is a three-year degree. In the three years students will tackle core subjects to ensure that they receive a solid grounding in fundamentals. The programme comprises courses on Biotechnology, Zoology, Botany and Chemistry which provides the opportunity to students for gaining knowledge in multidisciplinary subjects and labs, namely

- To develop skills for general Biotechnology techniques.
- To understand fundamentals of Cell Biology, Biochemistry, rDNA technology, Molecular Biology, Genetics, Plant tissue culture, Bioinformatics and Intellectual property Right.
- To develop advanced knowledge and understanding relevant to Zoology and acquire knowledge of Demonstrated a broad understood of animal diversity, including knowledge of the scientific classification and evolutionary relationships of major groups of animals.
- The entire animal's functions of the body are studied in this part. It includes nutrition. Respiration, heart, excretion, nerve physiology etc in which all structure, function, process and control are to be studied.
- Understand the environmental and basic concept of taxonomy, ecology, Determine economic & medicinal plant in agriculture and medicine, Analysis the relationship between plants and microbes, understand the biology of diversity of seed plants or phanerogames, Understand the behaviors of fossils and gymnospermic plants, Understand the plant disease, chemical properties and evolutionary relationship among taxonomic groups.
- The Bachelor of Science in Chemistry programs offer students a more quantitative experience in chemistry. To provide in-depth knowledge of element, compound, scientific and technological aspects of Chemistry. To familiarize with current and recent developments in Chemistry.

**Course outcomes:**

| S. No. | Course name | Credits | Course outcome |
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| | | **1st Semester** | |
| 1 | Biotechnology (Biochemistry & Metabolism) | 4 | Introduction to Biochemistry. To study the structure and functions of different biomolecules. To learn about enzymes including classification, properties and coenzymes. To study carbohydrate metabolism and beta oxidation. |
| 2 | Zoology (Animal Diversity) | 4 | To introduce the kingdom protista, Phyllum Porifera, Coelenterata, Platyhelminthes, Nematyhelminthes, Annelia, Arthropoda Mollusca, Echinodermata, and All classes of Chordata with referenceces general character and classification upto classes. To learn about the different phyllum system-locomotion in Protozoa, Canal System in Sycon (Porifera), Polymorphismin Hydrozoa(Cnidaria), Life history of Taenia and Ascaris (Helminthes), Metamerism inAnnelida, Metamorphosis in Insects(Arthropoda), Torsion in gastropods(Mollusca), vascular system in Asteroidea(Echinodermata), Phylogeny of Protochordata, Osmoregulation in Pisces, Parental care in Amphibia, Poisonous and non-poisonous snakes, Biting mechanism in snakes Flight adaptations and Origin of mammals. |
| 3 | Botany (Biodiversity (Microbes , Algae, Fungi and archegoniate)-) | 4 | To Understand the discovery, general characters Economic Importance and replication of virus and bacteria. To know about the, morphology, structure and Economic Importance and life cycle pattern of Algae and Fungi. To know about the general characters, classification morphology, anatomy and Economic Importance and life cycle pattern of Bryophytes, Pteridophytes, and Gymnosperms. To understand about fossil plants. To learn about the ecology and significance of lower plants. To know about general account and significance of lichens and mycorrhiza. |
| 4 | Chemistry (atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons) | 4 | Purpose of this paper at graduate level understanding of major concepts, theoretical principles and experimental findings in chemistry regarding Atomic structure, Chemical Bonding and Molecular Structure, Fundamental of Organic Chemistry, Stereochemistry and Aliphatic Hydrocarbons. |
| 5 | Laboratory course (Biochemistry & Metabolism) | 2 | To impart practical knowledge and hands on training based on course Biochemistry & Metabolism |
| 6 | Laboratory course (Zoology: Animal Diversity) | 2 | To impart the practical knowledge to identify the specimens and slides of different Phylum from Protozoa to Chordata. |
| 7 | Laboratory course (Botany: | 2 | To study about virus and bacteria by using photographs, temporary and permanent |

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| | Biodiversity -Microbes , Algae, Fungi and archegoniate) | | slides .<br>To study vegetative and reproductive structure of algae, fungi, bryophytes by temporary and permanent slides.( Mentioned in syllabus)<br>To study morphology and anatomy of pteridophytes and gymnosperms by temporary and permanent slides.<br>To know about lichens and mycorrhiza by using photograph. |
| 8 | Laboratory course (Chemistry: atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons) | 2 | Developed the ability to use modern instrumentation for chemical analysis and separation techniques regarding Volmetric Analysis and Organic Chemistry. |
| | English | 2 | Write focused, organized, well-developed, and text-based essays using effective paragraphs, which support a clear thesis statement, and demonstrate competence in standard English grammar and usage. |
| | | | **2nd Semester** |
| 9 | Biotechnology<br>(General Biotechnology) | 4 | To learn fundamentals of genetic engineering, PCR and Cloning. To understand the working and principles of instruments used in biotechnology. To understand the fundamentals of Animal Tissue Culture. To understand the concept of transgenics. To learn the applications of biotechnology in different fields. |
| 10 | Zoology (Comparative Anatomy and Developmental Biology) | 4 | To get knowledge about the integumentary system and their derivatives, skeletal system, digestive system, respiratory system as gills, lungs, air sacs and swim bladder, circulatory system as to study evolution of heart in differnt vertebrates. To study the comparative account of brain, evolution of urinogenital system, types of receptors in vertebrates.<br>To understand the embryonic developement by gaining the kmowledge of gametogenesis, vitellogenesis in birds and fertilization. To study the early developement of frog and humans upto the gastrula formation and study the movement in germ layers and their fate. To get knowledge about the late embryonic developement in humans and study plantation, placenta formation and types of placenta in humans. To study the metamorphic events in frog life cycle and control of developement by studying gene activation, determination, induction, differentiation, morphogenesis, intercellular communication and cell death. |
| 11 | Botany (Plant Ecology and Taxonomy) | 4 | To Understand the environments and basic concept of taxonomy, ecology.<br>Determine economic & medicinal plant in agriculture and medicine. Analysis of the relationship between biotic and abiotic components of ecosystem and their relationship..<br>Understand the soil biology. Understand the plant nomenclature and their classification given by different scientists. Understand the different families of angiospermic plants. |
| 12 | Chemistry (Chemical Energetics, | 4 | This paper provide desirable knowledge to the students regarding Chemical Energetics, |

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| | Equilibria Science & Functional Group Organic) | | Chemical Equilibrium, Ionic Equilibrium, Aromatic Hydrocarbons, Alcohol, Phenols, Ether and aldehydes and Ketones. |
| 12 | Ability Enhancement Compulsory Course : Environment Sciences | 2 | The Environmental Studies major prepares students for careers as leaders in understanding and addressing complex environmental issues from a problem-oriented, interdisciplinary perspective. |
| 13 | Laboratory course (Biotechnology: Biochemistry & Metabolism) | 2 | To impart practical knowledge and hands on training based on course General Biotechnology |
| 14 | Laboratory course (Zoology: Plant Anatomy and Embryology ) | 2 | To impart practical knowledge about the disarticulated skeleton of fowl and rabbit, Carapace and plastron of turtle /tortoise, mammalian skulls: One herbivorous and one carnivorous animal.<br>To get practical knowledge of frog developmental stages by whole mounts and sections through permanent slides as cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages, study of the different types of placentae through permanent slides or photomicrographs. Study of placental development in humans by ultrasound scans and Examination of gametes as frog/rat - sperm and ova through permanent slides or photomicrographs. |
| 15 | Laboratory course (Botany: Plant Ecology and Taxonomy) | 2 | Study the different instruments used in ecology and taxonomy.<br>Study the morphological adaptations of aquatic and xerophytic plants.<br>Determination of minimal quadrat size and minimum quadrat number to study the plant community.<br>Study the components of ecosystem.<br>Study of concept of herbarium.<br>Study the plant species belonging to various families. |
| 16 | Laboratory course (Chemistry: Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I) | 2 | Developed an ability to conduct experiments, analyze data, and interpret results to use various techniques like that determination of different physical parameters such as pH, surface tension, viscosity etc and various organic synthesis methods. |
| 17 | Biotechnology (General Microbiology) | 4 | To know the fundamentals, history and evolution of microbiology and study the microbial diversity, distribution and characterization of prokaryiotic and eukariotic cells. Know various Culture media and their applications and also understand various physical and chemical means of sterilization.<br>Comprehend the various methods for identification of unknown microorganisms<br>Understand the microbial transport systems and the modes and mechanisms of energy conservation<br>in microbial metabolism and mode of reproduction |

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| | | | To know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement. To get information of important microorganism. |
| 18 | Zoology (Physiology and Biochemistry) | 4 | Understand concepts of growth and reproduction of bacteria. Know parts of microscope, type and its principal. Get the theoretical concepts of related stain. Understand different methods of staining techniques. Understand nutritional requirements of bacterial. |
| 19 | Botany (Plant Anatomy and embryology) | 4 | Understand the scope & importance of Anatomy and embryology of angiosperms.<br>To know about the meristematic and permanent tissue, anatomy of dicot and monocot root, stem and leaf.<br>To know about the various tissue systems root apex meristem and shoot apex meristem, secondary xylem and leaf growth.<br>Understand the normal and anomalous secondary growth in plants and their causes. Sap wood and heart wood.<br>To know about the microspogenesis and megasporogenesis, organigation of embro sac, pollen pistil interaction, methods of pollination and fertilization, endosperm and embryogenesis and polyembrony, apomixis . |
| 20 | Chemistry (Solutions, Phase Equilibria,<br>Conductance, Electrochemistry & Functional Group Organic Chemistry-II) | 4 | The main purpose of this paper is to developed theoretical knowledge in various fields like that solutions, Phase Equilibria, Conductance, Electrochemistry under physical chemistry and carboxylic acid and their derivatives, amines and diazonium salts, amino acids, peptides and proteins, carbohydrates under organic chemistry. |
| 21 | Skill enhancement (for Zoology: Pisciculture) | 2 | To gain knowledge about the scope of aquaculture. To learn the techniques of fish farm managements. To gain knowledge about the fish culture techniques (Induced breeding & integrated fish farming). To learn about the fish nutrition and methods of live fish transportation. To gain knowledge about the fish diseases, treatment and preventive measures. |
| 22 | Laboratory course (Biotechnology: General Microbiology) | 2 | To impart practical knowledge and hands on training based on course General Microbiology. Develop basic skill in aseptic techniques. Understand various accessories for microbiology practicals. Perform various staining techniques. Cultivate bacteria with different cultivation technique. |
| 23 | Laboratory course (Zoology: Physiology and Biochemistry) | 2 | To impart practical knowledge about preparation of hemin and hemochromogen crystals, to examine the permanent slides of mammalian pituitary, thyroid, parathyroid, pancreas, adrenal, spinal cord, duodenum, liver, lung, kidney, bone,cartilage. To identify the unknown carbohydrates (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose) and proteins in given solution. To study the activity of salivary amylase under |

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| | | | optimum conditions. |
| 24 | Laboratory course (Botany: Plant Anatomy and embryology) | 2 | To study the simple and complex tissue by permanent slides.<br>To study the anatomy of monocot and dicot root, leaf and stem by temporary and permanent slides.<br>To study the abnormal secondary growth in some special case in root, leaf and stem by temporary and permanent slides.<br>To study the floral parts particularly anther and pistil.<br>To study the pollen grain and seed germination and viability in lab.<br>To study the organization of various embryo sac, endosperms, monocot and dicot embryo. |
| 25 | Laboratory course (Chemistry:Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II) | 2 | Developed an ability to conduct experiments, analyze data, and interpret results to use various techniques like that construction of phase diagram, Determination of critical points, study of variation of mutual solubility temperatures, determination of cell constant, equivalent conductance, potentiometric titration and different organic qualitative analysis, separation techniques etc.<br>Skill enhancement paper aware to the students regarding application and uses of pesticide in daily life and handle the different pesticide techniques. Pesticide like that organochlorine, organophosphate, carbonate and annelids etc. |
| **4th Semester** | | | |
| 26 | Biotechnology (Immunology) | 4 | To understand the fundamentals of immunity & the immune system. Regulation of immunoglobulin gene expression. Genetic basis of Ab Diversity. To understand the concept of Ag processing and presentation, autoimmunity and immunodefeciency. Introduction to immunodiagnostics.<br>To understand active and passive immunization. |
| 27 | Zoology (Genetics and Evolutionary Biology) | 4 | The goal of this course is create a deep understanding about inheritance, Mendelism, Chromosome to cistron journey and deviation Mendel and also how evolution works, and general knowledge about the most important research questions in evolutionary biology. To understand basic principles of Mendelian inheritance.<br>To study cell division & chromosome segregation. To explore the multifactorial inheritance. To acquire the chromosome structure, chromatin organization and variation.<br>To learn the concepts of Linkage concept of sex determination and sex linked inheritance.<br>To gain knowledge about the organellar inheritance. The subject introduces students to all aspects of evolutionary biology. the course is to provide students with a deeper |

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| | | | insight into the evolutionary processes - both selective and random - which can explain the genetic composition of populations, form, behaviour and distribution of organisms, and to teach students the basic methods of analysing the evolutionary relationships between species. |
| 28 | Botany (Plant Physiology and Metabolism) | 4 | To know about the metabolic activity and life cycle of the plant from germination through growth and development.<br>Know importance and scope of plant physiology.<br>Understand the plants and plant cells in relation to water-osmosis, imbibition, guttation, diffusion and water potential and the movement of sap and absorption of water in plant body, transpiration-structure and function of stomata, plant nutrition and essentiality and mechanism of absorption.<br>Understand the process of photosynthesis particular light and dark reaction, photorespiration, respiration particular emphasis on aerobic and anaerobic respiration.<br>To learn about enzymes structures, properties and their mechanism, nitrogen metabolism, plant growth regulators, photoperiodism and vernalization. |
| 29 | Chemistry (Chemistry-DSC 2d: coordination chemistry, states of matter &<br>chemical kinetics) | 4 | In this paper students are expected to understand the colours and magnetic behaviour of transition metal complexes. In this branch of chemistry students know how the matter exist and the progress of reaction. |
| | Skill enhancement Paper<br>(Chemistry: Pharmaceutical Chemistry<br>Botany: Plant Diversity & Human welfare) | 2 | Chemistry: Skill enhancement paper aware to the students regarding application and uses of pesticide in daily life and handle the different pesticide techniques. Pesticide like that organochlorine, organophosphate, carbamate and anelides etc.<br>Botany: To know about the plant diversity and its scope<br>To study the values of biodiversity.<br>To study the threats to biodiversity and its management practices.<br>To study the conservation studies of biodiversity.<br>To study the role of different plants in relation to human welfare. i.e. cereals, pulses, fruits etc.<br>To study the social forestry, its utilization and commercial aspects. |
| 30 | Laboratory course<br>(Biotechnology: Immunology) | 2 | To impart practical knowledge and hands on training based on course Immunology. |
| 31 | Laboratory course (Zoology: Genetics and Evolutionary Biology) | 2 | To impart practical knowledge, Numerical problems and evolutionary theories based on Genetics and Evolutionary Biology. |
| 32 | Laboratory course (Botany: Plant Physiology and Metabolism) | 2 | 1.To learn about measurement of water potential by osmosis and plasmolysis method.<br>2. To demonstrate the rate of transpiration by using potometer.<br>3.To learn demonstrate the importance of photo-synthesis by the help of wilmonnt |

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| | | | bubbler and inverted funnel exp.<br>4. To study plant movement by the help of clinostat.<br>5. To study separation of leaf pigments by paper strip chromatography.<br>6. To study structure of stomata and role of stomata in transpiration by using four leaves exp. |
| 33 | Laboratory course (Chemistry: Chemistry of s-and p-block Elements, States of Matter & Chemical) | 2 | All practicals are related to theory paper CHEMISTRY |
| **5th Semester** | | | |
| 34 | Biotechnology<br>(Plant Biotechnology) | | This course provides graduate-level knowledge of and expertise in plant tissue culture theory and practice. This course has a vocational focus and introduces the student to the theory and practice of plant tissue culture and their role from modifying plants in plant biotechnology to the propagation of endangered plants. Students study media, sterilisation, explants, micro propagation, callus culture, organogenesis, embryogenesis, somatic variation, doubled haploids, interspecific hybrids, protoplast fusion and environmental conditions required. These are related to uses of tissue culture and compared with traditional techniques. |
| 35 | Zoology<br>(Reproductive Biology) | 4 | To learn about the gonadal hormones, mechanism of hormone action and hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin.<br>To understand about male and female reproductive system, development and differentiation of gonads, genital ducts, external genitalia and mechanism of sex differentiation<br>To acquire knowledge about histology of male reprocuctive system, cellular functions, germ cell, system cell renewal, androgen synthesis and metabolism Epididymal function and sperm maturation, Accessory glands functions; Sperm transportation in male tract.<br>To understand the histology of ovary, folliculogenesis, ovulation, corpus luteum formation and regression, hormones biosynthesis and secretion of ovarian hormones, fertilization, hormonal control of implantation; hormonal regulation of gestation , diagnosis of pregnancy, parturition, lactation and its regulation and reproductive cycles.<br>To gain knowledge about infertility in male and female: causes, diagnosis and management<br>To understand the modern contraceptive technologies.<br>To acquire knowledge about the demographic terminology used in family planning. |
| 36 | Botany (Cell and molecular Biology) | 4 | Demonstrate understanding of selected basic principles & concepts about biological techniques like light and electron microscopy. To understand intracellular |

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| | | | compartmentalization. Their structure, organization and functions. To learn about the structure and functions of cell wall and cell membrane. To understand the concepts of Molecular Biology. Learn experimental evidences for nucleic acid as carrier of genetic information. To understand DNA replication, transcription, translation in Prokaryotes and Eukaryotes. To study the basic features of genetic code. To understand the regulation of gene expression in Prokaryotes and Eukaryotes. |
| 37 | Chemistry (ANALYTICAL METHODS IN CHEMISTRY) | 4 | Spectroscopy is basic tool for understanding analytical techniques. Students are expected to understand basic concept about spectroscopy.<br>Chromatography is an important biophysical technique that enables the separation, identification, and purification of the components of a mixture for qualitative and quantitative analysis. |
| 38 | Skill enhancement Paper (Biotechnology: IPR Entrepreneurship, Bioethics and Bio-safety) | 2 | Assessment of the potential of an opportunity and to determine its viability practical, social and commercial implications.<br>Understanding entrepreneurial behaviour & characteristics associated with successful entrepreneurs.<br>Efficient utilization of resources including finances to exploit an identified opportunity management of intellectual property, legal structures, ethical issues and risks of a new venture<br>Preparation of a feasibility report for an identified opportunity to assess its feasibility and sustainability. |
| 39 | Laboratory course (Biotechnology: Plant Biotechnology) | 2 | To impart practical knowledge and hands on training based on course. ractical applications of in vitro methods. Plant tissue culture lab organization. To maintain the aceptic condition. Preparations of MS stocks and media. |
| 40 | Laboratory course (Zoology: Reproductive Biology) | 2 | To learn about set up and maintenance of animal house, breeding techniques, care of normal and experimental animals. To gain knowledge about the examination of vaginal smear rats from live animals. To learn about the principles of surgery in endocrinology. Ovarectomy, hysterectorny, castration and vasectomy in rats. To learn about the histological sectionsof male female reproductive organ from photomicrographs/ permanent slides of rat/human.<br>To understand the human vaginal exfoliate cytology. To learn the technique of sperm count and sperm motility in rat. To learn about the modern contraceptive devices. |
| 41 | Laboratory course (Botany: Cell and Molecular Biology) | 2 | To impart practical knowledge and hands on training based on course. |
| 42 | Laboratory course (Chemistry: analytical methods in chemistry) | 2 | All practical's are related to analytical methods including spectroscopic technique and chromatographic techniques |

| 6th Semester | | | |
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| 43 | Biotechnology (Bioinformatics) | 4 | To know the history of Bioinformatics with notion of Homology discussed.<br>Sequence Information Sources like EMBL, GENEBANK, Entrez, Unigene and Protein Information Sources like PDB, SWISSPROT, TREMBL understood.<br>Sequence and Phylogeny analysis including detecting Open Reading Frames, Outline of sequence Assembly have been described. Mutation/Substitution Matrices for Pairwise Alignments, including BLAST discussed.<br>Multiple Sequence Alignment with reference to Phylogenetic Analysis outlined.<br>Searching Databases using SRS, Entrez detailed.<br>Genome Annotation including Pattern and repeat finding with emphasis on Gene identification tools performed. |
| 44 | Botany (Genetics and plant breeding) | 4 | To study the different terminologies involved in genetics.<br>To study different laws of inheritance and their modified ratios.<br>To study the cytoplasmic inheritance by different examples.<br>To study the sex determination and sex linked inheritance<br>To study the mutations and its role in plant breeding.<br>To study the different methods of crop improvement in plant breeding.<br>To study the inbreeding depression and heterosis.<br>To study the process of hybridization. |
| 45 | Zoology (Applied Zoology) | 4 | Introduce the Host parasite relationship.<br>To be learn about epidemiology for diseases transmission, Transmission, Prevention and control of diseases: Tuberculosis, swine flu, typhoid,<br>To develop awareness of *Rickettsia prowazekii, Borrelia recurrentis* and *Treponema pallidum.*<br>To learn fundamentals of Parasitic Protozoa : Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax,Trypanosoma gambiense. And* Parasitic Helminthes: Life history and pathogenicity of *Schistosoma haematobium, Ancylostoma duodenale* and *Wuchereria bancrofti.*<br>To develop the knowledge of Insects of Economic Importance Biology, Control and damage caused by *Helicoverpa armigera, Pyrilla perpusilla and Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum*; Safe storage of stored grains.<br>To develop the knowledge of Insects of Medical Importance Life cycle, medical importance and control of *Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla cheopis, Phlebotomus argentipes.*<br>To teach the students about Animal Husbandry Preservation and artificial insemination |

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| | | | in cattle; Induction of early puberty and synchronization of estrus in cattle.<br>To make the students aware about Poultry Farming Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs.<br>Understand the Fish Technology Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed. |
| 46 | Chemistry (Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy ) | 4 | This branch of chemistry is very much related to living being that how any metal ion or group is important to human body and functions in our body. Students are expected to understand basic concept about spectroscopy. |
| 47 | Skill enhancement (Biotechnology: Bioprocess Technology) | 2 | Describe the principle and applications of bioprocess technology.<br>Understanding of upstream and downstream processing for product recovery and purification.<br>Analyze the mass transfer and material balance calculation in different types of application in bioprocess.<br>Analyze the kinetics parameter values in different types of fermentation modes.<br>Discuss the important aspects in bioprocess technology for commercialization purpose of biotechnology products. |
| 48 | Laboratory course (Biotechnology: Bioinformatics) | 2 | To understand the sequence information resource.<br>Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR).<br>Understanding and using: PDB, Swissprot, TREMBL.<br>Using various BLAST and interpretation of results.<br>Retrieval of information from nucleotide databases.<br>Sequence alignment using BLAST.<br>Multiple sequence alignment using Clustal W. |
| 49 | Laboratory course (Zoology: Applied Zoology) | 2 | Give the knowledge of students to identify the permanent slides/photomicrographs and specimens of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Schistosoma haematobium, Ancylostoma duodenale and Wuchereria bancrofti.*<br>To impart the practical knowledge to identify arthropod vectors specimens associated with human diseases: *Pediculus, Culex, Anopheles, Aedes and Xenopsylla.*<br>To develop aptitude of insect damage to different plant parts/stored grains through damaged products/photographs.<br>To develop the skills for Identifying feature and economic *importance of Helicoverpa (Heliothis) armigera, Papilio demoleus, Pyrilla perpusilla, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum* |

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| | | | To learn the practical basic fundamentals to vsit a poultry farm or animal breeding centre and submission of visit report<br>To impart the practical knowledge to maintenance of freshwater aquarium. |
| 50 | Laboratory Botany: Genetics and Plant Breeding | 2 | To study the mendel's laws and its modified ratios.<br>To study the different types of aneuploidy syndromes.<br>To study the chi square test<br>To study the hybridization techniques.<br>To study the Pedigree analysis<br>To study the translocation ring, laggards and inversion bridge through photographs.<br>Demonstration of polyploidy conditions in plants. |
| 51 | Laboratory Chemistry: Organomettalics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy | 2 | In this lab course students are expected to understand the techniques so as they are able to analyses the organic compounds and synthesize their derivatives. |

# Bachelor of Commerce

**Programme Code**: 110

**Programme Summary**

Duration: 3 years

**Eligibility**

10+2 in any discipline with minimum 40% marks in aggregate.

**Program outcomes:**

- To demonstrate an advanced, specialized and well-rounded knowledge of the chosen academic discipline.
- To develop aptitude for formulating research problem and data collection and statistical planning.
- To acquire knowledge about Corporate accounting and Financial Accounting.
- To develop analytic thinking skills and sound oral and written communication skills so as to be able to communicate ideas effectively.
- Ability to compute taxable income of Individual.
- Ability to analyze financial data for managerial decision-making.
- Knowledge of business laws like contract Act, Sale of Goods Act ,Partnership Act , Negotiable Act.
- Knowledge of emerging field E-commerce and its working pattern.
- To be trained in recombinant in on-line filing return.
- Knowledge about GST and Cost Accounting procedure and technique.
- To gain knowledge of auditing and marketing.
- Understand the concepts of Indian economy & principle of micro economics.
- To integrate an advanced knowledge of ICT practices so as to make the best possible use of electronic sources for academic purposes.
- To develop creativity, sound judgment skills, autonomy, ethical maturity and academic integrity with regards to their chosen disciplines.
- To develop basic computer skills required for study and employment.
- Adapt to recent changes in Marketing, Human Resource, Taxation, Environment and in investment of securities

**Course outcome:**

| S. | Course code | Course name | Credits | Course outcomes |
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| **1st Semester** | | | | |
| 1 | BC-101 | Environmental Studies | 2 | To understand appropriate sociological and technological measures in environment management.<br>To focus on ecosystem services and human well being and livelihoods.<br>To learn basis of problems and solutions in natural resource management<br>To find solutions towards more sustainable societies around the globe.<br>To learn strategies for waste reduction and disposal<br>To contribute meaningfully for analysis of environmental systems planning and management with both a local and global perspective<br>To understand the concept of sustainable development<br>To be able to cope with the impacts of climate change by adopting adaptation and mitigation measures<br>To prepare the students for national and global employability |
| 2 | BC-102 | Financial Accounting | 6 | To provide knowledge on the fundamental of financial accounting.<br>To expose the student to various financial transaction and its current application.<br>Prepare ledger accounts using double entry book keeping and record journal entries accordingly<br>To familiarize the concept of Branch account and its system<br>To introduce the system of Hire Purchasing<br>To provide knowledge on the fundamental of financial accounting.<br>To familiarize the concept of Consignment and joint venture accounting<br>To make the students to learn the various aspects of dissolutions methods<br>Demonstrate the concepts of Tally ERP.9 Software, to create company, journal entries, and financial statement. |
| 3 | BC-103 | Business Organization and Management | 6 | To enlighten with nature and scope of Business Organisation<br>To familiarize the students about various sources of finance<br>To provide knowledge about stock exchange<br>To enable them with office equipments and system.<br>To study about the organizations structures<br>Processes underlying diversity within an organization . |

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| 4 | BC-104 | English Language | 6 | We frequently hear the fashionable phase "good communication skills" widely bandid about these days. The greater the skills in speaking and writing,the grater the chances of success in many aspects of life ranging from friendships to business dealings.<br>Students on completion of this course will be able to enhance their already learnt concepts in grammar like -parts of speech, uses of frequently confused articles , prepositions, common mistakes in writing.<br>They will also become aware of how to write business letters , report writing, paragraphs writing, precis writing and comprehensions. |
| **2nd Semester** | | | | |
| 5 | BC-201 | English Language | 2 | On completion of this course students will reach to the threshold of proficiency in English communication skills. It will not only enable them to pass their examination exeditably but will also help them learn a subject that holds the key to their success in future.<br><br>The significance of clear and effective communication in present age of globalization is self evident.<br>Student at the end of this course will find a difference in their personal and professional interaction.<br>They will become aware of the writing style of business letter ,note making, report writing, job application, cover letter, resume bio data, c.v. |
| 6 | BC-202 | Business Law | 6 | To understand the concepts of business law and its importance.<br>To understand the procedure of application of the business law in various aspects<br>To understand basic knowledge about Indian Contract Act 1872.<br>To know about Partnership act 1932 and LLP act 2008.<br>To know about the basic knowledge of sale of goods act 1930.<br>To know about the basic knowledge of Negotiable Instrument Act 1881 |
| 7 | BC-203 | Business Statistics | 6 | Understand Meaning and concepts of Statistics and different methods of presentation of Statistical data.<br>Classification of different measures of central tendency and variations.<br>Computation of simple correlation and regression which is comparing more than one set of data.<br>Analysis the causes of variations in Time series.<br>Application of statistics in business and economics. |
| 8 | BC-204 | Modern Hindi Language | 6 | **आधुनिक भारतीय भाषाः हिन्दी गद्य का उद्भव और विकास**<br>इस पाठ्यक्रम की समाप्ति पर छात्र हिन्दी गद्य साहित्य के बारे मे सामान्य जानकारी प्राप्त कर सकेंगे।<br>हिन्दी गद्य साहित्य का विभिन्न कालक्रमानुसाार विकास को परिभाषित कर सकेंगे।<br><br>छात्र हिन्दी गद्य की विभिन्न विद्याओं से परिचित हो सकेंगे। |

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| | | | | छात्र हिन्दी गद्य साहित्य के मूर्धन्य साहित्याकार<br>जैसे मुंशी प्रेमचन्द, यशपाल, कृष्णा सोबती, बालमुकुन्द गुप्त, भारतुन्दु हिरशचन्द, हरिशंकर परसाई एवं महादेवी वर्मा तथा इनके कृतियों से परिचित हो सकेंगे। |
| **3rd Semester** | | | | |
| 9 | BC-301 | Company Law | 6 | Classification of different types of Joint Stock Companies.<br>Understanding memorandum of association, Articles of association and Prospectus.<br>Knowledge on share capital, borrowing powers of companies.<br>Awareness about directors, meeting and resolutions passed.<br>Understand winding up of the company. |
| 10 | BC-302 | Income Tax Law and Practice | 6 | To introduce the basic concept of Income Tax.<br>In order to familiarize the different know-how and heads of income with its components.<br>It helps to build an idea about income from house property as a concept.<br>It give more idea about the income from business or profession. |
| 11 | BC-303 | Modern Hindi Language | 6 | **आधुनिक भारतीय भाषाः हिन्दी – हिन्दी**<br>इस पाठ्यक्रम के पूर्ण होने के उपरान्त छात्र<br>आधुनिक भारतीय भाषा (संविधान की आठवीं अनुसूचि में वर्णित 22 भाषा) का सामान्य परिचय दें सकेंगे।<br>हिन्दी साहित्य के आदिकाल, मध्यकाल एवं आधुनिक काल को उनकी प्रवृत्ति के आधार पर परिभाषित कर सकेंगे।<br>भक्तिकालीन प्रमुख कवियों एवं उनकी रचनाओं से परिचित हो सकेंगे।<br>रीतिकाल एवं आधुनिक काल के प्रमुख हिन्दी कवियों, उनकी प्रमुख रचनाओं एवं काल विशेष की प्रमुख प्रवृत्तियों की जानकारी प्राप्त कर सकेंगे। |
| 12 | BC-304 | Computer Applications in Business | 2 | To introduce the students about basics of MS-Office.<br>To provide practical knowledge exposure to MS-Word.<br>To provide practical knowledge exposure MS-Excel<br>To provide practical knowledge exposure MS-Power Point<br>Develop the competence of database management<br>To make them aware about information system concepts and features<br>To provide knowledge about Hardware and Software<br>Enable the students with data processing and modern electronic medium<br>Develop the students about application of information system<br>Create an awareness about security , threats and its protective measures |
| | | Computer Applications in | 2 | Provide basic knowledge about handling the computer |

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| | | Business (Practical) | | Provide knowledge of MSWord, MS Excel And MS PowerPoint<br>Surfing of internet<br>Knowledge about accounting package |
| **4th Semester** | | | | |
| 13 | BC-401 | Business Communication | 6 | To develop Communication skills and overall personality development of the students.<br>To acquire skills in reading ,writing ,comprehension and communication ,as also to use electronic media for Business Communication .<br>The effective use of various types of communication.<br>Develop communication skills for the workplace<br>Techniques to improving your presentation skills. |
| 14 | BC-402 | Corporate Accounting | 6 | Enabling the students to understand the features of Shares and Debentures<br>Develop an understanding about redemption of Shares and Debenture and its types<br>To give an exposure to the company final accounts<br>To provide knowledge on Valuation of Goodwill & Shares<br>Enable the students to understand about amalgamation , absorption and external reconstruction<br>Students can get an idea about internal reconstruction<br>To introduce and develop knowledge of holding companies accounts<br>To make them aware about accounts of banking companies<br>Keep them aware about CashFlow Statement |
| 15 | BC-403 | Cost Accounting | 6 | Aimed to familiarize the concept of cost accounting<br>Helps to gather knowledge on preparation of cost sheet in its practical point of view<br>To facilitate the idea and meaning of material control with pricing methods<br>Develop the knowledge about remuneration and incentives<br>To introduce the concept of overhead cost. |
| 16 | BC-404 | E-Commerce | 3 | Understand the concept of E-Commerce and Describe the opportunities and challenges offered by E-Commerce<br>Able to handle electronic payment technology and requirements for internet based payments<br>Understand the categories of E-Commerceand understand |

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| | | | | the different applications of E<br>-Commerce<br>To understand and identify<br>security issues of E-Commerce<br>Understand the concept of WEB Based BusinessUnderstand the M-Commerce applications. |
| | | E-Commerce (Practical) | 1 | Provide knowledge of Website Development<br>Provide knowledge of online Transactions through E-Commerce sites |
| **5th Semester** | | | | |
| 17 | BC-501 | Principles of Marketing | 6 | To provide understanding of Marketing and the Market driven enterprise to differentiate market.<br>Identify the basic approaches to formulate. Marketing strategy.<br>Identify stages of the Market planning process.<br>To know the overview of Management.<br>To study planning procedure. |
| 18 | BC-502 | Goods and Service Tax (GST) | 6 | It provides Knowledge to students regarding the laws and principal of taxation and custom laws<br>It enhances there capabilities to understand the taxation prevailing in the current economic system<br>It enhance there knowledge of taxation accounting of GST which is necessary for the current market system.<br>Identify the characters of customs duty.<br>Understand about tax Computation. |
| 19 | BC-503 | Principles Of Micro Economics | 6 | Students able to think critically and formulate independent and well considered conclusion about economic issues and policies.<br>Make rational decisions based on rudimentary marginal analysis.<br>Understand market structures and Market power .<br>Understand the demand analysis<br>Students able to understand cost analysis.<br>Students will able to understand knowledge of law of supply and demand. |
| 20 | BC-504 | Entrepreneurship | 4 | Inculcate innovative ideas for their new initiatives.<br>Manage their own/family business in skillful manner with new idea coping with fast changing requirements of the society.<br>Work together collaboratively for the startup of their new business instead of waiting for white collar job.<br>Communicate skillfully with government officials and financial institutes with full confidence. |

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| | | | | Ready their project for new venture after completion of their study. |
| **6th Semester** | | | | |
| 21 | BC-601 | Auditing And Corporate Governace | 6 | This paper gives the knowledge of examines the principles and practices of internal and external auditing<br>The students is capable in understanding the auditing as a component of recurrent and strategic activities, risk assessment, internal control, systems evaluation, forensic accountability, and contemporary audit issues and challenges.<br>Described about the concept of auditing, types and methods of auditing.<br>Acquired knowledge about vouching of cash & credit transaction, verification of assets and liabilities |
| 22 | BC-602 | Consumer Protection | 6 | Students will have a comprehensive understanding about the existing law on Consumer Protection in India.<br>Students will be conversant with major International Instrument on Consumer Protection.<br>Students will be aware of the basic procedure for handling consumer dispute.<br>Students will be able to appreciate the emerging questions and policy issues in consumer law for future research<br>Students able to know the rights of consumer .<br>Should able to know about the Ombudsman. |
| 23 | BC-603 | Indian Economy | 6 | To impart the knowledge about objectives and economic planning in India.<br>Mixes Economy and economic planning, development strategy in India, liberalisation, privatization and Globalisation.<br>Providing exposure to basis of Indian Economy.<br>To create student's ability to suggest of the various economic problems.<br>To know the development process in India after independence.<br>Should able to understand structures of economy.<br>Importance causes and impact of population growth. |
| 24 | BC-604 | Seminar and Comprehensive Viva Voce | 4 | To gain the experience of a interview before they go out seeking jobs in industry.<br>To develop confidence in a face to face interaction in a formal setting. |

## B.Sc. Forestry

**Programme Code: 103**

**Programme Summary**

Duration: 4 years

**Eligibility**

10+2 with at least 45% marks in PCB/PCM.

**Program outcomes:**

- To get acquainted with basics & principles of Plant Biochemistry, Biotechnology, Physiology, Botany, Cytology-genetics, Computers, Statistics and English.
- To understand the fundamentals of Hydrology, Geology and Soil science like chemistry and fertility of Forest soils, Sericulture, Environmental Science and Horticulture.
- To learn the ethnobotany along with medicinal and aromatic Plants and their uses and impacts on the tribal communities and remote villages using extension education concepts.
- To understand the effect of meteorology on crops production and weather forecasting models to cope up with the uncertainty of Indian weather conditions.
- To gain the preliminary knowledge on geographical distribution of grasslands, forests and their classification in the India and in the world. Critical examination of the world forest sources, productivity potential and increment of world forests.
- To learn the principles and practices of Silviculture, silvicultural and dendrological knowledge i.e. origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, tending operations and economic importance of important conifer and broad leaved tree species of India & also the nursery techniques of these tree species.
- To learn the Forest management skills for best growth of any forest and also to get acquainted with the Forest policies and the laws.
- To develop the skills to take-up forest mensuration exercises and ecological studies in the forested areas.
- To explore the anatomical studies of tree/woody perennials including monocot and dicot.
- The skills on tree-seed collection, seed storage, seed testing for purity, viability, moisture, germination etc will be developed in this program.
- To learn the principles & techniques of tree improvement i.e. selecting superior trees in natural stands and plantation, controlled crossing techniques, Vegetative propagation techniques, Pollen viability determination.
- It provides in depth information on logging operations in the forests, develop basic knowledge on chemical, physical, mechanical, electrical as well as sound related properties of timber, various treatments like seasoning of wood, preservation of wood and the utilization of the timber/wood collected in various industries.
- It imparts general idea about the use of wood as an engineering material for bridges, roads and building material.
- It also provides basic knowledge on the role and use of Remote Sensing in Forestry.
- To develop knowledge on methods of collection, extraction, classification, storage, uses, management and importance of Non-Timber Forest Products (NTFP) viz.- Fodder (grasses and tree leaves), canes and bamboos, essential Oils, non-essential oils, Gums and resins, Tans and dyes.

- To gain the knowledge on traditional & well designed Agroforestry systems, techniques, management and their advantages over sole cropping landuse systems.
- To develop the skills to identify and cure the diseases, insects, pests of the Forest trees.
- To explore about the wildlife and its management including habit & habitat of different wildlife, scientific names, behavior and adaptations of important wild species.
- To know about the basic concept of entrepreneurship and its development in forestry. Project planning, evaluation, Swot analysis.
- To become familiar with basic economic and business principles and how they can be applied to forestry. Utilize economic principles to address private and public policy issues related to allocating natural resources and environmental amenities.
- To develop skills to conduct various field based activities of forestry aspects.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.
- To provide hands-on-trainings or Forestry work experience on Socio-economic surveys in villages, Forest Department attachments, Forest-based-Industrial attachment and Production and marketing of quality planting material.

## Course outcomes:

| S.no. | Course code | Course name | Credits | Course outcomes |
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| | | | | **1st Semester** |
| 1 | SOA/FC101T | Fundamentals of Geology & Soil science | 2 | To explore about Composition of earth's crust, soil as a natural body major components by volume pedologyrocks types Igneous sedimentary and metamorphic classification soil forming minerals. Definition classification – silicates, oxides, carbonates, sulphides, phosphates occurrence. Weathering of rocks and minerals, weathering factors: physical, chemical, biological agents involved, weathering indices, factors of soil formation, land forms parent, material climate organism, relief time soil forming processes eluviations and illuviation formation of various soils.<br>To study about problem soils: salted soils, permeable, flooded, sandy soils properties. Physical parameters texture definition methods of textural analysis textural classes, absolute specific gravity definition apparent specific gravity/bulk density factors influencing field bulk density. Relation between BD. Pore space definition, factors affecting capillary and noncapillary porosity, soil colour definition, its significance, colour variable hue, value, chroma, Munsell colour chart, factors influencing parent material soil moisture organic matter, soil structure, types of structure, factors influencing genesis of soil structure. Soil air-air composition, amount of air space, soil air renewal, soil temperature sources and distribution of heat, chemical properties humus inorganic secondary silicate clay hydrous oxides.<br>To Acquire knowledge about Soil organic matter decomposition, pH nutrient availability, soil buffering capacity, soil water forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity, energy concepts, pF scale measurement-gravimetric, electric and tensiometer methods. Soil water movement, saturated and unsaturated infiltration and percolation. Soils of different eco-systems and their properties. |
| 2 | SOA/FC101P | Fundamentals of Geology & Soil science-Practical | 1 | To have a knowledge about Identification of rocks and minerals; Collection and preparation of soil samples; Soil analyses for moisture, color, bulk density, organic matter, pH, EC; textural analysis; study of soil profile I & II.<br>To have field experience by excursions/ tours for identification of rocks and minerals and profile studies; practical introduction to tensiometer, pressure plate and neutron probe etc. |
| 3 | SOA/FC102T | Plant Biochemistry and Biotechnology | 2 | To understand the significance of Biochemistry.<br>Describe the chemistry of carbohydrates, lipids, proteins and amino acids.<br>Describe the classification and structural organization of proteins.<br>Describe the mechanism of enzyme action and identify the classes of enzymes and factors affecting action.<br>Describe the catabolic reactions of carbohydrates, lipids and amino acids.<br>Understand Concepts, principles and processes in plant biotechnology.<br>Identify the class and functions of secondary metabolites |

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| 4 | SOA/FC102P | Plant Biochemistry and Biotechnology- Practical | 1 | Students will be able to assay the compound qualitatively or quantitatively<br>Determination of unknown compound.<br>Develop skills for application of tissue culture techniques in tree improvement.<br>To get knowledge about the plant tissue culture. |
| 5 | SOA/FC103T | Principles of Plant Physiology | 2 | To know about the metabolic activity and life, cycle of the plant from germination through growth and development.<br>To know importance and scope of plant physiology.<br>To understand the plants and plant cells in relation to water-osmosis, imbibitions, diffusion and water potential and the movement of sap and absorption of water in plant body, structure and function of stomata, opening and closing of stomata, different types of stresses- water, cold, heat, plant nutrition and essentiality and mechanism of absorption.<br>To understand the process of photosynthesis particular light and dark reaction, respiration particular emphasis on aerobic and anaerobic respiration, photo-hormones. |
| 6 | SOA/FC103P | Principles of Plant Physiology- Practical | 1 | To learn about measurement of water potential by osmosis and plasmolysis method.<br>To demonstrate the rate of transpiration by using Potometer.<br>To learn demonstrate the importance of photosynthesis by the help of wilmonnt bubbler and inverted funnel exp.<br>To study plant movement by the help of clinostat.<br>To study separation of leaf pigments by paper strip chromatography.<br>To study structure of stomata and role of stomata in transpiration by using four leaves exp. |
| 7 | SOA/FC104T | Statistics & Computer Application | 2 | Statistics: Basic Statistical concept.<br>Average and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, for raw and grouped data.<br>Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data.<br>Probability concepts.<br>Correlation & Regression.<br>Test of significance.<br>Computer Application:<br>Introduction to computers and personal computers given.<br>Basic concepts of hardware and software discussed.<br>Input and output devices demonstrated.<br>Operating system and its importance elaborated.<br>Exposure to MS Office , MS word, MS PowerPoint and MS Excel have been provided. |
| 8 | SOA/FC104P | Statistics & Computer Application-Practical | 1 | As per the SOA/FC104T<br>Practical case studies on MS Office practiced. |
| 9 | SOA/FAECC101T | Structural Grammer and Spoken English | 1 | Introduction to word classes; structure of the verb in English.<br>Uses of tenses. Study of voice. Use of conjunctions and prepositions.<br>Sentence patterns in English.<br>Spoken English: conversations of different situations in everyday life. The concept of |

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| | | | | stress, stress shift in words and sentences. |
| 10 | SOA/FAECC101P | Structural Grammar and Spoken English- Practical | 1 | As per the SOA/FC101T |
| 11 | SOA/FE101T | Chemistry & fertility of Forest Soils | 1 | To explore the knowledge of Chemistry & fertility of Forest Soils and their importance.<br>Scope, opportunities and constraints of soil and its chemistry.<br>Introduction to Forest soils and cultivated soils. Properties of soils under different forest ecosystems. And also know the Essential nutrient elements-occurrence, availability and their functions. |
| 12 | SOA/FE101P | Chemistry & fertility of Forest Soils- Practical | 1 | To identify and study forest soil profile and Determination of available N, P & K content of soil. |
| 13 | SOA/FE103T | Introductory Botany | 1 | Introduction to Botany and general classification of plants.<br>Structure and types of plant tissues.<br>Internal Structure of Dicot and Monocot Stems, roots and leaf.<br>Significance of life cycle with special reference to alternation of generations in *Chlamydomonas, Rhizopus, Funaria, Adiantum, Pinus* and a flowering plant. |
| 14 | SOA/FE103P | Introductory Botany- Practical | 1 | Studies of permanent slides of anatomy of stem root and leaf.<br>Study of various plant parts.<br>Survey to local area to study local vegetation. |
| 15 | SOA/FE104T | Sericulture | 1 | It provides exposure to the history of sericulture development and future scopes.<br>Detailed study of mulberry and its cultivation practices in different climatic zones of country. |
| 16 | SOA/FE104P | Sericulture- Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE104T. |
| **2nd Semester** | | | | |
| 17 | SOA/FC105T | Principles of Hydrology,Soil- Water Conservation and wasteland | 2 | Students know basic terms used in hydrology.<br>Students comprehend the hydrologic cycle and related major water quantity and quality challenges and their relevance to human health and well-being, ecosystems, and the food supply.<br>Students understand the role of hydrology, water resources management.<br>Students understand the principle of water flow in the nature.<br>Students understand the structure and activities of various types of aquifers.<br>Students know basic methods for measuring and analysing hydrologic parameters.<br>Students understand the importance of water sources and know how to adequately protect them.<br>Students understand the importance of soil and know how to conserve that.<br>Students understand the concept of Wasteland and reclamation of wasteland. |
| 18 | SOA/FC105P | Principles of Hydrology, Soil- Water Conservation and | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC105T. |

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| | | wasteland- Practical | | |
| 19 | SOA/FC106T | Principles of Cytology and Genetics | 2 | History of genetics and hypothesis-theories.<br>Physical basis of heredity, cell reproduction mitosis-meiosis and their significance.<br>Gametogenesis and syngamy in plants.<br>Mendel's principles of heredity, deviation from Mendelian inhritance, Chromosome theory of inheritance, gene interaction: modification of monohybrid and dihybrid ratios. Multiple alleles, quantitative inheritance, linkage and crossing over, sex determination - theories, sex linked inheritance and characters.<br>Cytoplasmic inheritance and maternal effects. Chemical basis of heredity:<br>Structure of DNA and its replication. Evidences to prove DNA as genetic material.<br>Mutation and its classification.<br>Chromosomal aberrations: Changes in chromosome structure and number |
| 20 | SOA/FC106P | Principles of Cytology and Genetics-Practical | 1 | As per the SOA/FC106T |
| 21 | SOA/FC107T | Ethnobotany | 2 | Traditional ecological knowledge of wild plant to the society.<br>To communicate and describes the healing uses of local plants.<br>To experience the cultural contact of the healing and food local food production process.<br>To describes and observe the use and role and importance of psycho active plant within their traditional contact.<br>To identify local plants and scientific names and mythology of syllabus related families.<br>Bring out the relevance of ethnobotany in the present context.<br>Know about the major and minor ethnic groups or Tribal's of India, and their lifestyles.<br>Learn about the methodology of Ethnobotanical studies.<br>Gain knowledge on the role of role of ethnobotany in modern medicine.<br>Get awareness on the conservation practices of medicinal plants. |
| 22 | SOA/FC107P | Ethnobotany-Practical | 1 | To learn about traditional local plants used as traditional medicine, as food, as fodder, as fiber etc. by local people.<br>To visit various local places to collect information regarding traditional uses of plants.<br>To study about identification of plants associated with mentioned families in syllabus.<br>To study mythology of some common local plants. |
| 23 | SOA/FC108T | Medicinal and Aromatic Plants | 2 | To excel the knowledge of Medicinal and aromatic plants and their importance. Scope, opportunities and constraints of medicinal and aromatic plants. Origin, importance, distribution, production, climate, soil, water, plant protection, harvesting and use of important medicinal and aromatic plants. Endangered medicinal and aromatic plants of India and their conservation. |
| 24 | SOA/FC108P | Medicinal and Aromatic Plants- Practical | 1 | To identify different types of plants including tree, shrub and herbs in surrounding forest areas. Different processing methods of medicinal and aromatic plant products through industrial/ institute visits. |
| 25 | SOA/FC109P | Technique / field tour | 1 | Field tours to study the forestry field techniques. |
| 26 | SOA/FAECC102T | Environmental Science | 1 | Environment: introduction, definition and importance. |

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| | | | | Components of environment -interactions with organisms. Global and Indian environment - past and present status.<br>Environmental pollution and pollutants.<br>Smog, acid rain, global warming, ozone hole, eutrophication, sewage and hazardous waste management.<br>Impact of different pollutions on humans, organisms and environment.<br>Introduction to biological magnification of toxins.<br>Deforestation - forms and causes relation to environment.<br>Prevention and control of pollution - technological and sociological measures and solutions - Indian and global efforts.<br>India, international and voluntary agencies for environmental conservation - mandates and activities.<br>International conventions and summits - major achievements.<br>Environmental policy and legislation in India.<br>Introduction to environmental impact assessment. Causes of environmental degradation - socio-economic factors.<br>Human population growth and lifestyle. |
| 27 | SOA/FAECC102P | Environmental Science-Practical | 1 | As per paper SOA/FAECC102P |
| 28 | SOA/FE105T | Fundamental of Extension Education | 1 | To explore about of extension forestry can be expressions of the end towards which our efforts are directed. And also with the help of extension education is the development of the rural people, and also to improve all aspects rural people lives within the framework of the national development policies and people's need for development. |
| 29 | SOA/FE105P | Fundamental of Extension | 1 | To learn about the structure, functions, linkages and extension programmes of ICFRE institutes/voluntary organizations/ Mahila Mandal, Village Panchayat, State Dept. of Forests/All India Radio (AIR). |
| 30 | SOA/FE106T | Fundamentals of Horticulture | 1 | To study the Economic importance and classification of horticultural crops.<br>To learn about the nutritive value of fruits and vegetables.<br>To learn about the area and production of horticultural crops.<br>To understand about the exports and imports of horticultural crops.<br>To learn about fruit and vegetable zones of India and of different states.<br>To understand the nursery management practices, soil and climate.<br>To gain knowledge about vegetable gardens, nutrition and kitchen garden and other types of gardens.<br>To understand the principles, planning and layout.<br>To learn about the management of orchards.<br>To understand the planting systems and planting densities.<br>To gain knowledge about production and practices for fruit, vegetables and floriculture crops.<br>To gain knowledge about nursery techniques and their management. |

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| | | | | To understand the principles and methods of pruning and training of fruit crops.<br>To learn about the types and use of growth regulators in horticulture.<br>To learn about water management, weed management and fertility management in horticultural crops.<br>To study about bearing habit and factors influencing fruitfulness and unfruitfulness.<br>To learn about the rejuvenation of old orchards, top working, frame working.<br>To understand about the principles of organic farming |
| 31 | SOA/FE106P | Fundamentals of Horticulture-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC106T |
| 32 | SOA/FE107T | Agrometeorology | 1 | Students understand the role of meteorology for crop production.<br>Students understand concepts of Weather & Climate and their significance for atmosphere.<br>Students get the knowledge of different type of clouds.<br>Students understand the science behind formation of cyclones and anticyclones.<br>Students comprehend effect of Solar radiation on plant growth.<br>Students know the concept of agroclimatic zones.<br>Students get to know about global warming and impact on climate change.<br>Students get to know the use of remote sensing in Agrometeorology. |
| 33 | SOA/FE107P | Agrometeorology-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC107T |
| **3rd Semester** | | | | |
| 34 | SOA/FC110T | Logging and Ergonomics | 2 | To learn about and scope of logging, study of logging plan and execution.<br>Study of Location and demarcation of the area for logging and estimation of produce available for extraction.<br>Study of Implements used in logging operation- traditional and improved tools.<br>Study of Felling rules and methods. Conversion.<br>Study about various means of transport of timber- carts, dragging, skidding, overhead transport, ropeways, and skylines.<br>Transport by road and railways. Transport by water- floating, rafting and concept of booms.<br>Study of Grading and Storage of timber in the depots for display and disposal. Timber Depots- types, lay out and management.<br>Study of Systems of disposal of timber.<br>Study of Ergonomics, components and provision of energy.<br>Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition.<br>Study of Personal protective equipments, safety helmets, ear and eye protections.<br>Accidents: causes, safety rules and first aids. |
| 35 | SOA/FC110P | Logging and Ergonomics-Practical | 1 | Field study of Survey and demarcation of area intended for logging and listing of permanent boundary marks; Marking of trees for logging operation and preparation of marking list. |

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| | | | | Study of Equipments and tools used in logging operations and their uses.<br>Study of Planning and execution of different logging operation in a phase wise manner;<br>Study of Application of felling rules in the forests for felling of standing trees at different localities.<br>Study of Instructions regarding maintenance of various records and registers in logging operations.<br>Study of Conversion of felled trees into logs, poles, firewood, pulpwood etc.<br>Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers.<br>Minor and other types of transport practicable at felling sites;<br>Study of Final transport, information regarding transit permits for various types of forest produce;<br>Visit to local dumping yard (timber depot) to trace the logs delivered from different forest sites;<br>Study of Sorting of logs, poles and firewood in the depots according to species, quality, length and girth classes; Study of Stacking and stock checking of different logs, poles and firewood in the depots so as to confirm that all the converted materials in the forests have reached their destination.<br>Study of Recording of the lots for auction sale. Final disposal of the material; Visit during the auction sale in the government timber depots;<br>Study of Preparation of ergonomic check lists. |
| 36 | SOA/FC111T | Soil Survey, Remote Sensing | 2 | Scope and objective; soil survey, sampling methods; planning, inventory, permanent sample plots; sample size allocation, landuse classes and planning.<br>Soil survey – classification–aerial photography–satellite–their interpretation, land-capability-classification.<br>Aerial photography and remote sensing-definition, meaning, scope, merits and brief history.<br>Electromagnetic spectrum; radiations, differential reflections by surfaces, active and passive remote sensing, earth observation satellites. Equipment and materials-aerial bases, cameras, filters, stereoscopes, computers, radars.<br>Photogrammetry: Vertical and oblique photography. Photographs and images, scales, resolution, photo interpretation, photogrammetry, image analysis, mapping.<br>Agencies involved in remote sensing and acquiring information from them.<br>Remote sensing; principles, uses in forestry, vegetation / cover classification and mapping, species identification, height and volume – estimation. Identification of tree species and their form stand delineation.<br>Interpretation of land forms and soils; use of micro-level survey of farm forests, large scale photos in forest inventory, site selection. Imagery and image analysis – video satellite, computer and radars. Geographic Information systems- Computer softwares used. |
| 37 | SOA/FC111P | Soil Survey, Remote Sensing -Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC111T |
| 38 | SOA/FC112T | Forest Mensuration | 2 | To understand different techniques to calculate parameters of tree like diameter, girth, age |

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| | | | | etc;<br>Understanding and use of instruments used in forest mensuration.<br>To prepare volume table concept of forest inventory and sampling techniques.<br>Application of Remote Sensing |
| 39 | SOA/FC112P | Forest Mensuration-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC112T |
| 40 | SOA/FC113T | Forest Engineering & Survey | 2 | Basic knowledge of types of survey and related instruments.<br>Concept and design of forest roads and building materials.<br>Design of bridges. |
| 41 | SOA/FC113P | Forest Engineering & Survey-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC113T |
| 42 | SOA/FC114P | Technique / field tour | 1 | Field tours to study the forestry field techniques. |
| 43 | SOA/FSEC101T | Tree Seed Technology | 1 | To learn about Seed and its importance. Study of Role of seed technology in nursery stock production.<br>Study of Production of quality seed, identification of seed collection areas-seed orchards – maintenance of genetic purity-isolation and rouging, seed study of source (provenance and stands). Study of Selection of seed tree (genotypic and phenotypic selection), plus tree (pure stands, elite seed tree, isolated tree and their location).<br>Study of Seed Collection – Planning and Organization, Collection methods, Factors affecting seed collection,<br>Study of Seed maturity and tests. Seed Study of processing – Seed extraction, drying, blending, cleaning, grading, treating, bagging, labeling and storage. Study of seed Storage – orthodox, intermediate and recalcitrant<br>seeds, precautions of handling of recalcitrant seeds, natural longevity of tree seeds, factors affecting longevity.<br>Study of Seed testing (sampling, mixing and dividing, determination of genuineness, germination, moisture, purity, vigour, viability). Seed Study of seed dormancy, classification and breaking of seed dormancy.<br>Study of Different viability and vigour tests, seed pelleting, seed health. Classes of tree seeds, study of seed certification and procedures of tree seeds certification. |
| 44 | SOA/FSEC101P | Tree Seed Technology-Practical | 1 | Identification of seeds of tree species; Seed<br>Study of maturity tests; Physical purity analysis;<br>Determination of seed moisture; Seed germination test; Hydrogen peroxide test;<br>Study of Tetrazolium test for viability; Seed vigour and its measurements; Identification of seed dormancy and methods of breaking dormancy in tree seeds; Testing membrane permeability;<br>Study of seed collection and equipments; Study of Planning of seed collection; Seed collection; Seed extraction;<br>Visit to seed production area and seed orchard; |

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| | | | | Visit to seed processing unit/testing laboratory;<br>Study of seed sampling equipments. |
| 45 | SOA/FE109T | Wood Anatomy | 1 | To explore the anatomical studies of tree including monocot and dicot. Plant cell and tissue and types. Stem root and leaf anatomical studies. Mechanism of secondary growth and its importance. Early wood and late wood formation. Sapwood and heart wood and abnormal secondary growth in plants. Micro- and macro properties of wood. |
| 46 | SOA/FE109P | Wood Anatomy-Practical | 1 | To learn Microscopic studies of meristem, simple and complex tissue. Anatomical features of stem root and leaf. |
| 47 | SOA/FE110T | Tree Physiology | 1 | To learn about tree structure, growth, development, differentiation and reproduction. Plant growth functions and growth kinetics, will increase their identification skill.<br>To explore about Physiological functions and processes in trees. To study the role of environmental effects on growth and development.<br>To highlight the students about light use efficiency in forest species, canopy structure, plant phyllotaxis and its importance in translocation. Plant light relationship. LAI, Photosynthetic efficiency and respiratory losses, source sink relationship, Factors affecting photosynthesis. Radiation interception. The content will definitely help the forestry students to know the forest environment and conducive conditions for the same.<br>To study transport processes with special reference to long distance transport in trees and its impact on plant water relations and photosynthesis. Biocides and growth regulators in forest ecosystems. Senescence and abscission. Role of trees in pollution control. |
| 48 | SOA/FE110P | Tree Physiology-Practical | 1 | To study about various physiological process of tree like growth, translocation of food, source and sink, effect of growth hormones and senescence in trees. |
| 49 | SOA/FE111T | Introductory Forest Economics | 2 | The students will be able to understand Nature and scope of economics and also its relationship with other sciences.<br>The students will be able to state the various theories related to consumer behavior such as equi-marginal utility, indifference curve, diminishing marginal utility.<br>The students will be able to define law of demand and understand the concept of price, income and cross elasticity's.<br>The students will be able to explain factors of production i.e. land, labour, capital and enterprise.<br>The students will be able to describe Law of diminishing marginal returns.<br>The students will be able to explain the Law of supply.<br>The students will be able to explain the theories of rent, wage, interest and profit.<br>The students will be able to understand the concepts of Price determination and forecasting under various market structures.<br>The students will be able to understand the concepts of National Income.<br>The students will be able to describe the concept and types of inflation. |
| **4th Semester** | | | | |
| 50 | SOA/FC115T | Principles and Practices of Silviculture | 2 | To learn about forestry and silviculture by studying definition of forest and forestry. Classification of forest and forestry, branches of forestry and their relationships. |

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| | | | | Definition, objectives and scope of Silviculture.<br>Status of forests in India and their role.<br>History of forestry development in India.<br>Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of these factors and their influence on Forest Production.<br>Impacts of controlled burning and grazing. Influence of forests on environment.<br>To acquire knowledge about Trees and their distinguishing features. Growth and development. Forest reproduction - flowering, fruiting and seeding behaviour. Natural, artificial and mixed regeneration. Natural regeneration - seed production, seed dispersal, germination and establishment. Requirement for natural regeneration.<br>Dieback in seedling with examples.<br>Plant succession, competition and tolerance.<br>Forest types of India and their distribution. |
| 51 | SOA/FC115P | Principles and Practices of Silviculture-Practical | 1 | To learn about forest composition, phenotypic characters of the trees, growth rings and forest succession in different forest types of Dehradun. |
| 52 | SOA/FC116T | Wood Science and Technology | 2 | To study kinds of wood and its properties as a raw material.<br>To get knowledge of physical, strength, electrical, acoustic and thermal properties.<br>To understand the relation between use of wood and the properties of wood.<br>To study wood-water relationship.<br>Detailed study of the treatments can be given to wood to increase its life for different uses.<br>To study the timber classification on the basis of durability and refractory nature.<br>To study the processing defects and its effect in woods utilization. |
| 53 | SOA/FC116P | Wood Science and Technology- Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FC116T |
| 54 | SOA/FC117T | Silviculture of Indian Trees | 2 | Study of Origin, distribution, general description, phenology, silvicultural characters, regeneration<br>methods, silvicultural systems and economic importance of the following conifer and broad leaved<br>tree species of India. Conifers: *Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii,Pinus wallichiana, P. gerardiana and Juniperus spp. Broad leaved species: Tectona grandis, Shorea robusta, Acacia spp., Dalbergia sissoo, D.latifolia, Quercus spp. Robinia pseudoacacia, Alnus spp.,Anogeissus spp., Populus spp., Eucalyptus spp., Casuarina equisetifolia, Terminalia spp., Santalum album, Swietenia mahagony, Albizzia spp, Prosopis spp., Pterocarpus santalinus, Azardirachta indica, Diospyros melanoxylon, Madhuca indica, Leucaena leucocephala* and Bamboos. |
| 55 | SOA/FC117P | Silviculture of Indian Trees-Practical | 1 | Study of species composition in surrounding areas.<br>Study of morphology and phenology of tree species growing in the area.<br>Study of artificial regeneration of Pines, Bamboo, Oak, *Dalbergia sisoo*<br>and *Acacia catechu*, etc.<br>Practicing thinning in Bamboo clumps. Study on tree responses to the abiotic and biotic |

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| | | | | factors viz., light, fire, drought, frost, root suckering, coppicing and pollarding, etc.<br>To study quality characters of nursery planting stock. |
| 56 | SOA/FC118T | Forest Pathology | 2 | History and importance of forest pathology in India and the world.<br>Relation of plant pathology with forest pathology and other sciences, classification of tree diseases.<br>Role of microbes and fungi in a natural forest ecosystem.<br>Broad classification of different pathogens causing tree diseases. General characteristics of fungi, bacteria, viruses, mycoplasma and phanerogames.<br>Important characters of ascomycetes and basidiomycetes.<br>Growth and reproduction of plant pathogens, infection and factors influencing disease development.<br>Dissemination and survival of plant pathogens.<br>Distribution, economic importance, symptoms, etiology and management of the following.<br>Diseases of important tree species like teak, *Dalbergia* spp., *Acacia* spp., neem, *Cassia*, sal, *Albizia, Terminalia*, mango, jack, pines, deodar, eucalyptus, bamboo, casuarina, rubber, sandal wood, medicinal and aromatic plants grown in different Agroforestry systems.<br>Biodegradation of wood in use. Types of wood decay, gross characters of decay, sapstain, different types of rots in hardwoods, softwoods and their prevention.<br>Graveyard test and decay resistant woods.<br>Principles, definition and scope of forest disease management in forestry. Importance of disease cycle and economic threshold in disease management. Principles of disease management.<br>Nature of disease resistance. Nursery diseases of important forest species.<br>Fungicides and their use in nurseries and plantations. Integration of cultural, chemical, biological and host resistance in disease management. |
| 57 | SOA/FC118P | Forest Pathology-Practical | 1 | To impart practical knowledge as per the course SOA/FC118T |
| 58 | SOA/FC119P | Technique/ Field tour | 1 | Field tours to study the forestry field techniques. |
| 59 | SOA/FSEC102T | Nursery Management & Commercial Forestry | 1 | To explore about the nursery site, its selection and layout. Different types of nurseries and the intercultural operation. Macro and micro propagation. Plant protection measures in nursery. Important tree species and their nursery practices. |
| 60 | SOA/FSEC102P | Nursery Management & Commercial Forestry-Practical | 1 | To explore about the nursery site, preparation of beds, sowing methods, treatment of seeds, intermediate operations for management of nursery. Study of vegetative propagation methods. |
| 61 | SOA/FE112T | Forest Ecology | 1 | To impart knowledge about ecology and the components of ecology, energy flow in ecology and parameters of population and community. |
| 62 | SOA/FE112P | Forest Ecology-Practical | 1 | To learn about the methods of studying the ecology at population and community levels by visiting different ecosystem. |
| 63 | SOA/FE113T | Fundamentals of Wild | 1 | To explore about the wildlife and its management. Different habitat type of wildlife. |

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| | | Life | | Biological basis of wildlife. Different agencies involved in wildlife sector. Wildlife ecology. Basic requirements of wildlife. Importance of wildlife in existing biodiversity globally and in India. |
| 64 | SOA/FE113P | Fundamentals of Wild Life-Practical | 1 | To learn about the habit of different wildlife regarding to their food and habitat. Scientific names of important wild species. Wildlife behavior and adaptations. |
| 65 | SOA/FE114T | Wood Products & Utilization | 1 | To explore the knowledge of paper industry, pulp and paper making, different types of papers, types of paper boards and plywood industry to study the manufacturing processes. To learn about the wood based industries, wood distillation unit. |
| 66 | SOA/FE114P | Wood Products & Utilization-Practical | 1 | Visits to various wood based industries to demonstrate various wood products manufacturing process. |
| **5th Semester** | | | | |
| 67 | SOA/FC120T | Rangeland Management | 2 | To explore about the Key management components seek to optimize such goods and services through the protection and enhancement of soils, riparian zones, watersheds, and vegetation complexes, sustainably improving outputs of consumable range products such as red meat, wildlife, water, wood, fiber, leather, energy resource extraction, |
| 68 | SOA/FC120P | Rangeland Management-Practical | 1 | To learn about identification of grasses, forbs and legumes and fodder trees; Rangeland inventory – ground cover, plant height, relative dominance, etc.; Assessing nutrient; Estimating range condition from plant composition; Determine range utilization, carrying capacity of rangelands; |
| 69 | SOA/FC121T | Silvicultural Systems | 2 | To understand scope/need of silvicultural systems<br>Detailed study of creation and management of various silvicultural systems. |
| 70 | SOA/FC122T | Experimental techniques in Forestry | 2 | Introduction to scientific methodology.<br>Measurement and scaling techniques.<br>Measures of central tendency and dispersion, introduction to distributions.<br>Tests of Significance -'z' test,'t' test and 'F' test.<br>Principles of field experimentation.<br>Comparison between field and forestry experimentation.<br>Design and analysis: Completely randomized design, Randomized complete block design, Latin square design and split-plot design, normalization of data. Concept of factorial experiments.<br>Sampling - Concept of population and sample, advantages of sampling and methods of sampling.<br>Models in Agroforestry research. Site selection, size, layout and shape of the plot, arrangement of blocks in traditional forestry and Agroforestry. Instrumentation in forestry research (for soil analyses, plant analyses). Development of a research plan. Research planning in Forestry in India. Scientific literature search / retrieval and scientific writing. |
| 71 | SOA/FC122P | Experimental techniques in Forestry-Practical | 1 | As per the Paper SOA/FC122T |

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| 72 | SOA/FC123T | Dendrology | 2 | Introduction – importance and scope of dendrology.<br>Classification of plants-Bentham and Hooker's, Engler and Prantles, and Hutchinson's Systems.<br>Plant Nomenclature – objectives, principles and International Code of Botanical Nomenclature.<br>Herbarium techniques, collection, processing and preservation of plant material. General study of herbarium, arboretum and Xylarium.<br>Description of the plant in scientific terms, study of sport characteristics of plants, naming and classifying based on adopted system.<br>Study of families, as survey of forest resources: Magnoliaceae, Rhizophoraceae, Ebenaceae, Sapotaceae, Fabaceae, Santalaceae, Elaeagnaceae, Meliaceae, Salicaceae, Apocynaceae, Betulaceae, Verbenaceae, Fagaceae, Asteraceae, Moraceae, Poaceae, Tiliaceae, Liliaceae, Euphorbiaceae, Myrtaceae, Glusiaceae, Dipterocarpaceae, Cupressaceae, Guttiferae, Taxaceae, Pinaceae and Combretaceae.<br>Geographical distribution of important Indian trees, native trees, exotic trees, endemism. |
| 73 | SOA/FC123P | Dendrology-Practical | 1 | Study of woody flora of families mentioned in theory. |
| 74 | SOA/FC124T | Wild life Management | 2 | To extend the view of wildlife regarding to management and wildlife survey. Wildlife population dynamics. Prey predators relationships. Management of basic requirements. Conservation of biodiversity at national and international level. Political role |
| 75 | SOA/FC124P | Wild life Management-Practical | 1 | To exercise of wildlife study in captivity and nature. Visit learning at different protected areas. |
| 76 | SOA/FSEC103T | Plantation Forestry | 1 | To explore about the plantation needs and its significance. Preparation of plantation site, tools used for different preparation of plantation area. Different methods of planting practices. Industrial plantation. Wastelands and their reclamation. |
| 77 | SOA/FSEC103P | Plantation Forestry-Practical | 1 | To study of tools used for preparation of plantation. Layout of plantation sites. Protection measures for established plantation. Planting design. |
| 78 | SOA/FE115T | Fundamental Forest Business Managements | 1 | Farm management-scope and approaches discussed.<br>Cost-concept, principles and functions its relevance to business demonstrated.<br>Basic laws of production explained.<br>Principles involved in farm management decision making decision as to what, how, when and how much to produce described.<br>Factor- factor-product and product-product relationships displayed.<br>Cost of cultivation and production calculated.<br>Break-even analysis discussed.<br>How to do decision making under risk and uncertainty discussed.<br>Farm business efficiency measures elaborated.<br>Economic order quality and ABC analysis done.<br>Management of resources-<br>land, labour, capital and machinery described. |

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| 79 | SOA/FE115P | Fundamental Forest Business Managements-Practical | 1 | To study:<br>Principles involved in farm management decision making decision as to what, how,when and how much to produce.<br>Factor- factor-product and product-product relationships.<br>Cost of cultivation and production.<br>Break-even analysis.<br>Principles involved in farm management decision making decision as to what, how, when and how much to produce. Factor- factor-product and product-product relationships.<br>Cost of cultivation and production.<br>Break-even analysis. |
| 80 | SOA/FE116T | World Forestry Systems | 2 | To study about Geographical distribution of forests and their classification.<br>Critical examination of the world forest sources, productivity potential and increment of world forests.<br>To learn about Forest resources and forestry practices in different regions of the world – North and South America, Europe, Africa, China, Japan, Russia, South-East Asia and Australia.<br>To study about Forest development and economy – forest based industries of the world.<br>To learn about Recent trends in forestry development in the world.<br>To study about International forestry organizations. |
| 81 | SOA/FE117T | Forest Entomology & Nematology | 1 | To understand classification, biology, natural history and diversity of insects affecting forest ecosystems.<br>To identify insects common to forests and recognize their damage.<br>To appreciate insect sampling in forest ecosystems, with particular attention paid to monitoring, forecasting and assessing the risk of insect outbreaks.<br>To illustrate the importance of silvicultural practices and management of natural enemies in preventing insect outbreaks.<br>To recognize the importance of cultural, physical, biological, and chemical strategies for preventing, controlling and managing forest pests.<br>To foster an appreciation for the significance of research on insect pests of forests.<br>To understand the morphology of nematodes as it relates to their taxonomic position, their ability to cause diseases of plants and the principles of controlling nematode diseases of plants. |
| 82 | SOA/FE117P | Forest Entomology & Nematology-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE117T |
| **6th Semester** | | | | |
| 83 | SOA/FC125T | Forest Management, Policy and Legislation | 2 | To study about the management aspects of forestry, yield regulations, rotation,legal aspects related to forestry and working plan. Sustained yield and normality in forestry. |
| 84 | SOA/FC125P | Forest Management, | 1 | To acquire knowledge by visiting forest departments and learning about the records they |

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| | | Policy and Legislation-Practical | | maintain in the department, formation of working plan and legal aspects they use |
| 85 | SOA/FC126T | Principles and Methods of Tree Improvement | 2 | Introductory study about forest genetics, tree breeding and improvement,<br>Study of history of tree improvement, justification for tree improvement programme, its relation with other disciplines of forest management; activities, advantage and limitation of tree improvement.<br>To learn about Forest reproduction and natural variation: sexual and asexual reproduction and their consequences.<br>Study about Causes and kinds of variability, variation in natural stands, concepts, evolutionary forces that force variations and level of genetic variation; conservation and utilization of forest tree genetic resources- principle & strategies.<br>Learn about quantitative genetics and importance of statistical methods in it, study about selection procedures and techniques in tree improvement, species and provenance selection, Plus tree selection and progeny trials. Study about Introduction to exotic forestry. Learn about seed production areas and seed orchards.<br>Study about Hybrid in tree improvement; mutation and polyploidy breeding. Study about recent techniques in tree improvement, Learn about vegetative propagation and tree improvement. |
| 86 | SOA/FC126P | Principles and Methods of Tree Improvement-Practical | 1 | Study about Seed collection and handling of forest seeds.<br>Learn about Techniques of selecting superior trees in natural stands and plantation. Floral biology and controlled crossing techniques.<br>Study about Vegetative propagation techniques.<br>Learn about Pollen viability determination. Visit to seed production areas and seed orchards.<br>Study about Numerical exercises and statistical analysis. |
| 87 | SOA/FC127T | Utilization of Non-timber Forest Products | 2 | Learn about various methods of collection, management and importance of Non-Timber Forest<br>Products (NTFP) viz.- Fodder (grasses and tree leaves), canes and bamboos. Essential Oils - methods of extraction, classification, storage and uses. Non-essential oils – nature, occurrence, methods of extraction, classification and uses. Important fixed oil yielding trees. Gums and resins –definition, classification, sources, collection and uses. Factors affecting gum formation. Important gum yielding plants. Resins and Oleoresins, their formation in plants and classification of resins. Tans-nature, classification, uses and important tannin yielding plants. Dyes – classification and sources of dyes. Beedi leaves – sources, collection and processing. Fibers and flosses. Katha and Cutch –sources, extraction and uses. Drugs, wild fruits, spices, poisons and bio-pesticides. |
| 88 | SOA/FC127P | Utilization of Non-timber Forest Products-Practical | 1 | Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and tree leaves. Study of canes and bamboos and their sources. Study of essential oils and their sources.<br>Study of non-essential oils and their sources. Study of gums and resins and their collection. |

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| | | | | Study of tans and dyes and their sources. Study of fibers, flosses and their collection from nearby forests.<br>Visit to Herbal Gardens and herbaria to study medicinal plants. Study of plants yielding drugs, spices, wild fruits, poisons and bio-pesticides and their collection from nearby forests. Visit to nearby extraction units. |
| 89 | SOA/FC128T | Agroforestry Systems and Management | 2 | Introduction and classification of Agroforestry system.<br>To learn about various traditional as well as modern agroforestry systems.<br>To know the characteristic and role of various components of agroforestry systems.<br>Impact of argoforestry practices in society, industries and environment. |
| 90 | SOA/FC128P | Agroforestry Systems and Management-Practical | 1 | To conduct the Agroforestry surveys.<br>To identify various Agroforestry systems.<br>To measure volume, biomass, tree dimensions of Agroforestry interest.<br>To do soil analysis. |
| 91 | SOA/FC129P | Technique / field tour | 1 | Field tours to study the forestry field techniques. |
| 92 | SOA/FSEC104T | Entrepreneurship Development and Communication Skills | 1 | Assessing overall business environment in the Indian and managerial economy done.<br>Concept of entrepreneurship and entrepreneurial characteristics discussed.<br>Managing an enterprise and its skills displayed.<br>Motivation and its types.<br>Importance of planning, monitoring, evaluation and follow up discussed.<br>Managing competition is an art and discussed how?<br>Entrepreneurship development programs conducted.<br>SWOT analysis explained.<br>Government schemes and incentives for promotion of entrepreneurship discussed.<br>Government policy on Small and Medium Enterprises (SMEs) / SSIs displayed.<br>Export and Import Policies relevant to forestry sector and its case studies discussed. |
| 93 | SOA/FSEC104P | Entrepreneurship Development and Communication Skills-Practical | 1 | Field surveys.<br>Market case studies.<br>Interviews. |
| 94 | SOA/FE118T | Principles of Forest Economics, Project Planning and Evaluation | 1 | To become familiar with *economics* and business principles and how they can be applied to *forestry.*<br>Utilize economic principles to address private and public policy issues related to allocating natural resources and environmental amenities. |
| 95 | SOA/FE118P | Principles of Forest Economics, project Planning and Evaluation-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE118T |
| 96 | SOA/FE119T | Marketing and Trade of Forest Produce | 1 | Demonstrate a basic knowledge of the role of markets and market failure with regards to the allocation of natural resources and environmental amenities. |

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| | | | | To familiar with the role of market channels for distribution of forest resources.<br>To understand the concept of different types of market<br>Students get to know about WTO & IPR. |
| 97 | SOA/FE119P | Marketing and Trade of Forest Produce-Practical | 1 | To impart practical knowledge and hands-on-training based on Course SOA/FE119T |
| 98 | SOA/FE120T | Biodiversity & Conservation | 1 | To explore about the biodiversity and its conservation at local as well as global level. Basic terms about biodiversity and its conservation. Diversity and its analytical features, different life forms under diversity. Conservation biology and its principles. Methods of conservation. Conservation efforts by India and worldwide. |
| 99 | SOA/FE120P | Biodiversity & Conservation-Practical | 1 | To exercise of diversity indices computation , visit of protected areas, case study regarding conservation. |
| **7th Semester** | | | | |
| 100 | SOA/FC130P | Socio-economic surveys -village Attachment (28 working days) | 4 | To prepare survey questionnaire for socio-economic survey.<br>To conduct the socio-economic surveys for data collection of relevance. |
| 101 | SOA/FC131P | Attachment with State Forest Department (70 working days) | 10 | To understand the construction of modern forest nurseries, herbal gardens and watersheds.<br>To see and understand the procedure of the felling and logging operations, timber lots and important industrial products extraction with the use of Forestry equipments/ instruments.<br>To see the working plan document of variuos Forest divisions and get to know enumeration, volume and yield calculation & compartment history<br>To study the 'CAT' (Catchment Area Treatment Plan) and FDA (Forest Development Agencies)<br>To study the regeneration and management of important forestry tree species.<br>To conduct layout studies, stump analysis, preparation of local volume table. |
| 102 | SOA/FC132P | Industrial Placement (28 working days) | 4 | To get acquinted with the nature, working environment, production and management process and Marketing & financial management various of wood-based industries. |
| 103 | SOA/FSEC105T | Report Writing and Presentation of FWE (14 Working days) | 2 | To learn the compilation of the workdone/skills gained.<br>To learn the data processing/ analysis.<br>To develop the skill of Presentation of the report. |
| **8th Semester** | | | | |
| 104 | SOA/FC133P | Project Development (2 weeks) | 2 | To develop the skill of project development to carry out any research activity. |
| 105 | SOA/FC134P | Collection, Handling, Processing and Storage of planting material (3 weeks) | 2 | To identify the superior seed sources.<br>To use various seed collection methods for different species on field.<br>To put seeds under various seed treatments to document their quality and regeneration potential.<br>To understand the methods of storage of collected planting materials. |
| 106 | SOA/FC135P | Vegetative Propagation under controlled and | 3 | To apply vegetative propagation methods like cutting, grafting for propagation of forest trees, medicinal plants and fruit trees. |

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| | | ambient conditions (3weeks) | | Production of bare root and containerized seedlings. |
| 107 | SOA/FC136P | Nursery Management (11 Weeks) | 9 | Practical application of the nursery management practices like seedbed preparation, sowing, planting, irrigation, polyhouse management, various intercultural operation. |
| | SOA/FSEC106P | Marketing of seeds and seedlings (2weeks) | 2 | To understand the marketing channels and links.<br>To grade the planting stocks on the basis of quality and do pricing for them |
| 108 | SOA/FSEC107P | Cost Benefit analysis, Project Report & Presentation (1 week) | 2 | To get acquainted with the economic analysis of projects.<br>To sharpen the skills of documentation of the field studies.<br>To sharpen the skill of Presentation of research projects. |

## B.Sc. Horticulture

**Programme Code**: 105

**Programme Summary:**

Duration 4 years; 8 semesters

**Eligibility**

10+2 with minimum 45% marks in aggregate with PCB/PCM.

# Program outcomes:

- To study vegetable farming systems, orchard planting systems, water and weed management in fruit, vegetable and flower crops.
- To know the physiology of the plants and application of growth regulators or bioregulators in the horticultural crops
- To study the production, propagation, breeding and seed production, aspects of tropical, sub-tropical and temperate fruits, vegetables, flowers, spices, condiments and medicinal and aromatic crops.
- To know the genetic diversity among the various horticultural crops.
- To enhance the communication skills and command on spoken english.
- To learn the different aspects of statistics and its application in the horticultural plants through the calculation as well as computation of data received from the field.
- To study the basics of the agronomical crops and fundamentals of soil science.
- To know about the plants and animals and their classification as well as characterization.
- To study the introduction of various types of microbes, insects, pathogens, nematodes etc. and their genetic make up, with aim of identification and control in horticultural crops.
- To know the importance, application (biofertilzers, bio-agents, vermicompost and soil amendments) and certification procedure for organic farming.
- To understand and calculate the economics or cost of cultivation of the horticultural crops to the growers or farmers.

**Course Outcomes:**

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | **1st Semester** |
| 1 | SOA/HC 101 T | Fundamentals of Geology and Soil Science | 2+1 | To study composition of earth's crust, soil as a natural body major components by volume pedology rockstypes Igneous sedimentary and metamorphic classification soil forming minerals.<br>To study the definition classification - silicates, oxides, carbonates, sulphides, phosphates occurrence.<br>To know the weathering of rocksand minerals, weathering factors: physical, chemical, biological agents involved, weathering indices,factors of soil formation, land forms parent, material climate organism, relief time soil forming processes eluviations and illuviation formation of various soils.<br>To understand the problem soils: salted soils, permeable, flooded, sandy soils properties. Physical parameters texture definition methods of textural analysis textural classes, absolute specific gravity definition apparent specific gravity/bulk density factorsinfluencing field bulk density.<br>To study the relation between BD.PD Practical Problem. Pore space definition, factors affecting capillary and noncapillary porosity, soil colour definition, its significance, colour variable hue, value, chroma, Munsell colour chart, factors influencing parent material soil moisture organic matter, soil structure, types of structure, factors influencing genesis of soil structure.<br>To study about Soil air , air composition, amount of air space, soil air renewal, soil temperature sources and distribution of heat, chemical properties humus inorganic secondary silicate clay hydrous oxides.<br>To know the soil organic matter decomposition, pH nutrient availability, soil buffering capacity, soil water forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity, energy concepts, pF scale measurement-gravimetric, electric and tensiometer methods. Soil water movement, saturated and unsaturated infiltration and percolation. Soils of different eco-systems and their properties. |
| 2 | SOA/HC 102 T | Elementary Plant Biochemistry and Biotechnology | 2+1 | Understand the significance of Biochemistry<br>Describe the chemistry of carbohydrates, lipids, proteins and amino acids<br>Describe the classification and structural organization of proteins<br>Describe the mechanism of enzyme action and identify the classes of enzymes and |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | factors affecting action<br>Describe the catabolic reactions of carbohydrates, lipids and amino acids<br>Understand Concepts, principles and processes in plant biotechnology.<br>Identify the class and functions of secondary metabolites |
| 3 | HC103T | Principles of Plant Physiology | 2+1 | To know about the metabolic activity and life, cycle of the plant from germination through growth and development.<br>Know importance and scope of plant physiology.<br>Understand the plants and plant cells in relation to water-osmosis, imbibition , diffusion and water potential and the movement of sap and absorption of water in plant body, structure and function of stomata, opening and closing of stomata, different types of stresses- water, cold, heat, plant nutrition and essentiality and mechanism of absorption.<br>Understand the process of photosynthesis particular light and dark reaction, respiration particular emphasis on aerobic and anaerobic respiration, photo-hormones. |
| 4 | SOA/HC 104T | Statistics and Computer application | 2+1 | To know the basic concepts of Variable statistics, types and sources of data, classification and tabulation of data, construction of frequency distribution, tables, graphic representation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve.<br>To calculate average and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, for raw and grouped data.<br>To know the concept of dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data.<br>To understand the probability: Basic concept, additive and multiplicative laws. Theoretical distributions, binominal, poison and normal distributions. Correlation: Scatter diagram, correlation co- efficient and its properties, regression, fitting of simple linear regression.<br>To know the test of significance: Basic concepts, Test of equality of one mean, Chi-square test for application of attributes and test for goodness of fit<br>The outcome was mixture of practical and theoretical explanation of topics concerning computational and statistical approaches.<br>Basics of computer, its input output devices, operating system and programming languages elaborated.<br>Databases to handle data with reference to Horticulture were also discussed. |
| 5 | SOA/HAECC 101 T | Structural Grammar and | 1+1 | To study about the introduction to word classes; structure of the verb in English.<br>To study the uses of tenses. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | spoken English | | To understand the study of voice.<br>To study the uses of conjunctions and prepositions.<br>To learn about sentence patterns in English.<br>To learn the conversations of different situations in everyday life.<br>To learn the concept of stress, stress shift in words and sentences.<br>To study the words with silent letters and their pronunciations.<br>To learn about the basic intonation patterns. |
| 6 | SOA/HE 101 T | Introductory Economics | 2+0 | The students will be able to understand Nature and scope of economics.<br>The students will be able to state the concepts and divisions of economics, and also define economics.<br>The students will be able to state the various theories related to consumer behavior such as equi-marginal utility, indifference curve, diminishing marginal utility.<br>The students will be able to classify goods.<br>The students will be able to state the characteristics of wants.<br>The students will be able to define law of demand and understand the concept of price, income and cross elasticity's.<br>The students will be able to explain consumer's surplus, Theory of firm and factors of production i.e. land, labour, capital and enterprise.<br>The students will be able to describe theories of population.<br>The students will be able to understand Cost concepts.<br>The students will be able to state the Law of supply.<br>The students will be able to explain the theories of rent, wage, interest and profit.<br>The students will be able to understand the concepts of Price determination and forecasting under various market structures. |
| 7 | SOA/HE 103 T | Introductory Biology | 1+1 | To Introduction to the living world and classification of plant kingdom.<br>To study about the binomial Nomenclature; characteristics of algae, fungi, bryophyte, pteridophyta; angiosperms and zymnosperm- structure and functions.<br>To study about Morphology and important modification of root, stem and leaf, inflorescence, flower and fruit, seed structure and germination.<br>To understand about cytology and histology (plant cell and tissues, internal structure of dicot and monocot plants).<br>Introduction to the living world and classification of plant kingdom, binomial Nomenclature; characteristics of algae, fungi, bryophyte, pteridophyta; angiosperms and zymnosperms- structure and functions.<br>Morphology and important modification of root, stem and leaf, inflorescence, flower |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | and fruit, seed structure and germination; cytology and histology (plant cell and tissues, internal structure of dicot and monocot plants).<br>To study the general classification of animal kingdom; characteristics of major groups of Non-chordata and chordate.<br>To know the cell structure and function- cell as unit of life, prokaryotes, eukaryotes, cell organelles.<br>To study the cell division- mitosis, meiosis; origin of life and an elementary knowledge of animal evolution; histology of gut, liver, kidney, ovary, testies and skeletal system of rabbit; physiology of digestion, respiration, circulation, excretion, coordination, endocrine and reproductive system.<br>To understand the economic importance of animals in Forestry/Agriculture. |
| 8 | SOA/HE 104 T | Sericulture | 1+1 | Importance and history of sericulture, future scope.<br>To study Mulberry cultivation geographical distribution, species and varieties, classification, climate, nursery and propagation, field preparation, planting methods, irrigation, manuring, pruning and training, insect pests and diseases and their management.<br>Types of silk worms, morphology and life cycle.<br>Rearing appliances and methods, maintenance of ericulture units, egg production techniques and post cocoon technology.<br>Pests and diseases of silk moth, properties of silk, uses.<br>Economics of sericulture. Recent trends in sericulture.<br>Biology and behaviour of lac insect, host plants.<br>The lac cultivation, manufacturing of shellac and its uses. |
| **2nd Semester** | | | | |
| 1 | SOA/HC 105 T | Introductory Microbiology | 1+1 | To understand about history and Scope of Microbiology:<br>To study about the discovery of micro-organism, spontaneous generation conflict, germ theory of diseases, microbial effect on organic and inorganic matter.<br>To learn the Development of microbiology in India and composition of microbial world.<br>To examine about Specimen Preparation and Microscopy:<br>To study about The bright field microscope, fixation, dyes and simple staining, differential staining. Difference between prokaryotic and eucaryotic cells.<br>To learn about the Prokaryotic cell structure and functions.<br>To study about Types of culture media and pre-culture techniques.<br>To study about Microbial growth in models of bacterial, yeast and mycelial growth |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | curve and measurement of bacterial growth.<br>To learn General properties of viruses and brief description of bacterophages.<br>To study about general principle of bacterial genetics, DNA as genetic material.<br>To understand Antibiosis, symbiosis, intramicrobial and extramicrobial association. |
| 2 | SOA/HC106 T | Principles of Genetics and Cytogenitics | 2+1 | Historical background, theories and hypothesis of genetics discussed.<br>Physical basis of heredity including cell reproduction, mitosis, meiosis and its significance explained.<br>Mendel's principles of heredity, deviation from Mendelian inheritance workout with different crosses.<br>Phenomenon of pleiotropy, co-dominance, penetrance and expressivity discussed.<br>Chromosome theory of inheritance with gene interaction explained.<br>Theories of multiple alleles, quantitative inheritance linkage and crossing over, sex linked inheritance discussed.<br>Chemical basis of heredity, structure of DNA its replication and evidence to prove DNA and RNA –as genetic material described.<br>Mutation and chromosomal aberrations discussed. |
| 3 | SOA/HC 107 T | Apiculture (1) | 1+1 | To understand about the morphology, anatomy, colony organization, behaviour, lifecycle, diseases and pests of honey bee.<br>To gain knowledge about the apiculture techniques and recent trends of it.<br>To understand the role of honey bee as pollinator and its role in increasing the productivity of horticultural crops in India economy |
| 4 | HC108T | Medicinal and aromatic plants | 2+1 | To know the different definitions of medicinal and aromatic plants<br>To study the importance and scope of production of medicinal and aromatic Crops<br>To know the cultivation practices and importance of pepper,cardamom,clove, ginger and turmeric,<br>To know the cultivation practices and importance of betelvine, periwinkle, rauvolfia and dioscorea,<br>To know the cultivation practices and importance of isabgol, ammi majus, belladonna, cinchona and pyrethrum<br>To know the cultivation practices and importance of citronella grass, khus grass, sweet flag (bach), lavender and geranium<br>To know the cultivation practices and importance of patchouli, bursera, mentha, muskdana (musk mallow), ocimum<br>To study the endangered medicinal and aromatic plants of India and their conservation strategies |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | To know the chemical composition of a few important medicinal and aromatic plants, their extraction and use.<br>To know the therapeutic and pharmaceutical uses of important species. |
| 5 | SOA/HC 109 T | Soil Fertility and Nutrient Management | 1+1 | Introduction to soil fertility and productivity- factors affecting. Essential plant nutrient elements- functions, deficiency systems, transformations and availability.<br>To study about acid, calcareous and salt affected soils -characteristics and management.<br>To know the role of microorganisms in organic matter- decomposition - humus formation.<br>To know the importance of C:N ratio and pH in plant nutrition. Integrated plant nutrient management.<br>To learn soil fertility evaluation methods, critical limits of plant nutrient elements and hunger signs. NPK fertilizers: composition and application methodology, luxury consumption, nutrient interactions, deficiency symptoms, visual diagnosis. |
| 6 | HAECC102 T | Environmental science | 1+1 | To understand appropriate sociological and technological measures in environment management<br>To focus on ecosystem services and human well being and livelihoods.<br>To learn basis of problems and solutions in natural resource management<br>To find solutions towards more sustainable societies around the globe<br>To learn strategies for waste reduction and disposal<br>To contribute meaningfully for analysis of environmental systems planning and management with both a local and global perspective<br>To understand the concept of sustainable development<br>To be able to cope with the impacts of climate change by adopting adaptation and mitigation measures<br>To prepare the students for national and global employability |
| 7 | SOA/HE 105T | Fundamentals of Extension Education | 1+1 | To know Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Forestry extension: process, principles and selected programmes of leading national and international forest institutes.<br>People's participation in forestry programmes.<br>To Motivate women community, children, youth and voluntary organizations for forestry extension work.<br>To understand Rural Development: meaning, definition, objectives and genesis.<br>To transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and Refinement Programme (TARP) etc. of ICAR. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | Communication: meaning, definition, elements and selected models.<br>Audio – visual aids: importance, classification and selection. Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods.<br>To understand the Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA).<br>Management and administration: meaning, definition, principles and functions.<br>The Concepts of human resource development (HRD), rural leadership. |
| 8 | SOA/HE 106 T | Fundamentals of Horticulture | 1+1 | To study the Economic importance and classification of horticultural crops.<br>To learn about the nutritive value of fruits and vegetables.<br>To learn about the area and production of horticultural crops.<br>To understand about the exports and imports of horticultural crops.<br>To learn about fruit and vegetable zones of India and of different states<br>To understand the nursery management practices, soil and climate.<br>To gain knowledge about vegetable gardens, nutrition and kitchen garden and other types of gardens.<br>To understand the principles, planning and layout.<br>To learn about the management of orchards.<br>To understand the planting systems and planting densities.<br>To gain knowledge about production and practices for fruit, vegetables and floriculture crops.<br>To gain knowledge about nursery techniques and their management.<br>To understand the principles and methods of pruning and training of fruit crops.<br>To learn about the types and use of growth regulators in horticulture.<br>To learn about water management, weed management and fertility management in horticultural crops.<br>To study about bearing habit and factors influencing fruitfulness and unfruitfulness.<br>To learn about the rejuvenation of old orchards, top working, frame working<br>To understand about the principles of organic farming. |
| 9 | SOA/HE 107 T | Agrometeorology | 1+1 | To study the definition, aim and scope of agrometeorology.<br>To gain knowledge on the factors and elements of weather and climate.<br>To study the composition and structure of atmosphere.<br>To understand the air and soil temperature regimes.<br>To learn about atmospheric humidity and types of clouds and precipitation, hails and frost. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | To understand the cyclones, anticyclones and thunderstorms.<br>To learn about solar radiations, their components and effect on plant growth.<br>To understand the effect of weather and climate on the growth and development of crops.<br>To gain knowledge on climatic normals of crops.<br>To understand the agroclimatic zones of India and Himachal Pradesh.<br>To understand evaporation and transpiration.<br>To learn the use of remote sensing techniques in agrometeorology.<br>To learn agriculture weather forecasting. |
| **III Semester** | | | | |
| 1 | SOA/HC 110 T | Tropical and Sub-Tropical Fruits | 2+1 | To know about Horticultural classification of fruits including genome classification.<br>To learn about Horticultural zones of India.<br>To understand about detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning.<br>Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops. Mango, banana, bael, banana.<br>To understand about detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops, grapes, citrus, papaya, sapota.<br>To understand about detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops. guava, pineapple, jackfruit, avocado, mangosteen.<br>To understand about detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops. litchi, carambola, durian and passion fruit.<br>To understand the Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures. Seediness and kokkan disease in banana, citrus decline and casual factors and their management. Bud forecasting in grapes.<br>To know about sex expression and seed production in papaya, latex extraction and crude papain production, economic of production.<br>To understand about Rainfed horticulture, importance and scope of arid and semi-arid zones of India.<br>To know about the Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind. |
| 2 | SOA/HC 111T | Weed Management in Horticultural Crops | 1+1 | Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination<br>To learn about Weed biology and ecology, crop weed association, crop weed competition and allelopathy<br>To understand the Concepts of weed prevention, control and eradication;<br>To know about Methods of weed control: physical, cultural, chemical and biological methods.<br>Integrated weed management.<br>To know about the Herbicides: advantages and limitation of herbicide usage in India. Herbicide classification, formulations, methods of application.<br>Introduction of Adjuvants and their use in herbicides.<br>Introduction of selectivity of herbicides; Compatibility of herbicides with other agro chemicals.<br>To understand the Weed management in major field and horticultural crops, shift of weed flora in cropping systems.<br>The concept of aquatic and problematic weeds and their control. |
| 3 | SOA/HC 112 T: | Tropical and Sub-Tropical Vegetables | 2+1 | To study of Area, production, economic importance and export potential of tropical and sub-tropical vegetable crops. Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvest, yield and seed production.Economic of cultivation of tropical and sub- tropical vegetable crops; Post-harvest handling and storage.<br>Marketing of tomato, brinjal, chillies, okra, amaranthus, cluster eans, cowpea, lab-lab, snap bean, cucurbits, moringa, curry leaf, portulaca and basella. |
| 4 | SOA/HC 113T | Orchard Management | 1+1 | To learn about Orchard management, importance, objectives, merits and demerits.<br>To understand the Clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches.<br>To learn about Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shootsystems.<br>To study about Biological efficiency of cropping systems in horticulture, systems of irrigation.<br>The Soil management in relation to nutrient and water uptake and their effect on soil environment,moisture,organisms and soil properties.<br>Integrated nutrient and pest management.<br>To Utilization of resources constraints in existing systems.<br>To have a Crop model and crop regulation in relation tocropping systems. |
| 5 | SOA/HC 114T | Principles of Plant Breeding | 2+1 | Introduction, limitations and major achievements in plant breeding discussed.Genetic basis of Plant Breeding explained.<br>Sexual and asexual reproduction discussed.<br>Pollination control mechanism viz., male sterility and self incompatibility described.<br>Genetic components of polygenic variation explained.<br>Hybrid development and concepts of heterosis explained. |
| 6 | SOA/HSEC 101 T | Plant Propagation and Nursery Management | 1+1 | To gain knowledge on plant Propagation and its Need, potentialities and types, sexual and asexual methods<br>To study about sexual and asexual methods of plant Propagation and its advantages and disadvantages.<br>To understand Seed dormancy and its types and internal and external factors<br>To learn about nursery techniques, hardening of plants in nurseries, Nursery registration act, tools and implements and Insect/pest/disease control in nursery<br>To study about mono embrony and polyembrony.<br>To gain knowledge on Propagation structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds and poly-houses |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | To understand about growth regulators and its use in plant Propagation<br>To gain knowledge on cutting, layering, grafting , budding and Micrografting<br>To study about bio chemical basis of rooting, factors influencing rooting of cuttings and layering<br>To learn about Anatomical studies of bud union, selection and maintenance of mother trees, graft incompatibility, collection of scion wood stick, scion-stock relationship, and their influences.<br>To understand about techniques of propagation through specialized organs, corm, runners, suckers |
| 7 | SOA/HE 109 T | Fundamentals of Entomology & Nematology | 1+1 | Introduction to phylum arthropoda. Importance of class Insecta. Insect dominance. Definition, division and scope of entomology. Comparative account of external morphonology.<br>ypes of mouth parts, antennae, legs, wings and genetallia.<br>Anatomy of digestive, excretory, nervous and reproductive systems.<br>Postembryonic developmenteclosion. Matamorphosis. Types of larvae and pupa.<br>Classification of insects upto orders and families of economic importance and their distinguished characters.<br>History of development of nematology- definition, economic importance.<br>General characters of plant parasitic nematodes, their morphology. taxonomy and classification, biology, symptomatology and control of important plant parasitic nematodes of fruits- tropical, subtropical and temperate fruits, vegetables, tubers, ornamental and plantation crops.<br>Role of nematodes in plant disease complex. |
| 8 | SOA/HE 110 T | Introduction to major field Crops | 1+1 | To study about the classification and distribution of major field crops (Cereals, Legumes, Oilseeds, Fodder Crops)<br>To study about the Concept of Multiple Cropping,Mixed Cropping,Inter Cropping,Relay Cropping.<br>To study about the Methods of Raising,Growing of Field crops.<br>To study about Green Manuring<br>To study about Crop Rotation<br>To Identify weeds of Field Crops<br>To study about the Methods of Fertilizer ,Herbicides and Insecticides Application in field Crops. |
| 9 | SOA/HE 111 T | Fundamentals of Plant Pathology | 1+1 | To understand about introduction to the science of phytopathology, its objectives, scope and historical background. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | To study about Classification of plant diseases, symptoms, signs, and related terminology.<br>To learn the Parasitic causes of plant diseases (fungi, bacteria, viruses, phytoplasma, protozoa, algae and flowering parasitic plants), their characteristics and classification.<br>To understand about non-parasitic causes of plant diseases.<br>To study about infection process, Survival and dispersal of plant pathogens.<br>To learn the Plant disease epidemiology, forecasting and disease assessment.<br>To Understand about the Principles and methods of plant disease management and Integrated plant disease management. |
| **IV Semester** | | | | |
| 1 | SOA/HC 115 T | Spices and Condiments | 1+1 | History, scope and importance, area and production, uses, export potential and role in national economy.<br>Classification, soil and climate, propagation-seed, vegetative and micro propagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products of Cardamom, pepper, ginger, turmeric and clove.<br>Classification, soil and climate, propagation-seed, vegetative and micro propagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products of nutmeg, cinnamon, all spice, curry leaf, coriander.<br>Classification, soil and climate, propagation-seed, vegetative and micro propagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products of fenugreek, fennel, cumin, dill, celery, bishops weed, saffron.<br>Classification, soil and climate, propagation-seed, vegetative and micro propagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products of vanilla, thyme and rosemary. methods of |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | extraction of essential oil and oleoresins.<br>Economics of cultivation, role of Spice Board and Pepper Export Promotion Council, institutions and research centers in R&D. |
| 2 | SOA/HC 116 T | Temperate Fruits | 2+1 | To gain knowledge on introduction and classification of temperate fruits.<br>To study about areas, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinisers, use of growth regulators, nutrient and weed management, harvesting, post-harvest handling and storage of apple, pear, peach, apricot, cherry, persimmon, strawberry, kiwi, Queens land nut (Mecademia nut), almond, walnut, pecan nut, hazel nut and chest nut.<br>To understand about Re- plant problem and special production problems like pre-mature leaf fall, physiological disorders, important insect – pests and diseases and their control measures rejuvenation |
| 3 | SOA/HC117T | Ornamental Horticulture | 2+1 | Exposure to the history, scope of gardening, aesthetic values.<br>To study about different gardens in India and various styles of garden.<br>To acquaint with the term landscaping, its historical background, definition and basic principles and basic components.<br>To gain the knowledge about floriculture industry and its importance, area and production,<br>To get information about lawn making and various methods of designing rockery, water garden, vertical gardens, roof gardens, etc.<br>To identify various ornamental plants like tree, climbers, shrubs, indoor plants, cactus, palm plants and different summer and winter annual flowering plants.<br>To explore various propagation methods of shrubs and herbaceous perennials.<br>To study the different kinds of flower arrangement and the cut flower crop with under subhead like importance, production details and cultural operations, constraints, post-harvest practices.<br>To understand bio-aesthetic planning and its need in round country planning and in urban planning.<br>To learn the various landscaping of schools, villages, railway stations, dam sites, hydroelectric stations,<br>colonies, river banks, play grounds, parks and public gardens.<br>To get introduced to bonsai and art of making bonsai. |
| 4 | SOA/HC 118 T | Water Management in | 1+1 | To study about mportance of water, water resources in India. Area of different crops under irrigation, function of water for plant growth. To study the effect of moisture |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | Horticultural Crops | | stress on crop growth.<br>To learn Available and unavailable soil moisture – distribution of soil moisture – water budgeting –rooting characteristics –moisture extraction pattern.<br>To study water requirement of horticultural crops – lysimeter studies – Plant water potential climatological approach – use of pan evaporimeter.<br>To learn about factor for crop growth stages – critical stages of crop growth for irrigation.<br>To understand about irrigation scheduling – different approaches<br>To study the methods of irrigation –surface and sub-surface pressurized methods viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water.<br>To learn about water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops.<br>To study about Layout of different irrigation systems, drip, sprinkler.<br>Layout of underground pipeline system. |
| 5 | SOA/HC 119T | Plantation Crops | 2+1 | History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by products utilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of coconut, arecanut.<br>History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by productsutilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of oil palm, palmyrah palm, cocoa.<br>History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | productsutilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of cshew nut, coffee, tea and rubber. |
| 6 | SOA/HSEC 102 T | Organic Farming | 1+1 | To study about Introduction, concept, relevance in present context.<br>To understand Organic production requirements; Biological intensive nutrient management-organic manures vermicomposting, green manuring.<br>To learn recycling of organic residues, biofertilizers; Soil improvement and amendments.<br>To study about Integrated diseases and pest management use of biocontrol agents, biopesticides pheromones, trap crops, bird perches; Weed management.<br>To understand about Quality considerations, certification, labeling and accreditation processors, marketing, exports. |
| 7 | SOA/HE 112 T | Breeding of Fruit and Plantation Crops | 1+1 | To gain knowledge on Fruit breeding, history, importance in fruit production<br>To study about distribution, domestication and adaptation of commercially important fruits<br>To learn about variability for economic traits, breeding strategies, clonal selection, bud mutations, mutagenesis.<br>To understand about application in crop improvement, policy manipulations, *in vitro* breeding tools of important fruit and plantation crops. |
| 8 | SOA/HE113T | Growth and Development of Horticultural Crops | 1+1 | To study the growth and development, definitions, components, photosynthetic productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, growth analysis in horticultural crops.<br>To study the Plant bioregulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening. Flowering-factors affecting flowering, physiology of flowering.<br>To study about photoperiodism, long day, short day and day neutral plants, vernalisation and its application in horticulture, pruning and training physiological basis of training and pruning, source and sink relationship, translocation of assimilates. Physiology of seed development and maturation, seed dormancy and bud dormancy, |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | causes and breaking methods in horticultural crops.<br>To understand Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development,physiology of ripening of fruits-climatic and non climacteric fruits. |
| 9 | HE114T | Genetic Resources of Horticultural Crops | 1+1 | To understand the role of genetic resources- centres of origin and diversity of crops plants- law of homologous series<br>To study about the plant introduction in horticultural crops and exchange of genetic resources<br>To know the principles and concepts of plant quarantine<br>To know the germplasm collection and centres- gene band- gene sanctuary- need for conservation- genetic erosion- germplasm exploration- germplasm conservation- in vitro conservation cryopreservation<br>To study the application of DNA finger printing in Horticulture.<br>To know the wild relatives and sources of resistance to biotic, abiotic stresses and quality characters for fruit, vegetable, flower and plantation crops, spices and medicinal plants.<br>To know the International institutes and organizations for germplasm<br>To understand and know the trade Related Intellectual Property Rights (TRIPPS) and IPR for Indian cultivars. |
| **V Semester** | | | | |
| 1 | SOA/HC 120 T | Temperate Vegetables | 2+1 | To gain knowledge on Importance of cool season vegetable crops in nutrition and national economy.<br>To study about Area, production, export potential, description of varieties and hybrids, origin, climate and soil, production technologies, seed production, post-harvest technology, Diseases, insect pest , disorders and Marketing of cabbage, cauliflower, knol-khol, sprouting broccoli, Brussels' sprout, lettuce, palak, Chinese cabbage, spinach, garlic, onion, leek, radish, carrot, turnip, beet root, peas, broad beans, rhubarb, asparagus, globe artichoke. |
| 2 | SOA/HC 121 T | Principles of Landscape Gardening | 1+1 | To understand the Landscaping: historical background, basic principles and components. landscape composition of hills and plains. identification and use of landscape drafting equipments. drawing and designing of home gardens, public parks, avenues, farm complexes and institutions.<br>Layout of formal garden, informal garden, terrace garden, rock garden, bog garden, sunken garden, designing of conservatory and lathe house. Landscape design for specific areas. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| 3 | SOA/HC 122 T | Farm Power and Machinery | 1+1 | To know the basic concepts of various forms of energy, unit and dimensions of force, energy and power, calculations with realistic examples. IC Engines: basic principles of operation of compression, ignition and spark ignition engines, two stroke and four stroke engines, cooling and lubrication system, power transmission system, broad understanding of performance and efficiency ractors, power tillers and their types and uses. Electric motors: types, construction and performance comparison.<br>To know Tillage: objectives, method of ploughing. Primary tillage implements: construction and function of indigenous ploughs, improved indigenous ploughs, mould board ploughs, disc and rotary ploughs. Secondary tillage implements: construction and function of tillers, harrows, levelers, ridgers and bund formers. Sowing and transplanting equipment: seed drills, potato planters, seedling transplanter. Grafting, pruning and training tools and equipment.<br>To know the Inter-culture equipment: sweep. Junior hoe, weeders, long handle weeders.<br>To know the Crop harvesting<br>equipments: potato diggers, fruit pluckers, tapioca puller and hoists |
| 4 | SOA/HC 123 T | Diseases of Fruits, Plantation and Medicinal and Aromatic Crops | 2+1 | To study about Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases of fruits crops *viz* mango, banana, grape, citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate, ber, apple, pear and peach, plum, almond, walnut, strawberry.<br>To learn the Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases of plantation crops *viz* areca nut, coconut, oil palm, coffee, tea, cocoa, cashew, rubber, betel vine.<br>To understand about the Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases of medicinal and aromatic crops *viz* senna, neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint, opium, Solanum khasianum and Tephrosia.<br>To study about the important post-harvest diseases of fruit, plantation and medicinal and aromatic crops and their management. |
| 5 | SOA/HC 124 T | Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops | 2+1 | General–economic classification of insects; ecology and insect-pest management with reference to fruit, plantation, medicinal and aromatic crops pest surveillance. Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting tropical, sub- tropical and temperate fruits, plantation, medicinal and aromatic crops like coconut, areca nut, oil palm, cashew, cacao, tea, coffee, cinchona, rubber, betel vine pest surveillance. Distribution, host range, bio-ecology, |

| S.No. | Course code | Course name | Credits | Course outcomes |
|---|---|---|---|---|
| | | | | injury, integrated management of important insect pests affecting crops senna, neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint, opium, Solanum khasianum and Tephrosia.<br>Storage insects – distribution, host range, bioecology injury, integrated management of important insect pests attacking stored fruits, plantation, medicinal and aromatic crops and their processed products.<br>Toxicology – insecticide residue problems in fruit, plantation, medicinal and aromatic crops and their tolerance limits. |
| 6 | SOA/HSEC103T | Communication Skills and Entrepreneurship Development | 1+1 | To understand about Entrepreneurship development and how to assess overall business environment in the Indian economy<br>To have a brief overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs<br>To learn about Globalisation and the emerging business / entrepreneurial environment<br>To learn the Concepts of entrepreneurship, entrepreneurial and managerial characteristics<br>To understand the management of an enterprise, motivation and entrepreneurship development, importance of planning, monitoring, evaluation and follow up, managing competition, entrepreneurship development programs<br>To understand the SWOT analysis, generation, incubation and commercialization of ideas and innovations Government schemes and incentives for promotion of entrepreneurship<br>Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to horticulture sector. Venture capital. Contract farming and joint ventures<br>To learn about the Characteristics of Indian horticultural processing and export industry.<br>To understand the Social Responsibility of a Business<br>To study about Communication<br>Skills: Structural and functional grammar<br>To gain knowledge on meaning and process of communication, verbal and non-verbal communication listening and note taking, writing skills, oral presentation skills<br>To maintain field diary and lab record<br>To understand indexing, footnote and bibliographic procedures<br>To have a brief knowledge of reading and comprehension of general and technical articles |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | To understand precise writing, summarizing, abstracting, individual and group presentations, impromptu presentation, public speaking,<br>Group discussion<br>To study about organizing seminars and conferences |
| 7 | SOA/HE 115 T | Soil and Plant Analysis | 1+1 | Methods of soil and plant sampling and processing for analysis.<br>Quantification of minerals and their abundance. Soil structure and aggregate analysis.<br>Theories and concepts of soil moisture estimation – gravimetric, tensiometric, gypsum block, neutron probe and pressure methods.<br>Characterization of hydraulic mobility – diffusion and mass flow.<br>Renewal of gases in soil and their abundance. Methods of estimation of oxygen diffusion rate and redox potential.<br>Soil fertility evaluation methods. Use of radio tracer techniques in soil fertility evaluation.<br>Soil micro-organisms and their importance. Saline, alkali, acid, waterlogged and sandy soils, their appraisal and management.<br>Chemical and mineral composition of horticultural crops.<br>Leaf analysis standards, index tissue, interpretation of leaf analysis values.<br>Principles of working of pH meter, electrical conductivity meter, spectrophotometer, flame photometer and atomic absorption spectrophotometer. Quality of irrigation water. |
| 8 | SOA/HE 116 T: | Mushroom Culture | 1+1 | Introduction to mushroom fungi (Pleurotus, Volvariella and Agaricus) nutritional and medicinal value, edible and poisonous types mushroom Genetic improvement of mushroom Preparation of culture, mother spawn<br>production, multiplication of spawn, cultivation techniques, harvesting, packing and storage Problems in cultivation diseases, pest and nematodes – weed moulds and their management strategies.<br>Economics of cultivation Post harvest technologies. |
| 9 | SOA/HE117T | Fundamentals of Food Technology | 1+1 | To study about Food and its function, physico-chemical properties of foods and food preparation techniques<br>To understand nutrition and its relation to good health.<br>To learn about the Characteristics of well and malnourished<br>population<br>To gain knowledge on Energy and its definition, determination of energy requirements, food energy and total energy<br>To study about Carbohydrates, their classification, properties, functions, sources and |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | their requirements<br>To learn about the digestion, absorption and utilization of Proteins, their classification, properties, functions, sources, requirements, digestion, absorption, essential and non-essential amino acids, quality of proteins<br>To learn PER/NPR/NPU, supplementary value of proteins and their deficiency<br>To understand about Lipids – classification, properties, functions, sources, requirements, digestion, absorption and utilization, saturated and unsaturated fatty acids, deficiency, rancidity, refining of fats<br>To learn about Mineral nutrition, macro and micro-minerals (Ca, Fe and P), functions, utilization, requirements, sources, effects of deficiency<br>To have a knowledge on Vitamins, functions, sources, effects of deficiency, requirements of water soluble and fat-soluble vitamins<br>To understand about Balanced diet, recommended dietary allowances for various age groups, assessment of nutritional status of the population |
| **VI Semester** | | | | |
| 1 | SOA/HC 125 T | Potato and Tuber Crops | 1+1 | To study of origin, area, production economic importance and export potential of potato and tropical, subtropical and temperate tuber crops;<br>To learn description of varieties and hybrids. Climate and soil requirements, season; seed rate; preparation of field; planting practices; spacing; water nutrient and weed management; nutrient deficiencies.<br>To study about the use of chemicals and growth regulators; cropping systems.<br>To learn about harvesting practices, yield; seed production, economics of cultivation. Post-harvest handling and storage, field and seed standards, marketing of the following Crops: potato, tapioca, sweet potato, arrow root, cassava, colocasia, xanthosoma, amorphophallus, dioscorea, jerusalem artichoke, horse radish and other under-exploited tuber crops. |
| 2 | SOA/HC 126 T | Breeding of Vegetable Tuber and Spice Crops | 2+1 | To know the centres of origin, plant bio-diversity and its conservation. Modes of reproduction, pollination systems and genetics of important vegetable, tuber and spice crops.<br>To understand Selfincompatibility and male sterility, its classification and application in crop improvement.<br>To study the principles of breeding self-pollinated crops, pure line selection, mass selection, heterosis breeding, hybridization, pedigree method, mass pedigree method, |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | bulk method, modified bulk method, single seed descent method and back cross method.<br>To study the Polyploidy breeding.<br>To study the Mutation breeding. Principles of breeding cross pollinated crops, mass selection, recurrent selection, heterosis breeding, synthetics and composits.<br>To know the Application of biotechnology in crop improvement of crops: Solanaceous vegetables, cole crops, cucurbits, bulb crops, root crops, leafy vegetables, okra, leguminous crops. |
| 3 | SOA/HC 127T | Post-Harvest Management of Horticultural Crops | 2+1 | To study the importance of post-harvest technology in horticultural crops<br>To learn about maturity indices, harvesting, handling, grading of fruits, vegetables, cut flowers, plantation crops, medicinal and aromatic plants<br>To understand the Pre-harvest factors affecting quality and the factors responsible for deterioration of horticultural produce<br>To learn the physiological and bio-chemical changes, hardening and delaying ripening process<br>To gain knowledge on Post-harvest treatments of horticultural crops. Quality parameters and specification<br>To write about the Structure of fruits, vegetables and cut flowers related to physiological changes after harvest<br>To learn the various Methods of storage for local market and export.<br>To gain knowledge on Pre-harvest treatment and precooling, pre-storage treatments<br>Different systems of storage, packaging methods and types of packages, recent advances in packaging<br>To learn the types of containers and cushioning materials, vacuum packaging, cold storage, poly shrink packaging, grape guard packing treatments<br>To learn about the different Modes of transport in various horticultural crops |
| 4 | SOA/HC 128 T | Seed Production of Vegetable, Tuber and Spice | 2+1 | To study about seed and its history of seed industry in India<br>To gain knowledge on Differences between grain and seed and mportance and scope of vegetable seed production in India<br>To learn about Principles of vegetable seed production.<br>To understand about Role of temperature, humidity and light in vegetable seed production<br>To study about Methods of seed production of cole crops, root vegetables, solanaceous vegetables, cucurbits, leafy vegetables, bulb crops, leguminous vegetables and exotic vegetables. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | | To gain knowledge on Seed germination and purity analysis, Field and seed standards<br>To learn about Seed legislation, Seed drying and extraction. |
| 5 | SOA/HC 129 T | Insect Pests of Vegetable, Ornamental and Spice Crops | 2+1 | To be learn about the economic importance of insects in vegetable, ornamental and spice crops<br>To be introduce the ecology and pest management with reference to these crops. Pest surveillance in important vegetable, ornamental and spice crops.<br>To study the distribution, host range, bio-ecology, injury, integrated management of important insect-pests affecting vegetable, ornamental and spice crops.<br>To introduce the basic concepts of Important storage insect-pests of vegetable, ornamental and spice crops, their host range, bioecology, injury and integrated management.<br>To learn the insect –pests of processed vegetables and ornamental crops, their host range, bio-ecology, injury and integrated management.<br>To Solve the insecticidal residue problems in vegetables and ornamental crops, tolerance limits etc. |
| 6 | SOA/HSEC 104 T | Commercial Floriculture | 1+1 | To study about the scope and importance of commercial floriculture in India,<br>To learn various production techniques of ornamental plants like rose, marigold, chrysanthemum, orchid, carnation, gladiolus, jasmine, dahlia, tuberose, bird of paradise, china aster and gerbera for domestic and export market. To get the knowledge of growing of flowers under protected environments such as glass house, plastic house etc.,<br>To get acquaint with the knowledge of post harvest technology of cut flowers in respect of commercial flower crops, dehydration technique for drying of flowers,<br>To learn production techniques for bulbous plants |
| 7 | SOA/HE 118T | Breeding and Seed Production of Ornamental Plants | 1+1 | History and objectives of ornamental plant breeding discussed.<br>Crop improvement methods like introduction, selection, hybridization, mutation and biotechnological technique explained.<br>Breeding strategies for disease resistance described.<br>Development of promising cultivars of important ornamentals.<br>Role of heterosis and its exploitation explained.<br>Hybrid seed production using male sterility elaborated.<br>Production of open pollinated varieties and concept of seed certification described. |
| 8 | SOA/HE 119 T | Diseases of Vegetable, Ornamental and | 1+1 | To study about Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases of the following vegetable crops: tomato, brinjal, chilli, bhindi, cabbage, cauliflower, radish, knol-khol, pea, beans, potato, beet root and onion. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | Spice Crops | | To study about Etiology, symptoms, mode of spread epidemiology and integrated management of diseases of the following spice crops: fenugreek, ginger, garlic, turmeric, pepper, cumin, cardamom, nutmeg, coriander, clove, cinnamon.<br>To learn about Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases of the following ornamental crops jasmine, rose, crossandra, tuberose, geranium.<br>To understand Important post-harvest diseases of vegetables and ornamental crops and their management. |
| 9 | SOA/HE 120 T | Protected Horticulture | 1+1 | Importance and scope, basic principles of protected cultivation.<br>Green and polyhouse designs. green house environment control, heating and cooling system- use of portable tunnel.<br>Green house cultivation of important horticultural crops- rose, carnation, gerbera, orchids, anthurium,tomato, bell, pepper and strawberry.<br>Insect pest and disease management under protected cultivation. |
| **VII Semester** | | | | |
| 1 | SOA/HC 130 T | Processing of Horticultural Crops | 2+1 | To gain knowledge on Importance and scope of fruit and vegetable preservation industry in India<br>To study about food pipe line, losses in post-harvest operations, unit operations in food processing.<br>To learn about Principles and guidelines for the location of processing units<br>To understand about Principles and methods of preservation by heat pasteurization, canning, bottling<br>To gain knowledge on Methods of preparation of Jam, jelly and marmalade<br>Pickling, chutneys juices, tomato products, mushrooms products squashes, syrups, cordials and fermented beverages.<br>To learn about Processing of plantation crops, products, spoilage in processed foods, quality control of processed products<br>To study about Govt. policy on import and export of processed fruits. Food laws. |
| 2 | SOA/HC 131 T | Protected Cultivation of Horticultural Crops<br>1.Project Preparation<br>1.Project | 3+3 | Visit to commercial polyhouses, Project preparation and planning. Specialised lectures by commercial export house. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | Preparation | | |
| 3 | SOA/HC 132 T | Nursery Production and Management | 3+3 | Project preparation |
| 4 | SOA/HSEC 105 T | Horti- Business Management | 2+0 | To study farm management definition, nature, characteristics and scope.<br>To learn Farm management principles and decision making, production function, technical relationships, cost concepts, curves and functions – factors, product, relationship – factors relationship, product relationship, optimum conditions, principles of opportunity cost-equi-marginal returns and comparative advantages,<br>To understand time value of money, economic of scale, returns to scale,<br>To learn cost of cultivation and production, break even analysis, decision making under risk and uncertainty.<br>To understand Farming systems and types. Planning – meaning, steps and methods of planning, types of plan, characteristics of effective plans.<br>To learn Organizations – forms of business organizations, organizational principles, division of labour.<br>To understand Unity of command, scalar pattern, job design, span of control responsibility, power authority and accountability.<br>To learn direction – guiding, leading, motivating, supervising, coordination meaning, types and methods of controlling – evaluation, control systems and devices.<br>To understand budgeting as a tool for planning and control. Record keeping as a tool of control.<br>To understand Functional areas of management – operations management – physical facilities, implementing the plan, scheduling the work, controlling production in terms of quantity and quality.<br>To understand the materials management – types of inventories, inventory costs, managing the inventories, economic order quantity (EOQ).<br>To understand Personnel management – recruitment, selection and training, job specialization.<br>To learn Marketing management – definitions, planning the marketing programmes, marketing mix and four P' s. Financial management – financial statements and rations, capital budgeting.<br>To prepare project and its evaluation measures. |

| S.No. | Course code | Course name | Credits | Course outcomes |
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| **VIII Semester** | | | | |
| 1 | SOA/HC 132T | Horticultural Work Experience 1. | 6 | The students will spend one full semester working with State Department of Horticulture; Horticulture based industries, commercial horticulture farms, plantation industries etc. to gain **first hand information and hands-on-training** in the chosen area of interest<br>Project Preparation |
| 2 | SOA/HC 133P | Horticultural Work Experience II. | 6 | Field Work |
| 3 | SOA/HC 134 T | Horticultural Work Experience III. | 6 | Report writing, Presentation and Discussion |

# B.Sc. Medical Lab Technology

**Programme Summary**

Duration: 3 years + 6 months internship

**Eligibility**

10+2 with at least 45% marks in PCB/PCM or DMLT from any state technical board or university.

**Program outcomes:**

- Perform routine clinical laboratory procedures within acceptable quality control parameters in Hematology, Biochemistry, Microbiology, Serology, Histopathology, Blood banking, Urinalysis and other body fluids under the supervision of Pathologist or technologist.
- Learn proper care and safe use of basic laboratory glassware and equipment including the cell counter, microscope, centrifuge, incubator, colorimeter, analytical balance, microtome .
- Learn the role of the phlebotomist and display professional behavior in dealing with patients, their family, and public.
- Appropriately and successfully collection of blood specimens through venipuncture and capillary puncture .
- Learn to maintain quality control system in pathology lab in order to improve efficiency and accuracy of various investigations.
- Learn about the morphological variations of various blood cells and discuss their clinical importance.
- Learn normal ranges/values for all common hematology /Biochemical parameters and their clinical significance.
- Discuss theory and principles of haemostasis including synthesis of various extrinsic and intrinsic coagulation factors of plasma and platelet function.
- Learn primary aspects of the blood bank including ABO-Rh and other common blood group systems, their antigens and antibodies compliment, agglutination, antiglobulin, antibody identification, transfusion therapy, transfusion reactions, and hemolytic disease of the newborn.
- Learn immunology and serology basics such as antigens, antibodies, compliments, Antigen-antibody reaction, immunity , inflammation, vaccines etc.
- Learn various gram positive and gram negative bacteria, viruses and fungi causing diseases to human beings.
- Learn various microbial diseases and their methods of lab investigations. Discuss principles, rationale use and interpretation of culture media to isolate and identify different microbes found in blood, urine or other body fluid cultures. Demonstrate proficient use of routine media.
- Explain and perform all phases of the Gram stain including smear preparation, stain, evaluation, reading, reporting and interpretation.

- Describe principle, rationale uses and interpretation of routine biochemical tests for organism identification. Demonstrate proficient use of routine biochemical tests.
- Identify basic guidelines for safe use of chemicals including proper labeling, protective measures, location and use of SDS, and disposal of hazardous chemicals.
- Discuss the principle and limitations of each dipstick test for chemical analysis of the urine.
- Operate and maintain laboratory equipment, utilizing appropriate quality control and safety procedures.
- Study routine tissue processing and freeze drying technique in histopathology. Study of various staining techniques to identify premalignant or malignant condition.
- Study of various aspiration techniques such as FNAC.

**Course outcomes:**

| S.No | Course code | Course name | Maximum Marks (theory+Lab) | Course Outcomes |
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| **1** | **BMLT 101** | **Human Anatomy & Physiology** | 70+30 | The prime concern of this subject is to learn the terminology of the subject and basic knowledge of cells & tissues and to understand anatomy of human body.<br>After successful completion of this course students are expected to be able to understanding the structure and function of organs and organ systems in normal human body. Discuss the physiology of the nervous, musculoskeletal, respiratory, and cardiovascular systems from a regional perspective.<br><br>Analyze and describe the structures and functions of human anatomy and physiology from a regional perspective for the following regions: head and neck, thoracic, abdomino-pelvic, and upper and lower extremities.<br><br>Compare and contrast the major bones and their processes as they relate to each region of the body.<br>Describe briefly the basic components and functions of the digestive, urinary, and endocrine systems. |
| **2** | **BMLT 102** | **Basic Pathology** | 70+30 | The syllabus of pathology aims at preparing the students in basic understanding of diseases and their pathogenesis.<br>Introduction to Hematology. Laboratory organization and safety measures.<br><br>Study of Formation, composition and functions of blood. Learn to anticoagulants, mode of action of anticoagulants and their merits and demerits. Demonstrate Collection, preservation, transport and handling and disposal of blood samples.<br><br>To learn Basic hematology and estimation of haematocrit values, physiological variations, normal and absolute values, and quality assurance in hematology.<br><br>Pathology of inflammation in response to microbial invasion. Pathology of specific chronic infective disorders : Tuberculosis, Leprosy, Syphilis, and rheumatological disorders.<br><br>Introduction to blood banking technology. |
| **3** | **BMLT 103** | **Clinical Biochemistry** | 70+30 | This syllabus has been formulated to impart basics knowledge of biochemistry, apparatus, units, equipment, and volumetric analysis in the Clinical Biochemistry.<br><br>Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of bio-molecules<br>To Learn introduction to Clinical Biochemistry and role of medical microbiologist, ethics, responsibility, safety measure and hazards in clinical biochemistry lab and first aid in laboratory accidents.<br><br>Unit of measurements and calibration of volumetric apparatus. Colorimetry, spectrophotometry, flame- |

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| | | | | photometry, analytical balance etc. (principles, instrumentations and applications).<br><br>To the study the Structure, Classification and function of carbohydrates, lipid, proteins, nucleic acid and enzymes in biological system.<br><br>Qualitative tests for glycosuria, pentosuria, galactosuria, proteinuria, microalbuminuria and Bence Jones Proteinuria and their clinical significance. Qualitative test of urine for uric acid, urea and creatinine. Quantitative estimation of 24 hrs urine for albumin and 17-ketosteroids and their clinical significance. |
| **4** | **BMLT104** | **Preventive Medicine and Health Care** | 70+30 | After completion of this syllabus students are able to tailor their education plan to meet their own interests in Preventive Medicine. This may include content areas such as occupational medicine, addiction medicine, or infectious diseases.<br>To learn water, air and noise pollution: Removal of water hardness, purification of water and standards of water quality.<br>To understand the concepts of Hygiene and sanitation: Sanitation barriers, excreta disposal and disposal of hospital waste. Incineration and disinfection.<br>To study Infections and control: Microbial pathogenicity, source and spread of infections in community.<br><br>To demonstrate the prophylactic immunization: rationale of immunization, immune response and duration of immunity. Various national immunization programs and vaccine schedules.<br>To understand the concepts of Reproductive, Family planning and Child Health Care Programs.<br><br>To learn bacteriology examination of water, milk, food and air.<br><br>To study of health care by balance diet and yoga. Normal constituents of diet, various diet programs, balance diet. Health Planning and Management. |
| **5** | **BMLT 105** | **Microbial Biology** | 70+30 | After successful completion of this course students are expected to be able to: Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.<br><br>Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea.<br><br>This subject gives a general insight into the history, basics of microbiology and imparts knowledge about equipment used in microbiology. Discovery of micro-organisms. Contribution of Robert Koch, Antony Van Leeuwen Hock, Louis Pasteur, Bordot, Paul Ehrlich, Alexander Fleming, Matchnikoff, Needham, Tyndall Jensson, Joseph Lister, Kal Land Steiner etc.<br><br>To study of Morphology and Nature of bacteria, Classification and identification of bacteria, Sterilization and disinfection. |

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| | | | | To learn Cultural Medias, Cultivation of bacteria and Growth and Nutrition of Bacteria.<br><br>To demonstrate the lab. Organization, Management, Recording of Results and Quality Control in Medical Microbiology. |
| **6** | **BMLT 106** | **Technical Methods in Microbial Biology** | 70+30 | This course make the students to know handling of instruments and sterilization techniques<br>To demonstrate the safety measures in Microbiology Laboratory : Occurrence of lab infections, route of infections in laboratory, safety measures precaution in use of pathogens in teaching. Lab organization, management, recording of results and quality control in Medical Microbiology Lab.<br>To study of various types of Microbiological Instruments such as microscope, pH meter Autoclave, Incubator, Hot air oven, Laminar Air Flow, Colony Counter, Muffle Furnace, Refrigerator, Inoculator, Mac-intos Field-jar etc.<br><br>To learn Instruments used in immunology : Electrophoresis, Immunodiffusion, starplate, chromatography, ELISA reader, automatic washer and RIA equipments etc.<br><br>To understand the concepts of Preparation of stains used in microbiology lab.<br>To learn care and management of experimental animals.<br>To learn Culture and Drug Sensitivity tests. |
| **7** | **Practical Paper I** | **Laboratory course -I** | 70+30 | To impart practical knowledge based on theory papers BMLT 101 / BMLT 102. |
| **8** | **Practical Paper II** | **Laboratory course - II** | 70+30 | To impart practical knowledge based on theory papers BMLT 103 / BMLT 104. |
| **9** | **Practical Paper III** | **Laboratory course - III** | 70+30 | To impart practical knowledge based on theory papers BMLT 105 / BMLT 106. |
| **2nd year** | | | | |
| **1** | **BMLT 201** | **Clinical Biochemistry – I** [Separative and Instrumental Techniques] | 70+30 | The syllabus has been formulated to impart basics knowledge of biochemistry, apparatus, units, equipment, and volumetric analysis in the Clinical Biochemistry.<br><br>To learn thin layer Chromatography, gas liquid Chromatography, Colorimetry, flame photometry, Atomic absorption spectroscopy etc<br><br>To learn the Paper and gel electrophoresis for hemoglobin, urinary proteins, serum, CSF & LDH.<br><br>To understand the concepts of Immunochemical, Immunoprecipitation, Immunofixation and radial immunodiffusion tests, ELISA,RIA, Polymerase chain reaction (PCR), Osmometry, Semi autoanalyzer.<br><br>Students will use current biochemical and molecular techniques to plan and carry out experiments. They will generate and test hypotheses, analyze data using statistical methods where appropriate, and appreciate the limitations of conclusions drawn from experimental data. |

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| **2** | **BMLT 202** | **Clinical Biochemistry – II** [Metabolic and Blood Chemistries] | 70+30 | This syllabus has been formulated to impart basics knowledge of Carbohydrate metabolism, lipid metabolism, protein metabolism.<br><br>To learn the Principle, assay procedures and clinical significance of Glucose, Proteins, A/G, urea, BUN, uric acid, creatinin cholesterol, Bilirubin (Direct and Indirect).<br><br>To learn about the electrolytes, Quantitative estimation of sodium, potassium, calcium, chloride, lithium, phosphorus, magnesium and their clinical significance.<br><br>To the study of Acid base balance test, Xylose Absorption test and insulin tolerance test, Urea and creatinin clearance tests, Renal function tests, Glycosylated Hb & Liver function tests.<br><br>Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of bio-molecules, metabolic pathways, and the regulation of biological and biochemical processes. |
| **3** | **BMLT 203** | **Medical Microbiology - I** [Bacterial Pathogens & Associated Diseases] | 70+30 | After successful completion of this course students are expected to be able to:<br><br>Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.<br><br>Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea.<br><br>Understand the normal microflora of human body, Skin, Respiratory System, Gastrointestinal and Genitourinary tracts. Source of infection, mode of spread and portals of entry.<br><br>Understand the pathogenecity, mode of infection, incubation period and toxigenecity of *Staphylococcus, Streptococcus,Pneumococcus, Neisseria, Bordetella, Haemophilus, Salmonella, Shigella, Proteus, Pseudomonas, Loefflerella, Vibrio, Escherichia coli Clostridia,Corynbacteria, Erysipelothrix, Listeria, Mycobacteria, Brucella, Yersenia, Pasteurella & Francisella.*<br>To learn host Parasite interaction in bacterial infections. Pathogenic properties of bacteria (colonization of surfaces, invasion of tissue, production of exo and indo toxins). Anti bacterial defense of the host.<br><br>Understand the concepts of Physiology and Biochemistry of Bacteria : Protein, Carbohydrate, lipids and nucleic acid as antigens. |
| **4** | **BMLT 204** | **Medical Microbiology-II** [Technical Methods in Medical | 70+30 | After successful completion of this course students are expected to be able to: Know various Culture media and their applications and also understand various physical and chemical means of sterilization<br><br>Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and |

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| | | Microbiology] | | algae<br><br>Learn the role of laboratory in the diagnosis and control of infections. Management and quality control of medical microbiology laboratory.<br><br>Learn the specimen collection from patients, clinics and hospitals and Specimen collection for epidemiological investigations.<br><br>Learn the Morphology, Staining, Cultural Character of Bacteria. Selective cultural medias, indentification by special tests, biochemical reactions and sero-typing, pathogenesis of Gram's postivie cocci ( Cluster forming, chain forming and diplo cocci), Neisseria, Bordetella , Haemophilus, Corynebacterium, Mycobacterium, Atypical Mycobacterium, Anthrax bacillus, Brucella, Yersenia, Pasteurella etc.<br><br>To understand the concepts of Microbial drugs sensitivity test's and its clinical interpretation. |
| **5** | **BMLT 205** | **Pathology & Allied Subjects-I (Hematology)** | 70+30 | After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.<br><br>To learn Coagulation and its mechanism of coagulation, coagulation regulation, hypercoaguable states, different types of bleeding disorders, role of platelets in haemostasis.<br><br>To the study of various types of anaemia and its etiological causes, lab diagnosis and changes in the blood morphology due to anaemia.<br><br>Discussion on Leucocytosis, neutoropenia and pancytopania their causes.<br><br>To the study of hematological malignancies: such as Leukemia, Lymphomas, Multiple myeloma and their identification and clinical features and lab investigation.<br><br>To learn the Various Parasites in blood and their clinical significance. Lab investigations and methods of identification. |
| **6** | **BMLT 206** | **Pathology and Allied Subjects – II** (Histotechnology) | 70+30 | At the end of the course the students should be able to :<br><br>• Diagnose routine and complex clinical problems on the basis of Histopathology (Surgical Pathology) and Cytopathology specimens, Blood and Bone Marrow examination and various tests under the domain of Laboratory Medicine (Clinical Pathology, Clinical Biochemistry/Chemical Pathology) as well as Blood Banking (Transfusion Medicine).<br><br>• Interpret clinical and laboratory data with reasonable accuracy.To demonstrate the Reception recording |

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| | | | | and labeling of histology specimens in the histopathology lab.<br><br>To learn the various histological techniques used in histopathology lab and during the tissue processing such as Fixation, fixatives, emebedding, Decalcification, Microtomy , mounting etc<br><br>To learn the dye chemistry theory, routine staining procedures H and E, Special staining procedures for connective tissues carbohydrates, amyloids and pigments.<br>Meta chromasia and meta chromatic dyes.<br><br>To understand the concepts of Museum techniques and faults & remedies during the section cutting. |
| **7** | **Practical Paper I** | **Laboratory course -I** | 70+30 | To impart practical knowledge based on theory papers BMLT 201 / BMLT 202 |
| **8** | **Practical Paper II** | **Laboratory course - II** | 70+30 | To impart practical knowledge based on theory papers BMLT 203 / BMLT 204. |
| **9** | **Practical Paper III** | **Laboratory course - III** | 70+30 | To impart practical knowledge based on theory papers BMLT 205 / BMLT 206. |
| **3rd Year** | | | | |
| **1** | **BMLT 301** | **Clinical Biochemistry – 1** (Biostatics, Automation & Endocrinology) | 70+30 | This syllabus has been formulated to impart basics knowledge bio-static for clinical quality control. Standard deviation, standard error, coefficient of variation, normal distribution, t-test and chi-square test.<br><br>Students will use current biochemical and molecular techniques to plan and carry out experiments. They will generate and test hypotheses, analyze data using statistical methods where appropriate, and appreciate the limitations of conclusions drawn from experimental data<br><br>To understand the concepts of establishment and maintenance of quality control for laboratory tests based upon medical usefulness.<br><br>To discuss normal ranges of various bio-metabolites and their confidence limits.<br><br>To demonstrate the Automation, Handling of automatic analyzers, management of hospital laboratory.<br><br>To learn the Toxicology with screening & drug interference with laboratory findings and Endocrinology &their clinical interpretation. |

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| **2** | **BMLT 302** | **Clinical Biochemistry – II** (Diagnostic Enzymology) | 70+30 | After completion of this course student is able to understand the basics about enzymes, enzyme activity determination, units for expressing enzyme activity, factors affecting enzyme activity and mechanisms responsible for abnormal enzyme levels.<br><br>To learn isoenzymes such as serum CPK, CK – MB, LDH, SGOT (AST), SGPT (ALT), Cholinesterase HBDH, amylase, alpha amylase, lipase, aldolase and myoglobin.<br><br>Learn about Serum leucine, amino peptidase, alkaline, acid phosphatases,fructosamine test in semen.<br><br>Learn the Gastric analysis, pentagastrin test, histamine & caffeine stimulation tests, thyroid function test and infertility profile. |
| **3** | **BMLT 303** | **Medical microbiology – i** (Pathogenic Viruses and Misc. Microbes) | 70+30 | After successful completion of this course students are expected to be able to learn the microbes such asActinomyces,Nocardia,Donovania,Treponema,Chalamydia, Rekettsiae, Mycoplasma and its pathogenesis and lab diagnosis.<br><br>To understand the concepts of Pox – viruse, HerpesVirus, Adenoviruses, Orthomixoviruses, Paramyxovirus, Miscellaneous Viruses , Picorna Viruses.<br><br>To learn the Hepatitis, Encephalitis Yellow fever, Dengue fever, Rabies.<br><br>To demonstrate the cell culture and observation of effect of viruses on cell and its technique, procedure and interpretation of results. |
| **4** | **BMLT 304** | **MEDICAL MICROBIOLOGY – II** [Technical Methods in Medical Microbiology] | 70+30 | This syllabus has been formulated to impart basics knowledge about preparation of container and swabs for collections of specimens for microbial examinations, transport of specimen, and documentation of specimen in laboratory. Flowchart of lab diagnostic procedures.<br><br>At last students will use current biochemical and molecular techniques to plan and carry out experiments.<br><br>To demonstrate the preservation of Micro-organisms, periodic subculture method, cold storage, freezing, deep freezing, lypholization methods. Total and viable counts of bacteria.<br><br>Learn the concepts of Immunology, sero-diagonsis and advanced diagnostic techniques of torch profile, myco, dot, IgG, IgA, IgM and IgE testing, Australia Ag (HBs) etc.<br><br>To learn test for bacterial sensitivity to antimicrobial agents and their interpretation. |

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| **5** | **BMLT 305** | **PATHOLOGY & ALLIED SUBJECTS-I** (*IMMUNOPATHOLOGY & TRANSFUSION MEDICINE*) | 70+30 | After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills.<br><br>To learn the immunity, antigens, antibodies & Immunoglobulin, cells and organs of the immune system, Humoral & Cellular immune response.<br><br>To understand the concepts of detection of various allergic agents and immunopathology of allergy.<br><br>To learn Pathogenesis and Lab diagnosis of Rheumatological diseases, inflammation megaloblastic anaemias, iron deficiency, haemolytic anemia and leukemia<br><br>To understand the concepts of detection of Cancer immunology & Tumor markers.<br><br>To demonstrate the tissue typing for kidney transplant & bone marrow transplant.<br><br>To demonstrate the Laboratory investigations in coagulation disorder, bleeding disorder and Platelet functions tests.<br><br>To learn the cytogenetics in hematology and Radioisotopes and their applications. |
| 6 | **BMLT 306** | **PATHOLOGY AND ALLIED SUBJECTS - II** (HISTOPATHOLOGY & CYTOLOGY) | 70+30 | To study the types of tissue seen in histopathology i.e Connective tissue, Epithelial tissue, Glandular tissue, Benign/ Malignant tumor tissue, Bone tissue etc.<br>To study the handling of fresh histological specimen.<br>To learn about freeze drying and cryostat.<br>To study about identification and demonstration of lipids.<br>To learn about various staining techniques for identification and demonstration of microorganisms in tissue.<br>To study about various enzymes demonstration in tissues such as phosphatases, dehydrogenase, oxidase and peroxidases, etc.<br>To learn about Electron Microscopy and Ultra microtomy.<br>To learn about Aspiration Cytology like FNAC for premalignant lesions.<br>To learn about hormonal assessment by cytological techniques. |
| **7** | **Practical Paper I** | **Laboratory course -I** | 70+30 | To impart practical knowledge based on theory papers BMLT 301 / BMLT 302. |
| **8** | **Practical Paper II** | **Laboratory course - II** | 70+30 | To impart practical knowledge based on theory papers BMLT 303 / BMLT 304. |
| **9** | **Practical Paper III** | **Laboratory course - III** | 70+30 | To impart practical knowledge based on theory papers BMLT 305 / BMLT 306. |

## B.Sc. Medical Microbiology

**Programme Summary**

Duration: 3 years

**Eligibility**

10+2 in Science stream

**Programme outcome:**

- To provide comprehensive knowledge of structure, function and pathological changes of the organs and the clinical correlation of diseases and its pathology .
- To study the Clinical Biochemistry and role of medical microbiologist, ethics, responsibility, safety measure and hazards in clinical biochemistry lab. First aid in laboratory accidents. To understand fundamentals of biochemistry including carbohydrates, lipids, proteins nucleotides, enzymes.
- To provide knowledge of epidemiology, surveillance and control of infections (community & hospital).
- To understand the basic microbial structure and function and characteristics of prokaryotes and eukaryotes .
- To introduce various culture media and their applications.
- To skill the microbial techniques for isolation of pure cultures of bacteria and fungi and to understand concept of
- sterilization.
- Introduction to principle and application of fundamental laboratory equipments related to microbiological techniques.
- To learn the basic principles of medical microbiology and infectious diseases including mechanism of disease transmission, principles of aseptic practices, and the role of normal micro flora.
- To teach laboratory diagnosis of infectious diseases ( cultural, biochemical and sero diagnosis).
- To acquire knowledge of Immune reactions and laboratory tests for detection of antigen and antibodies and its clinical significance.
- To analyze the biological data using bioinformatics tools.

**Course outcome:**

| S. No. | Course Code | Course name | Max marks | Course outcome |
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| | | **1st Year** | | |
| 1. | BMM-101 | Human Anatomy & Physiology | 70+30 | To learn the Organization of human body and integrated physiology.<br>To impart the knowledge of gross anatomy and histology of organs of respiratory system, digestive system, reproductive system and cardiovascular system.<br>To gain knowledge of anatomy and histology of musculo-skeletal system, classification and functions of bones and muscles.<br>To learn about the mechanism of hormone production, factors controlling it and their mechanism of action. |
| 2. | BMM-102 | Basic Pathology | 70 | To gain the knowledge of Collection, preservation, transport and handling and disposal of blood samples.<br>To understand the various pathological processes and their importance in human disease.<br>Build a basic understanding of Various routes of transport of Microbes to human body and methods of defense. Invasive techniques for diagnosis of acute and chronic microbial infections.<br>Evaluate the ways in which pathology contributes to the understanding of patient presentation in a clinical setting.<br>Introduction to blood banking technology. |
| 3. | BMM-103 | Clinical Biochemistry | 70 | Basic awareness of clinical biochemistry laboratory in respect to equipments and glassware.<br>To study the preparation of standard solutions, buffer solutions and pH determination.<br>To learn the biochemical composition of body fluids and their physiological variations.<br>To gain the knowledge of qualitative tests for glycosuria, pentosuria, galactosuria, proteinuria, microalbuminuria and Bence Jones Proteinuria and their clinical significance.<br>Acquire the knowledge of Classification, nomenclature, structure, general properties and functions of Carbohydrates, Lipids, Proteins, Nucleic acid and Enzymes. |
| 4. | BMM-104 | Preventive Medicine & Health Care | 70 | Role of laboratory in community and hospital infections.<br>Management of patients in infectious diseases hospital (IDH).<br>Awareness of Various national immunization programs and vaccine schedules.<br>Reproductive, Family Planning & Child Health Care Programs.<br>To learn the Bacteriology of water, milk, food and air.<br>Awareness of normal constituents of diet, various diet programs, balance diet and factors responsible for etiology of various nutritional disorders.<br>Role of regular exercise & yoga in prevention and management of various diseases. |
| 5. | BMM-105 | Fundamentals of Medical Microbiology | 70 | To gain Knowledge of the historical background of Microbiology.<br>To understand the Role of medical microbiology in identification and management of various infectious diseases. To Acquire the knowledge of microbial cell structure, classification, growth and metabolism.<br>To appreciate the scope and relevance of medical microbiology. |

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| | | | | To understand the Collection, transport processing & storage of clinical samples for microbiological analysis.<br>To learn Introduction of bacteriology, virology, mycology and parasitology.<br>To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods).<br>To learn about Disinfectants, antiseptics, chemotherapeutic agents, future development of chemotherapy, antibiotics and effect of antibiotics on protein, nucleic acid and cytoplasmic membrane. |
| 6. | BMM-106 | Instrumentation Techniques in Medical Microbiology | 70 | To learn in detail about Principles and applications of Microscopy.<br>To be skilled on the basic instruments used in microbiology and immunology.<br>To learn about the basic staining techniques used in microbiology .<br>To gain knowledge and develop skills of Care and management of experimental animals This helps to understand the use of lab animals in medical field.<br>To document the results of Culture, isolation and identification of pathogens from urine, pus and sputum. |
| | | 03 Practicals (Course 1&2=1; 3&4=1; 5&6=1) | | To impart practical knowledge and hands on training based on courses BMM-101 and BMM-102<br>To impart practical knowledge and hands on training based on courses BMM-103 and BMM-104 To impart practical knowledge and hands on training based on courses BMM-105 and BMM-106 |
| | | **2nd Year** | | |
| 6. | BMM-201 | Bacterial Pathogens & Associated Diseases | 70 | To learn infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora.<br>To provide knowledge regarding mechanism of pathogenesis.<br>To learn in detail account of pathogenecity, mode of infection, incubation period and toxigenecity of various grams positive and gram negative bacteria.<br>To gain knowledge of antigenic properties of Protein, carbohydrate, lipids and nucleic acid . |
| 7. | BMM-202 | Systematic Bacteriology | 70 | To learn the management and quality control of medical microbiology laboratory.<br>To provide knowledge regarding Specimen collection from patients, clinics and hospitals for epidemiological investigations.<br>Training of medical microbiologist to handle epidemics.<br>To learn in detail account of morphology, staining, cultural character of bacteria.<br>To learn selective cultural media, identification by special tests, biochemical reactions and stereotyping of various gram-positive and gram-negative bacteria.<br>To learn the microbial drugs sensitivity test and its clinical interpretation. |
| 8. | BMM-203 | Misc. Microbes, Fungal Pathogens & Ass. Diseases | 70 | To understand the Principle and mode of action of antibiotics, antifungal and antiviral agents.<br>To study the detail accounts of description, pathogenecity, mode of infection, incubation period and toxiegenecity of Bacteroides, Streptobacilli, Donovania, Lactobacillus, Actinomyces,Treponema, Borrelia, Mycoplasma, Chalamydia and Rickettsiae.<br>To learn the superficial and deep fungal infections of eye, ear and skin. |

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| 9. | BMM-204 | Lab Diagnosis of Microbial | 70 | To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.<br>To learn in detail Itiopathogenesis, pathology, clinical features and lab diagnosis of Aspergillosis, Cryptococcosis, Candidiasis, Blastomycosis, ringworms and mycetoma. |
| 10. | BMM-205 | Human Parasitology | 70 | To learn the Introduction and Classification of different parasitic diseases.<br>To study the detail account of lab diagnostic procedures and special methods of demonstrations of human parasites in blood, stool, tissue and other body fluids. |
| 11. | BMM-206 | Applied Medical Microbiology | 70 | It provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of common infections and infestations.<br>To impart knowledge regarding portal regulation and transport of specimen.<br>To study the epidemiology markers of microorganisms (Serotyping and bacteriophages).<br>To understand the specific serological methods of diagnosis.<br>To learn the test of sensitivity to antimicrobial agents and their preparation. |
| | | 03 Practical (Course 1&2=1; 3&4=1; 5&6=1) | | To impart practical knowledge and hands on training based on courses BMM-201 and BMM-202<br>To impart practical knowledge and hands on training based on courses BMM-203 and BMM-204 To impart practical knowledge and hands on training based on courses BMM-205 and BMM-206 |
| | | **3rd Year** | | |
| 12. | BMM-301 | Pathogenic Viruses and Associated Diseases | 70 | To learn the essential concepts of virology which include the structure of different viruses, properties, replication and classification of virus.<br>To understand the different methods of viral cultivation such as tissue culture, embryonated egg and animal inoculations.<br>To gain knowledge about the clinical features, etiology, pathogenesis and methods of laboratory diagnosis of viral infections and apply that knowledge in the treatment, prevention and control of communicable diseases caused by viruses. |
| 13. | BMM-302 | Applied immunology & Serodiagnosis | 70 | To gain the knowledge of immune reactions and laboratory tests for detection of antigen and antibodies.<br>To study the Clinical significance of tumor markers and hepatitis markers.<br>To learn the Pathogenesis and clinical feature of Autoimmune disorders markers.<br>To be trained in Industrial production of antibiotics and vaccines.<br>To deliver knowledge of Widal, ASO, CRP, Rose Waller, Rubella-Agglutination, cold agglutination, VDRL, TPHA and STS. |
| 14. | BMM-303 | Advanced Diagnostic Technology | 70 | Ability to develop and perform a range of diagnostic techniques relevant to the field of laboratory medicines.<br>To study the classification, morphological groups and applications of bacteriophages in medical microbiology.<br>To gain knowledge of principles, technology and applications of DNA replication, translation and transduction in diagnosis.<br>To learn the various immunological techniques such as IgM to HB core antigen ,IgG to Hepatitis C |

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| | | | | virus, IgG to Hepatitis A virus, Cystecercosis IgG, Chalamydia IgM, IgG, IgA, IgM combined rapid test and dengue IgM in diagnosis of diseases. |
| 15. | BMM-304 | Automation & Computerization in Medical Micro. | 70 | To Acquire the knowledge of computer Hardware central Processing Unit (CPU), input drives, storage and output devices, binary decimal, octal and hexadecimal systems, BCD, EBCDIC and ASCII coding systems.<br>To learn the Computer Application and their use in Medical Microbiology.<br>To understand the Basic guidelines for medical transcription.<br>To study the automation in Medical Microbiology Laboratory. |
| 16. | BMM-305 | Molecular Biology & Clinical Lab. | 70 | To gain the knowledge of blood glucose, liver function, blood urea and cardiac profile tests.<br>To learn the organization, operation, administration, quality assurance and safety measures in Blood Banking.<br>To understand the definition, classification, pathogenesis and diagnostic procedures of anemia and leukemia.<br>To impart the knowledge of histopathology and histochemistry.<br>To understand the Theories of Blood Coagulation & Diagnostic procedures for Coagulation disorders. |
| | | 03 Practicals (Course 1&2=1; 3&4=1; 5=1) | | To impart practical knowledge and hands on training based on courses BMM-301 and BMM-302<br>To impart practical knowledge and hands on training based on courses BMM-303 and BMM-304 To impart practical knowledge and hands on training based on courses BMM-305 and BMM-306 |

## Bachelor in Physiotherapy (B.P.T.)

**Programme Summary**

Duration: 4 years + 6 months internship

**Eligibility**

10+2 from the CBSE/ICSE/ State boards or intermediate or pre university examination (2 years) or any other examination recognized and equivalent to any of the above, with at least 50% marks in aggregate or in PCB.

**Program outcomes:**

- The aim of the course is to provide comprehensive, individually focused training that prepares the students for providing a quality Physiotherapy care to the patients.
- Demonstrate sufficient understanding of knowledge in Physiotherapy.
- Able to integrate theoretical knowledge with clinical assessment.
- Develop the ability to collect history, perform relevant clinical assessment and frame appropriate electrotherapeutic and exercise therapy management for the patients.
- Demonstrate clinical decision making ability and provide appropriate patient care.
- Develop effective communication with patients, family, colleagues and students.
- Promote health education and improved quality of life through the practice of the profession.
- To carry out research and publications towards upliftment of the field of Physiotherapy.
- Actively engage in lifelong learning activities.
- Work effectively in various inter professional collaborative settings like hospitals, Rehabilitation Centers, Special Schools, Educational Institutions, Health and Fitness Centers, Geriatric Centers, Ergonomic Consultant in Corporate Sectors, Private Consultation, Home Care Services, Industrial Sectors, Sports Management, Fitness Consultant.

**Course outcomes:**

| S.No. | Course code | Course name | Maximum marks | Course outcomes |
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| **1st Year** | | | | |
| 1 | BP-101 | Human Anatomy | 70+30 | To understand about the structure of human body.<br>To learn about the scope of anatomy in the field of Physiotherapy.<br>Classification of bones, joints, and muscles<br>Structure of skin, layers of skin.<br>To learn about the axis and planes of body on which the movement occur.<br>To understand about the structure of pectoral region, arm, forearm, hand, gluteal region, thigh, leg, ankle and foot.<br>To know about the shoulder joint, elbow joint, wrist joint, hip joint, knee joint, ankle joint, sacro iliac joint, Temporomandibular joint and their movements.<br>To learn about the para vertebral muscles, intercostals muscles, Brain, parts of brain, Spinal cord, Cerebrospinal fluid, IIIrd and IVth ventricles, Cerebellum, muscles of face and neck.<br>To understand about thorax, heart, lungs, esophagus, abdomen and abdominal organs like Diaphragm, stomach, kidney, liver, uterus, structure of male and female reproductive organs<br>To understand about the blood supply and nerve supply of all the bones, muscles and joints and other soft tissue structures.<br>To understand the course of blood vessels, veins and nerves in the human body.<br>To understand about the clinical aspects regarding the joints, bones and all soft tissue structures. |
| 2 | BP-102 | Human Physiology | 70+30 | To understand fundamentals of cell structure and function.<br>To acquire knowledge about physiology of muscle function, sliding filament theory, types of contractions, muscle fatigue.<br>To know about the composition of blood, formation and functions of RBC, WBC, Plasma, and blood groups.<br>To learn about the blood coagulation time, bleeding time, clotting time, blood pressure, cardiac cycle and cardiac output, examination of ECG<br>To attain knowledge about respiration, mechanism of respiration, muscles performing respiration, volume and capacities of lung, and gaseous exchange.<br>To know about the digestive system, gastric juices performing digestion, enzymatic activity of juices, absorption and metabolism of food.<br>To understand about the structure and function of endocrine glands, hormones and their effect on every system of the human body.<br>To know about the function of kidney, urine formation, normal and abnormal urine output, constituents of urine, micturition, and kidney function tests.<br>To attain knowledge about the neuron, reflex arc, normal and abnormal reflexes, sympathetic and parasympathetic nervous system, sensory and motor areas. |
| 3 | BP-103 | General, clinical and Social | 70+30 | To acquire knowledge about the nature and fields of Psychology, scope of Psychology in Physiotherapy.<br>To obtain knowledge about behaviour and experience. |

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| | | Psychology | | To get information about motivation, types of motivation, learning theories, nature of emotion and relationship with autonomic nervous system, Gestalt's theory of learning.<br>To know about memory, its types, and causes of forgetting.<br>To get information about Nature of attention, factors deterring attention; nature of perception, principles of perceptual grouping; illusions and Hallucinations.<br>Mental mechanisms and their role in health and disease.<br>Psychological reaction of patients to physical illness, reaction to loss, death, bereavement. Emotional needs and Psychological factors in relation to unconsciousness handicap.<br>To know about intelligence tests – their uses; how the test is standardized Intelligence Quotient (I.Q.) general intelligence and special intelligence.<br>To understand the concept of Personality, types, measurement of Personality with the help of various Questionnaire |
| 4 | BP-104 | Biochemistry | 70+30 | To understand the concepts of Biochemical organization of human cell.<br>Learn experimental evidences for proteins and physiotherapeutic significance of structural proteins. To know about the biochemical asspects of hemoglobin, connective tissue, muscle tissue and nervous tissue, protein, carbohydrate and lipid metabolism. |
| 5 | BP-105 | Basic principles of Physiotherapy | 70+30 | To study the definition, branches and scope of Physiotherapy in day today's life.<br>It includes general knowledge of electrotherapy modalities with reference to current and magnetism, conductors and non conductors, light, heat and cold, and exercises like active and passive exercises, resistive exercises.<br>It gives knowledge about wax therapy, pulleys, gym ball, fundamental positions, walking pattern. |
| 6 | | Laboratory course 1 | 70+30 | |
| 7 | | Laboratory course 2 | 70+30 | To learn about physiologic examinations like blood sampling, clotting time, bleeding time, platelet count, RBC and WBC count |
| **2nd Year** | | | | |
| 1 | BP201 | Exercise Therapy | 70+30 | To understand the principles and techniques of relaxation and its principles.<br>To learn the use of suspension for treatment. Use of various techniques like PNF, Hydrotherapy their principles for treating various conditions.<br>To learn evaluation methods – Principles – techniques of muscle testing, goniometry, limb girth and length, posture, chest expansion and hand function.<br>To learn various soft tissue manipulations.<br>Learning the normal gait pattern and correction of gait abnormalities.<br>To learn the various techniques of mobilization, 7.strengthening and stretching along with their principles.<br>To learn the basic concepts of various types of co-ordination exercises, breathing exercises ADL, hand function.<br>To learn the different types of traction, and its uses.<br>To learn the history of yoga and various types of asana along with the advance yoga therapy and its therapeutic utilities. |
| 2 | BP202 | Electrotherapy | 70+30 | Learning the basic of all low frequency current modalities like, TENS, muscle stimulator, di-dynamic and |

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| | | and Actinotherapy | | sinusoidal currents,their indications and contra indications.<br>To learn the nature, indications and contra indications of various medium frequency current modalities like IFT and Russian currents.<br>Learning the physiological and therapeutic effects of high frequency currents and their uses for various conditions, modalities are SWD and MWD.<br>Learning the use of various radiations for treatment purpose like, UVR, IRR and LASER.<br>To learn the therapeutic uses of Ultrasound, its physiological effects, indications and contra indications.<br>To learn about various thermotherapy techniques like, paraffin wax bath, contrast bath and moist heat therapy for treating various conditions.<br>To learn about various diagnostic techniques like biofeedback, SD curve, NCV and EMG to know about the condition of muscles and nerves and use the information to treat the conditions.<br>To learn the various advanced techniques of treatment like combination therapy, long wave, and treating some conditions using techniques of cryotherapy. |
| 3 | BP203 | Biomechanics and Kinesiology | 70+30 | Introduction to kinesiology, learning fundamental concepts of COG,LOG, planes, axis and starting positions.<br>To learn about body musculature, all joints, reflexes, muscle tone and all neuromuscular functions.<br>Fundamentals of anatomical levers, pulleys, and principles of motion.<br>Fundamental principles of force and work- Force and its magnitude, direction, point of application, components of muscular force, components of external force, graphic representation of force, true force and the resistance arms of the lever, the confused affects of two or more forces.<br>Principles of Stability, covering all the joints.<br>Application of Kinesiology to Locomotion, Biomechanics of all phases of gait cycle.<br>Evaluation of exercise for conditions like kyphosis, lordosis, scoliosis etc for corrective purposes. |
| 4 | BP204 | Pathology microbiology | 70+30 | Introduction to etiology and classification of diseases.<br>To learn various types of inflammations.<br>Introduction to wound and its healing.<br>Learning various degenerative and metabolic disorders of bone, tumors, and fractures.<br>To learn the pathology of CNS diseases and peripheral nerve diseases.<br>Diseases of respiratory, CVS, and musculoskeletal system.<br>Introduction and Historical background of microbiology<br>Discovery of micro organisms.<br>To learn the contribution of various scientists in the field of microbiology.<br>To learn the chemotherapy basics and vaccination.<br>To learn the microbial structure, function and culture media.<br>To learn about main pathogens and human body immunity, antigen antibody reaction.<br>Types of infections. |
| 5 | BP205 | Pharmacology | 70+30 | Learning definition of Pharmacology and its scope in Physiotherapy.<br>To learn Dosage forms & Modes of Drugs administration, drug absorption, metabolism and Biotransformation. |

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| | | | | Basic concepts of drug toxicity, allergy and drug resistance.<br>Learning pharmacodynamics, drug potency and drug antagonism.<br>To learn the pharmacology and physiotherapeutic role of following Pharmacodynamics agents.<br>General and local anesthetics, anxiolytics, anticonvulsants, sedatives, antihistaminic agents, anti inflammatory analgesic agents, neuro-muscular blockers and muscle relaxants.<br>Introduction to drug classification, effects and side effects of some drugs. |
| 6 | | Laboratory course 1 | 70+30 | To learn about various types of exercises, manipulations, mobilization, joint range by goniometry and learning various yoga asana. |
| 7 | | Laboratory course 2 | 70+30 | To learn the practical application of various modalities for different conditions , learning indications and contraindications, and to learn what are the precautions to be taken in an electro lab and how to work with patients and modalities. |
| 8 | | Laboratory course 3 | 70+30 | Evaluation and assessment of various joint motions posture and gait. To evaluate various soft tissues. |
| **3rd Year** | | | | |
| 1 | BP-301 | Clinical Orthopedics | 70+30 | Basic introduction to orthopedics, general idea about terminology, deformity, diseases of bones, joints and soft tissues<br>Clinical features, investigations and treatment of bone and joint infection<br>General diseases of bones and joints like RA, AS, gout, rickets etc<br>Regional diseases of ligaments , menisci and tendons<br>Types, features, complications and surgical management of fractures<br>Diseases of spine<br>Regional conditions like deformities of hand, foot etc, tennis elbow, VIC etc<br>Clinical features, assessment, types and treatment of leprosy, CP, PNI, polio and amputation |
| 2 | BP-302 | Clinical neurology and psychiatry | 70+30 | Review the anatomy and physiology of nervous system.<br>Clinical features and management of congenital disorders.<br>To study in detail the clinical features , investigation and treatment of brain vascular diseases like stroke and head injury.<br>Features, assessment and treatment of spinal cord disorders like tumors, syringomyelia, etc.<br>To know about the demyelinating and degenerative diseases and their treatment like GBS, Parkinon's etc<br>To study about the cranial nerves and their diseases.<br>To know about the nerve and muscle diseases and their management.<br>To understand some of the psychiatric disorders like MR, schizophrenia etc. |
| 3 | BP-303 | Clinical cardiothoracic conditions | 70+30 | To review the basic anatomy and physiology of heart and lungs.<br>To understand the basic principles of cardiothoracic assessment and investigations.<br>To study the thoracic cage deformities.<br>Common conditions of cardiovascular system like cardiac failure, CHD, IHD etc.<br>To know the common cardiac surgeries, types of incisions, pre and postoperative management<br>Common respiratory diseases like asthma, TB, etc.<br>Thoracic surgeries like thoracoplasty. |
| 4 | BP-304 | General | 70+30 | To understand the concepts of medicine and general medical conditions |

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| | | medicine , skin and pediatrics | | Learn clinical features, assessment and medical management of heart diseases, respiratory diseases, digestive system diseases, kidney and genitourinary system, blood diseases, skin and pediatric diseases |
| 5 | BP-305 | General surgery, obg, gyne, ent and plastic surgery | 70+30 | To study the clinical features, pathology and management of hemorrhages, about anesthesia and pain relief.<br>General and plastic surgery procedures and their management.<br>To understand the anatomy and physiology of ear, nose and throat and their diseases.<br>To know about some obs and gynecological disorders and their management. |
| 6 | BP-306 | Disability, prevention and rehabilitation | 70+30 | To understand the basic terminologies in rehabilitation<br>To know the ethics in hospital and work<br>To understand the interdepartmental relationships, with patients, family members and community<br>To know the basic philosophy of rehabilitation and its use in some conditions<br>To know the social and vocational problems and how to deal with them |
| 7 | | Lab course 1 | 70+30 | Demonstration and practice of general orthopedic examination.<br>Discussion of common orthopedic appliances and instrument. |
| 8 | | Labcourse 2 | 70+30 | Demonstration and practice of neurological examination.<br>Discussion about investigations in neurology like CT,MRI etc |
| **4th Year** | | | | |
| 1 | BP 401 | PT in Orthopedics | 70+30 | Detailed study on causes, types and management of fractures. With detailed study on assessment, investigations of fractures and dislocations of upper limb, lower limb and spine.<br>Detailed assessment, diagnostic test, management of Soft Tissue Injuries of upper & lower limb.<br>Degenerative and infective conditions of joints<br>Deformities of joints and spinal column with investigations & management.<br>Orthopedic Surgery of upper/lower limb with pre & post rehabilitation.<br>Aamputation causes & management .low back pain with causative factors, tests and its rehab. |
| 2 | BP 402 | PT in Neurology | 70+30 | Evaluation and application of advanced neuro rehab techniques for rehabilitation.<br>Evaluation, assessment of various neurological disorders.<br>Peripheral injuries and neuropathies rehabilitation.<br>Assessment and treatment of paralytic conditions. |
| 3 | BP403 | PT in Cardio thorasic conditions | 70+30 | Detailed evaluation and procedures for cardiac rehab including management in ICU.<br>Physiotherapy management of various cardiac disorders along with management of complications of peripheral vascular problems.<br>Pre and post operative Physiotherapy management of various heart surgeries. |
| 4 | BP404 | PT in Gen. Medical and surgical conditions | 70+30 | Physiotherapy management of systemic diseases, Oedema, Inflammation, Artherosclerosis, Aneurysms, Tumors, Rickets Diabetes, Panniculitis, obesity, Lymphedema, tetanus.<br>Physiotherapy management pre and post operative for all abdominal surgeries.<br>Physiotherapy management of various skin disorders.<br>Physiotherapy management of gynecological conditions including bladder management.<br>Physiotherapy management of ENT disorders.<br>Skin grafting and flaps, liposuction, mamoplasty, Rhinoplasty & it PT management.<br>Physiotherapy management of various pediatrics neurological disorders.<br>Physiotherapy management of various sports injuries. |

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| 5 | BP405 | Research methodology, biostatistics and computer | 70+30 | Measurement of Central Tendency (mean, median mode).<br>Theory of probability – Definition, Mathematical definition, Law of Probability (Addition and Multiplication theorems).<br>Condition Probability, expectations – expected values or the mathematical expectation, addition and multiplication theorem on expectation.<br>Test-t-test, f-test and $X^2$ – test<br>Correlation and regression line:-<br>Computer: Application, Soft and Hardware, Application in Medicine, Programming etc. Modern concept of Computer Technology in Rehabilitation of persons with disabilities. |
| 6 | | Lab course 1 | 70+30 | Practicals include detailed assessment of all joints with relevant diagnostic tests. |
| 7 | | Lab course 2 | 70+30 | Practicals include evaluation, assessment of various neurological disorders, application of various approaches. |
| 8 | | Lab course 3 | 70+30 | Practical's various techniques for management in ICU, respiratory care techniques of postural drainage. |
| 9 | | Lab course 4 | 70+30 | Practical assessment of various medical & surgical conditions, diagnostic tests techniques for rehabilitation. |

# B.Sc. Medical Lab Technology

**Programme Summary**

Duration: 3 years + 6 months internship

**Eligibility**

10+2 with at least 45% marks in PCB/PCM or DMLT from any state technical board or university.

**Program outcomes:**

- Perform routine clinical laboratory procedures within acceptable quality control parameters in Hematology, Biochemistry, Microbiology, Serology, Histopathology, Blood banking, Urinalysis and other body fluids under the supervision of Pathologist or technologist.
- Learn proper care and safe use of basic laboratory glassware and equipment including the cell counter, microscope, centrifuge, incubator, colorimeter, analytical balance, microtome .
- Learn the role of the phlebotomist and display professional behavior in dealing with patients, their family, and public.
- Appropriately and successfully collection of blood specimens through venipuncture and capillary puncture .
- Learn to maintain quality control system in pathology lab in order to improve efficiency and accuracy of various investigations.
- Learn about the morphological variations of various blood cells and discuss their clinical importance.
- Learn normal ranges/values for all common hematology /Biochemical parameters and their clinical significance.
- Discuss theory and principles of haemostasis including synthesis of various extrinsic and intrinsic coagulation factors of plasma and platelet function.
- Learn primary aspects of the blood bank including ABO-Rh and other common blood group systems, their antigens and antibodies compliment, agglutination, antiglobulin, antibody identification, transfusion therapy, transfusion reactions, and hemolytic disease of the newborn.
- Learn immunology and serology basics such as antigens, antibodies, compliments, Antigen-antibody reaction, immunity , inflammation, vaccines etc.
- Learn various gram positive and gram negative bacteria, viruses and fungi causing diseases to human beings.
- Learn various microbial diseases and their methods of lab investigations. Discuss principles, rationale use and interpretation of culture media to isolate and identify different microbes found in blood, urine or other body fluid cultures. Demonstrate proficient use of routine media.
- Explain and perform all phases of the Gram stain including smear preparation, stain, evaluation, reading, reporting and interpretation.

- Describe principle, rationale uses and interpretation of routine biochemical tests for organism identification. Demonstrate proficient use of routine biochemical tests.
- Identify basic guidelines for safe use of chemicals including proper labeling, protective measures, location and use of SDS, and disposal of hazardous chemicals.
- Discuss the principle and limitations of each dipstick test for chemical analysis of the urine.
- Operate and maintain laboratory equipment, utilizing appropriate quality control and safety procedures.
- Study routine tissue processing and freeze drying technique in histopathology. Study of various staining techniques to identify premalignant or malignant condition.
- Study of various aspiration techniques such as FNAC.

**Course outcomes:**

| S.No | Course code | Course name | Maximum Marks (theory+Lab) | Course Outcomes |
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| **1** | **BMLT 101** | **Human Anatomy & Physiology** | 70+30 | The prime concern of this subject is to learn the terminology of the subject and basic knowledge of cells & tissues and to understand anatomy of human body.<br>After successful completion of this course students are expected to be able to understanding the structure and function of organs and organ systems in normal human body. Discuss the physiology of the nervous, musculoskeletal, respiratory, and cardiovascular systems from a regional perspective.<br><br>Analyze and describe the structures and functions of human anatomy and physiology from a regional perspective for the following regions: head and neck, thoracic, abdomino-pelvic, and upper and lower extremities.<br><br>Compare and contrast the major bones and their processes as they relate to each region of the body.<br>Describe briefly the basic components and functions of the digestive, urinary, and endocrine systems. |
| **2** | **BMLT 102** | **Basic Pathology** | 70+30 | The syllabus of pathology aims at preparing the students in basic understanding of diseases and their pathogenesis.<br>Introduction to Hematology. Laboratory organization and safety measures.<br><br>Study of Formation, composition and functions of blood. Learn to anticoagulants, mode of action of anticoagulants and their merits and demerits. Demonstrate Collection, preservation, transport and handling and disposal of blood samples.<br><br>To learn Basic hematology and estimation of haematocrit values, physiological variations, normal and absolute values, and quality assurance in hematology.<br><br>Pathology of inflammation in response to microbial invasion. Pathology of specific chronic infective disorders : Tuberculosis, Leprosy, Syphilis, and rheumatological disorders.<br><br>Introduction to blood banking technology. |
| **3** | **BMLT 103** | **Clinical Biochemistry** | 70+30 | This syllabus has been formulated to impart basics knowledge of biochemistry, apparatus, units, equipment, and volumetric analysis in the Clinical Biochemistry.<br><br>Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of bio-molecules<br>To Learn introduction to Clinical Biochemistry and role of medical microbiologist, ethics, responsibility, safety measure and hazards in clinical biochemistry lab and first aid in laboratory accidents.<br><br>Unit of measurements and calibration of volumetric apparatus. Colorimetry, spectrophotometry, flame- |

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| | | | | photometry, analytical balance etc. (principles, instrumentations and applications).<br><br>To the study the Structure, Classification and function of carbohydrates, lipid, proteins, nucleic acid and enzymes in biological system.<br><br>Qualitative tests for glycosuria, pentosuria, galactosuria, proteinuria, microalbuminuria and Bence Jones Proteinuria and their clinical significance. Qualitative test of urine for uric acid, urea and creatinine. Quantitative estimation of 24 hrs urine for albumin and 17-ketosteroids and their clinical significance. |
| **4** | **BMLT104** | **Preventive Medicine and Health Care** | 70+30 | After completion of this syllabus students are able to tailor their education plan to meet their own interests in Preventive Medicine. This may include content areas such as occupational medicine, addiction medicine, or infectious diseases.<br>To learn water, air and noise pollution: Removal of water hardness, purification of water and standards of water quality.<br>To understand the concepts of Hygiene and sanitation: Sanitation barriers, excreta disposal and disposal of hospital waste. Incineration and disinfection.<br>To study Infections and control: Microbial pathogenicity, source and spread of infections in community.<br><br>To demonstrate the prophylactic immunization: rationale of immunization, immune response and duration of immunity. Various national immunization programs and vaccine schedules.<br>To understand the concepts of Reproductive, Family planning and Child Health Care Programs.<br><br>To learn bacteriology examination of water, milk, food and air.<br><br>To study of health care by balance diet and yoga. Normal constituents of diet, various diet programs, balance diet. Health Planning and Management. |
| **5** | **BMLT 105** | **Microbial Biology** | 70+30 | After successful completion of this course students are expected to be able to: Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.<br><br>Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea.<br><br>This subject gives a general insight into the history, basics of microbiology and imparts knowledge about equipment used in microbiology. Discovery of micro-organisms. Contribution of Robert Koch, Antony Van Leeuwen Hock, Louis Pasteur, Bordot, Paul Ehrlich, Alexander Fleming, Matchnikoff, Needham, Tyndall Jensson, Joseph Lister, Kal Land Steiner etc.<br><br>To study of Morphology and Nature of bacteria, Classification and identification of bacteria, Sterilization and disinfection. |

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| | | | | To learn Cultural Medias, Cultivation of bacteria and Growth and Nutrition of Bacteria.<br><br>To demonstrate the lab. Organization, Management, Recording of Results and Quality Control in Medical Microbiology. |
| **6** | **BMLT 106** | **Technical Methods in Microbial Biology** | 70+30 | This course make the students to know handling of instruments and sterilization techniques<br>To demonstrate the safety measures in Microbiology Laboratory : Occurrence of lab infections, route of infections in laboratory, safety measures precaution in use of pathogens in teaching. Lab organization, management, recording of results and quality control in Medical Microbiology Lab.<br>To study of various types of Microbiological Instruments such as microscope, pH meter Autoclave, Incubator, Hot air oven, Laminar Air Flow, Colony Counter, Muffle Furnace, Refrigerator, Inoculator, Mac-intos Field-jar etc.<br><br>To learn Instruments used in immunology : Electrophoresis, Immunodiffusion, starplate, chromatography, ELISA reader, automatic washer and RIA equipments etc.<br><br>To understand the concepts of Preparation of stains used in microbiology lab.<br>To learn care and management of experimental animals.<br>To learn Culture and Drug Sensitivity tests. |
| **7** | **Practical Paper I** | **Laboratory course -I** | 70+30 | To impart practical knowledge based on theory papers BMLT 101 / BMLT 102. |
| **8** | **Practical Paper II** | **Laboratory course - II** | 70+30 | To impart practical knowledge based on theory papers BMLT 103 / BMLT 104. |
| **9** | **Practical Paper III** | **Laboratory course - III** | 70+30 | To impart practical knowledge based on theory papers BMLT 105 / BMLT 106. |
| **2nd year** | | | | |
| **1** | **BMLT 201** | **Clinical Biochemistry – I** [Separative and Instrumental Techniques] | 70+30 | The syllabus has been formulated to impart basics knowledge of biochemistry, apparatus, units, equipment, and volumetric analysis in the Clinical Biochemistry.<br><br>To learn thin layer Chromatography, gas liquid Chromatography, Colorimetry, flame photometry, Atomic absorption spectroscopy etc<br><br>To learn the Paper and gel electrophoresis for hemoglobin, urinary proteins, serum, CSF & LDH.<br><br>To understand the concepts of Immunochemical, Immunoprecipitation, Immunofixation and radial immunodiffusion tests, ELISA,RIA, Polymerase chain reaction (PCR), Osmometry, Semi autoanalyzer.<br><br>Students will use current biochemical and molecular techniques to plan and carry out experiments. They will generate and test hypotheses, analyze data using statistical methods where appropriate, and appreciate the limitations of conclusions drawn from experimental data. |

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| **2** | **BMLT 202** | **Clinical Biochemistry – II** [Metabolic and Blood Chemistries] | 70+30 | This syllabus has been formulated to impart basics knowledge of Carbohydrate metabolism, lipid metabolism, protein metabolism.<br><br>To learn the Principle, assay procedures and clinical significance of Glucose, Proteins, A/G, urea, BUN, uric acid, creatinin cholesterol, Bilirubin (Direct and Indirect).<br><br>To learn about the electrolytes, Quantitative estimation of sodium, potassium, calcium, chloride, lithium, phosphorus, magnesium and their clinical significance.<br><br>To the study of Acid base balance test, Xylose Absorption test and insulin tolerance test, Urea and creatinin clearance tests, Renal function tests, Glycosylated Hb & Liver function tests.<br><br>Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of bio-molecules, metabolic pathways, and the regulation of biological and biochemical processes. |
| **3** | **BMLT 203** | **Medical Microbiology - I** [Bacterial Pathogens & Associated Diseases] | 70+30 | After successful completion of this course students are expected to be able to:<br><br>Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.<br><br>Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea.<br><br>Understand the normal microflora of human body, Skin, Respiratory System, Gastrointestinal and Genitourinary tracts. Source of infection, mode of spread and portals of entry.<br><br>Understand the pathogenecity, mode of infection, incubation period and toxigenecity of *Staphylococcus, Streptococcus,Pneumococcus, Neisseria, Bordetella, Haemophilus, Salmonella, Shigella, Proteus, Pseudomonas, Loefflerella, Vibrio, Escherichia coli Clostridia,Corynbacteria, Erysipelothrix, Listeria, Mycobacteria, Brucella, Yersenia, Pasteurella & Francisella.*<br>To learn host Parasite interaction in bacterial infections. Pathogenic properties of bacteria (colonization of surfaces, invasion of tissue, production of exo and indo toxins). Anti bacterial defense of the host.<br><br>Understand the concepts of Physiology and Biochemistry of Bacteria : Protein, Carbohydrate, lipids and nucleic acid as antigens. |
| **4** | **BMLT 204** | **Medical Microbiology-II** [Technical Methods in Medical | 70+30 | After successful completion of this course students are expected to be able to: Know various Culture media and their applications and also understand various physical and chemical means of sterilization<br><br>Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and |

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| | | Microbiology] | | algae<br><br>Learn the role of laboratory in the diagnosis and control of infections. Management and quality control of medical microbiology laboratory.<br><br>Learn the specimen collection from patients, clinics and hospitals and Specimen collection for epidemiological investigations.<br><br>Learn the Morphology, Staining, Cultural Character of Bacteria. Selective cultural medias, indentification by special tests, biochemical reactions and sero-typing, pathogenesis of Gram's postivie cocci ( Cluster forming, chain forming and diplo cocci), Neisseria, Bordetella , Haemophilus, Corynebacterium, Mycobacterium, Atypical Mycobacterium, Anthrax bacillus, Brucella, Yersenia, Pasteurella etc.<br><br>To understand the concepts of Microbial drugs sensitivity test's and its clinical interpretation. |
| **5** | **BMLT 205** | **Pathology & Allied Subjects-I (Hematology)** | 70+30 | After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.<br><br>To learn Coagulation and its mechanism of coagulation, coagulation regulation, hypercoaguable states, different types of bleeding disorders, role of platelets in haemostasis.<br><br>To the study of various types of anaemia and its etiological causes, lab diagnosis and changes in the blood morphology due to anaemia.<br><br>Discussion on Leucocytosis, neutoropenia and pancytopania their causes.<br><br>To the study of hematological malignancies: such as Leukemia, Lymphomas, Multiple myeloma and their identification and clinical features and lab investigation.<br><br>To learn the Various Parasites in blood and their clinical significance. Lab investigations and methods of identification. |
| **6** | **BMLT 206** | **Pathology and Allied Subjects – II** (Histotechnology) | 70+30 | At the end of the course the students should be able to :<br><br>• Diagnose routine and complex clinical problems on the basis of Histopathology (Surgical Pathology) and Cytopathology specimens, Blood and Bone Marrow examination and various tests under the domain of Laboratory Medicine (Clinical Pathology, Clinical Biochemistry/Chemical Pathology) as well as Blood Banking (Transfusion Medicine).<br><br>• Interpret clinical and laboratory data with reasonable accuracy.To demonstrate the Reception recording |

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| | | | | and labeling of histology specimens in the histopathology lab.<br><br>To learn the various histological techniques used in histopathology lab and during the tissue processing such as Fixation, fixatives, emebedding, Decalcification, Microtomy , mounting etc<br><br>To learn the dye chemistry theory, routine staining procedures H and E, Special staining procedures for connective tissues carbohydrates, amyloids and pigments.<br>Meta chromasia and meta chromatic dyes.<br><br>To understand the concepts of Museum techniques and faults & remedies during the section cutting. |
| **7** | **Practical Paper I** | **Laboratory course -I** | 70+30 | To impart practical knowledge based on theory papers BMLT 201 / BMLT 202 |
| **8** | **Practical Paper II** | **Laboratory course - II** | 70+30 | To impart practical knowledge based on theory papers BMLT 203 / BMLT 204. |
| **9** | **Practical Paper III** | **Laboratory course - III** | 70+30 | To impart practical knowledge based on theory papers BMLT 205 / BMLT 206. |
| **3rd Year** | | | | |
| **1** | **BMLT 301** | **Clinical Biochemistry – 1** (Biostatics, Automation & Endocrinology) | 70+30 | This syllabus has been formulated to impart basics knowledge bio-static for clinical quality control. Standard deviation, standard error, coefficient of variation, normal distribution, t-test and chi-square test.<br><br>Students will use current biochemical and molecular techniques to plan and carry out experiments. They will generate and test hypotheses, analyze data using statistical methods where appropriate, and appreciate the limitations of conclusions drawn from experimental data<br><br>To understand the concepts of establishment and maintenance of quality control for laboratory tests based upon medical usefulness.<br><br>To discuss normal ranges of various bio-metabolites and their confidence limits.<br><br>To demonstrate the Automation, Handling of automatic analyzers, management of hospital laboratory.<br><br>To learn the Toxicology with screening & drug interference with laboratory findings and Endocrinology &their clinical interpretation. |

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| **2** | **BMLT 302** | **Clinical Biochemistry – II** (Diagnostic Enzymology) | 70+30 | After completion of this course student is able to understand the basics about enzymes, enzyme activity determination, units for expressing enzyme activity, factors affecting enzyme activity and mechanisms responsible for abnormal enzyme levels.<br><br>To learn isoenzymes such as serum CPK, CK – MB, LDH, SGOT (AST), SGPT (ALT), Cholinesterase HBDH, amylase, alpha amylase, lipase, aldolase and myoglobin.<br><br>Learn about Serum leucine, amino peptidase, alkaline, acid phosphatases,fructosamine test in semen.<br><br>Learn the Gastric analysis, pentagastrin test, histamine & caffeine stimulation tests, thyroid function test and infertility profile. |
| **3** | **BMLT 303** | **Medical microbiology – i** (Pathogenic Viruses and Misc. Microbes) | 70+30 | After successful completion of this course students are expected to be able to learn the microbes such asActinomyces,Nocardia,Donovania,Treponema,Chalamydia, Rekettsiae, Mycoplasma and its pathogenesis and lab diagnosis.<br><br>To understand the concepts of Pox – viruse, HerpesVirus, Adenoviruses, Orthomixoviruses, Paramyxovirus, Miscellaneous Viruses , Picorna Viruses.<br><br>To learn the Hepatitis, Encephalitis Yellow fever, Dengue fever, Rabies.<br><br>To demonstrate the cell culture and observation of effect of viruses on cell and its technique, procedure and interpretation of results. |
| **4** | **BMLT 304** | **MEDICAL MICROBIOLOGY – II** [Technical Methods in Medical Microbiology] | 70+30 | This syllabus has been formulated to impart basics knowledge about preparation of container and swabs for collections of specimens for microbial examinations, transport of specimen, and documentation of specimen in laboratory. Flowchart of lab diagnostic procedures.<br><br>At last students will use current biochemical and molecular techniques to plan and carry out experiments.<br><br>To demonstrate the preservation of Micro-organisms, periodic subculture method, cold storage, freezing, deep freezing, lypholization methods. Total and viable counts of bacteria.<br><br>Learn the concepts of Immunology, sero-diagonsis and advanced diagnostic techniques of torch profile, myco, dot, IgG, IgA, IgM and IgE testing, Australia Ag (HBs) etc.<br><br>To learn test for bacterial sensitivity to antimicrobial agents and their interpretation. |

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| **5** | **BMLT 305** | **PATHOLOGY & ALLIED SUBJECTS-I** (*IMMUNOPATHOLOGY & TRANSFUSION MEDICINE*) | 70+30 | After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills.<br><br>To learn the immunity, antigens, antibodies & Immunoglobulin, cells and organs of the immune system, Humoral & Cellular immune response.<br><br>To understand the concepts of detection of various allergic agents and immunopathology of allergy.<br><br>To learn Pathogenesis and Lab diagnosis of Rheumatological diseases, inflammation megaloblastic anaemias, iron deficiency, haemolytic anemia and leukemia<br><br>To understand the concepts of detection of Cancer immunology & Tumor markers.<br><br>To demonstrate the tissue typing for kidney transplant & bone marrow transplant.<br><br>To demonstrate the Laboratory investigations in coagulation disorder, bleeding disorder and Platelet functions tests.<br><br>To learn the cytogenetics in hematology and Radioisotopes and their applications. |
| 6 | **BMLT 306** | **PATHOLOGY AND ALLIED SUBJECTS - II** (HISTOPATHOLOGY & CYTOLOGY) | 70+30 | To study the types of tissue seen in histopathology i.e Connective tissue, Epithelial tissue, Glandular tissue, Benign/ Malignant tumor tissue, Bone tissue etc.<br>To study the handling of fresh histological specimen.<br>To learn about freeze drying and cryostat.<br>To study about identification and demonstration of lipids.<br>To learn about various staining techniques for identification and demonstration of microorganisms in tissue.<br>To study about various enzymes demonstration in tissues such as phosphatases, dehydrogenase, oxidase and peroxidases, etc.<br>To learn about Electron Microscopy and Ultra microtomy.<br>To learn about Aspiration Cytology like FNAC for premalignant lesions.<br>To learn about hormonal assessment by cytological techniques. |
| **7** | **Practical Paper I** | **Laboratory course -I** | 70+30 | To impart practical knowledge based on theory papers BMLT 301 / BMLT 302. |
| **8** | **Practical Paper II** | **Laboratory course - II** | 70+30 | To impart practical knowledge based on theory papers BMLT 303 / BMLT 304. |
| **9** | **Practical Paper III** | **Laboratory course - III** | 70+30 | To impart practical knowledge based on theory papers BMLT 305 / BMLT 306. |

## B.Sc. Medical Microbiology

**Programme Summary**

Duration: 3 years

**Eligibility**

10+2 in Science stream

**Programme outcome:**

- To provide comprehensive knowledge of structure, function and pathological changes of the organs and the clinical correlation of diseases and its pathology .
- To study the Clinical Biochemistry and role of medical microbiologist, ethics, responsibility, safety measure and hazards in clinical biochemistry lab. First aid in laboratory accidents. To understand fundamentals of biochemistry including carbohydrates, lipids, proteins nucleotides, enzymes.
- To provide knowledge of epidemiology, surveillance and control of infections (community & hospital).
- To understand the basic microbial structure and function and characteristics of prokaryotes and eukaryotes .
- To introduce various culture media and their applications.
- To skill the microbial techniques for isolation of pure cultures of bacteria and fungi and to understand concept of
- sterilization.
- Introduction to principle and application of fundamental laboratory equipments related to microbiological techniques.
- To learn the basic principles of medical microbiology and infectious diseases including mechanism of disease transmission, principles of aseptic practices, and the role of normal micro flora.
- To teach laboratory diagnosis of infectious diseases ( cultural, biochemical and sero diagnosis).
- To acquire knowledge of Immune reactions and laboratory tests for detection of antigen and antibodies and its clinical significance.
- To analyze the biological data using bioinformatics tools.

**Course outcome:**

| S. No. | Course Code | Course name | Max marks | Course outcome |
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| | | **1st Year** | | |
| 1. | BMM-101 | Human Anatomy & Physiology | 70+30 | To learn the Organization of human body and integrated physiology.<br>To impart the knowledge of gross anatomy and histology of organs of respiratory system, digestive system, reproductive system and cardiovascular system.<br>To gain knowledge of anatomy and histology of musculo-skeletal system, classification and functions of bones and muscles.<br>To learn about the mechanism of hormone production, factors controlling it and their mechanism of action. |
| 2. | BMM-102 | Basic Pathology | 70 | To gain the knowledge of Collection, preservation, transport and handling and disposal of blood samples.<br>To understand the various pathological processes and their importance in human disease.<br>Build a basic understanding of Various routes of transport of Microbes to human body and methods of defense. Invasive techniques for diagnosis of acute and chronic microbial infections.<br>Evaluate the ways in which pathology contributes to the understanding of patient presentation in a clinical setting.<br>Introduction to blood banking technology. |
| 3. | BMM-103 | Clinical Biochemistry | 70 | Basic awareness of clinical biochemistry laboratory in respect to equipments and glassware.<br>To study the preparation of standard solutions, buffer solutions and pH determination.<br>To learn the biochemical composition of body fluids and their physiological variations.<br>To gain the knowledge of qualitative tests for glycosuria, pentosuria, galactosuria, proteinuria, microalbuminuria and Bence Jones Proteinuria and their clinical significance.<br>Acquire the knowledge of Classification, nomenclature, structure, general properties and functions of Carbohydrates, Lipids, Proteins, Nucleic acid and Enzymes. |
| 4. | BMM-104 | Preventive Medicine & Health Care | 70 | Role of laboratory in community and hospital infections.<br>Management of patients in infectious diseases hospital (IDH).<br>Awareness of Various national immunization programs and vaccine schedules.<br>Reproductive, Family Planning & Child Health Care Programs.<br>To learn the Bacteriology of water, milk, food and air.<br>Awareness of normal constituents of diet, various diet programs, balance diet and factors responsible for etiology of various nutritional disorders.<br>Role of regular exercise & yoga in prevention and management of various diseases. |
| 5. | BMM-105 | Fundamentals of Medical Microbiology | 70 | To gain Knowledge of the historical background of Microbiology.<br>To understand the Role of medical microbiology in identification and management of various infectious diseases. To Acquire the knowledge of microbial cell structure, classification, growth and metabolism.<br>To appreciate the scope and relevance of medical microbiology. |

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| | | | | To understand the Collection, transport processing & storage of clinical samples for microbiological analysis.<br>To learn Introduction of bacteriology, virology, mycology and parasitology.<br>To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods).<br>To learn about Disinfectants, antiseptics, chemotherapeutic agents, future development of chemotherapy, antibiotics and effect of antibiotics on protein, nucleic acid and cytoplasmic membrane. |
| 6. | BMM-106 | Instrumentation Techniques in Medical Microbiology | 70 | To learn in detail about Principles and applications of Microscopy.<br>To be skilled on the basic instruments used in microbiology and immunology.<br>To learn about the basic staining techniques used in microbiology .<br>To gain knowledge and develop skills of Care and management of experimental animals This helps to understand the use of lab animals in medical field.<br>To document the results of Culture, isolation and identification of pathogens from urine, pus and sputum. |
| | | 03 Practicals (Course 1&2=1; 3&4=1; 5&6=1) | | To impart practical knowledge and hands on training based on courses BMM-101 and BMM-102<br>To impart practical knowledge and hands on training based on courses BMM-103 and BMM-104 To impart practical knowledge and hands on training based on courses BMM-105 and BMM-106 |
| | | **2nd Year** | | |
| 6. | BMM-201 | Bacterial Pathogens & Associated Diseases | 70 | To learn infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora.<br>To provide knowledge regarding mechanism of pathogenesis.<br>To learn in detail account of pathogenecity, mode of infection, incubation period and toxigenecity of various grams positive and gram negative bacteria.<br>To gain knowledge of antigenic properties of Protein, carbohydrate, lipids and nucleic acid . |
| 7. | BMM-202 | Systematic Bacteriology | 70 | To learn the management and quality control of medical microbiology laboratory.<br>To provide knowledge regarding Specimen collection from patients, clinics and hospitals for epidemiological investigations.<br>Training of medical microbiologist to handle epidemics.<br>To learn in detail account of morphology, staining, cultural character of bacteria.<br>To learn selective cultural media, identification by special tests, biochemical reactions and stereotyping of various gram-positive and gram-negative bacteria.<br>To learn the microbial drugs sensitivity test and its clinical interpretation. |
| 8. | BMM-203 | Misc. Microbes, Fungal Pathogens & Ass. Diseases | 70 | To understand the Principle and mode of action of antibiotics, antifungal and antiviral agents.<br>To study the detail accounts of description, pathogenecity, mode of infection, incubation period and toxiegenecity of Bacteroides, Streptobacilli, Donovania, Lactobacillus, Actinomyces,Treponema, Borrelia, Mycoplasma, Chalamydia and Rickettsiae.<br>To learn the superficial and deep fungal infections of eye, ear and skin. |

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| 9. | BMM-204 | Lab Diagnosis of Microbial | 70 | To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.<br>To learn in detail Itiopathogenesis, pathology, clinical features and lab diagnosis of Aspergillosis, Cryptococcosis, Candidiasis, Blastomycosis, ringworms and mycetoma. |
| 10. | BMM-205 | Human Parasitology | 70 | To learn the Introduction and Classification of different parasitic diseases.<br>To study the detail account of lab diagnostic procedures and special methods of demonstrations of human parasites in blood, stool, tissue and other body fluids. |
| 11. | BMM-206 | Applied Medical Microbiology | 70 | It provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of common infections and infestations.<br>To impart knowledge regarding portal regulation and transport of specimen.<br>To study the epidemiology markers of microorganisms (Serotyping and bacteriophages).<br>To understand the specific serological methods of diagnosis.<br>To learn the test of sensitivity to antimicrobial agents and their preparation. |
| | | 03 Practical (Course 1&2=1; 3&4=1; 5&6=1) | | To impart practical knowledge and hands on training based on courses BMM-201 and BMM-202<br>To impart practical knowledge and hands on training based on courses BMM-203 and BMM-204 To impart practical knowledge and hands on training based on courses BMM-205 and BMM-206 |
| | | **3rd Year** | | |
| 12. | BMM-301 | Pathogenic Viruses and Associated Diseases | 70 | To learn the essential concepts of virology which include the structure of different viruses, properties, replication and classification of virus.<br>To understand the different methods of viral cultivation such as tissue culture, embryonated egg and animal inoculations.<br>To gain knowledge about the clinical features, etiology, pathogenesis and methods of laboratory diagnosis of viral infections and apply that knowledge in the treatment, prevention and control of communicable diseases caused by viruses. |
| 13. | BMM-302 | Applied immunology & Serodiagnosis | 70 | To gain the knowledge of immune reactions and laboratory tests for detection of antigen and antibodies.<br>To study the Clinical significance of tumor markers and hepatitis markers.<br>To learn the Pathogenesis and clinical feature of Autoimmune disorders markers.<br>To be trained in Industrial production of antibiotics and vaccines.<br>To deliver knowledge of Widal, ASO, CRP, Rose Waller, Rubella-Agglutination, cold agglutination, VDRL, TPHA and STS. |
| 14. | BMM-303 | Advanced Diagnostic Technology | 70 | Ability to develop and perform a range of diagnostic techniques relevant to the field of laboratory medicines.<br>To study the classification, morphological groups and applications of bacteriophages in medical microbiology.<br>To gain knowledge of principles, technology and applications of DNA replication, translation and transduction in diagnosis.<br>To learn the various immunological techniques such as IgM to HB core antigen ,IgG to Hepatitis C |

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| | | | | virus, IgG to Hepatitis A virus, Cystecercosis IgG, Chalamydia IgM, IgG, IgA, IgM combined rapid test and dengue IgM in diagnosis of diseases. |
| 15. | BMM-304 | Automation & Computerization in Medical Micro. | 70 | To Acquire the knowledge of computer Hardware central Processing Unit (CPU), input drives, storage and output devices, binary decimal, octal and hexadecimal systems, BCD, EBCDIC and ASCII coding systems.<br>To learn the Computer Application and their use in Medical Microbiology.<br>To understand the Basic guidelines for medical transcription.<br>To study the automation in Medical Microbiology Laboratory. |
| 16. | BMM-305 | Molecular Biology & Clinical Lab. | 70 | To gain the knowledge of blood glucose, liver function, blood urea and cardiac profile tests.<br>To learn the organization, operation, administration, quality assurance and safety measures in Blood Banking.<br>To understand the definition, classification, pathogenesis and diagnostic procedures of anemia and leukemia.<br>To impart the knowledge of histopathology and histochemistry.<br>To understand the Theories of Blood Coagulation & Diagnostic procedures for Coagulation disorders. |
| | | 03 Practicals (Course 1&2=1; 3&4=1; 5=1) | | To impart practical knowledge and hands on training based on courses BMM-301 and BMM-302<br>To impart practical knowledge and hands on training based on courses BMM-303 and BMM-304 To impart practical knowledge and hands on training based on courses BMM-305 and BMM-306 |

**Programme: B.Sc. Agriculture**
**Programme Code**: 102
**Course Summary**
Duration: 4 years
**Eligibility**
10+2 with minimum 45% marks in aggregate with PCB/ PCM/Agriculture.

**Programme Outcomes:**

- To get acquaintance with basics and principles of Elementary Statistics, Computer, English, Rural Sociology & Educational Psychology, Elementary Agriculture, Plant Biochemistry, Microbiology.
- To understand the fundamentals of Principles of Agronomy, Soil Science, e.g. Chemistry, soil fertility and nutrient management, Environmental Science, Horticulture.
- To learn the Control of Weed Management in different agricultural and horticultural crops.
- To understand the effect of meteorology on crops production and weather forecasting models which are helpful for prediction of Indian weather conditions?
- To gain the preliminary knowledge of genetic principles and thereby implementing for breeding of field crops.
- To learn the basic concepts of plant pathology for best growth of crops against the prevalent crop diseases of particular crop-zones.
- To develop the Principles and skills of vegetable production, fruit production, ornamental plants and medicinal & aromatics plants.
- To learn principles and techniques of field crops (Kharif & Rabi) production in diverse agroclimatic conditions of India.
- To learn the different methods of irrigating field crops, horticultural crops and managing water as precious element of crop production and increasing water use efficiency.
- To develop skills to conduct various field based activities related to agricultural aspects.
- It imparts the general ideas for the allied aspects of agriculture like Mushroom production, Beekeeping, Sericulture and Lac cultivation.
- To understand and gain the preliminary knowledge for plant biotechnology, establishment of tissue culture lab., generation of transgenic plants.
- To learn the basic concepts of agriculture co-operation, finance and business management related to agriculture products, it gives knowledge for availing different types of agriculture credits by Institutional and non-institutional sources.
- To learn the basic principles and techniques for control of insects, pests on cereals, sugar crops, fruit crops, vegetable crops, plantation crops, stored grain and house hold pests.
- It provides the in-depth knowledge for breeding and nutritional aspects for increasing the production of livestock products like milk, meat, egg, and its by-products and controlling livestock, poultry diseases.
- To learn the in-depth information of crop physiology for augmenting crop productivity. Physiology of growth and development, growth regulators which influence productivity of major cereals, pulses and oilseed crops.
- It provides general idea about the farm machinery which includes sources of farm power, tillage equipments, plant protection equipments, harvesting and threshing machineries, different types of tractors etc.

- To gain the knowledge of extension education different extension and rural development related programmes to understand extension training centres etc.
- To gain the knowledge and applying the principles and practices for different processing techniques for fruits and vegetables after their harvest and increasing their shelf life.
- To learn the principles and practices of farming systems and sustainable agriculture by using LEISA and HEISA. Using different conservation and management practices for soil & water resources.
- It provides basic knowledge for soil survey, soil taxonomy and the role of remote sensing in agriculture.
- The skills for seed production, seed storage, seed testing for purity, viability, moisture and germination related to field crops.
- After learning and imbibing the technical and articulated aspects of agriculture production students' undergoe Rural Agriculture Work Experience (RAWE) of any four components of their choice wherein students gets exposure in real field experience.

## Course outcomes of B.Sc. Agriculture programmes:

| Sr.No. | Course name | Credits | Course outcome |
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| | | | **1st Semester** |
| **1** | Elementary Statistics | 1+1 | To learn about Introduction to statistics, arithmetic mean, median, mode and partition values range, interquartile range, quartile deviation, mean deviation, variances, standard deviation, coefficient of variation, moments, skewness, Kurtosis and its measure.<br><br>To gain knowledge of Simple problems based on probability theory; Definition of correlation; Scatter diagram; Karl pearson's coefficient of correlation; Linear regression equations; introduction to test of significance, one sample and two sample test for mean. |
| **2** | Agriculture Meteorology | 1+1 | To understand the basic concepts of Earth atmosphere its composition, extent and structure; Atmospheric weather variables: Atmospheric pressure, its variation with height; Daily and seasonal variation of wind speed and direction. Cyclones and anticyclones, air masses and fronts.<br><br>To receive knowledge about Agriculture and weather relations: Modification of crop microclimate, use of weather data for irrigation scheduling, pesticides sprays, fertilizer application, climatic normals for crop production. Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave and thermal radiation, net radiation, albedo, atmospheric temperature – temperature inversion, daily and seasonal variation of temperature balance of earth;<br><br>To understand the concept of atmospheric humidity;sssss saturation, vapour process of condensation, formation of dew, fog, mist, frost, snow rain and hail: precipitation cloud formation and movement. |
| **3** | Computer Application | 1+1 | To learn Introduction to personal computer, peripherals, operating systems (Dos & Windows) and high-level language- Interaction with software pack-ages (Lotus, Foxpro, Statistical, packages) and its execution for applications in relation to solution of simultaneous equations, plotting of graph and diagrams. Simple agricultural statistics computations. Database file; creation and Query. |
| **4** | Str. & Spoken English | 1+1 | To understand the structural patterns of communicative grammar; modern usages; functional language disorder and common structural errors in part of speech-noun, pronoun, verb, adjective, adverb, preposition, conjunction; articles; word-formation and vocabulary building-affixes, prefixes, suffixes, synonyms, antonyms, substitutions and foreign words; prepositions; phrases idioms; gerunds; participles; infinitives; time and tense; modal verbs, conditional parities; synthesis; transformation controlled writing; paragraph writing;<br><br>To learn and make use of modern technical prose; listening and reading skills; comprehension; phonetic and scientific systems of spoken English – speech mechanism; symbols and sounds; stress and intonation. |
| **5** | Elementary Agriculture | 2+1 | To learn about the basic concepts of Indian agriculture its scope and resources; crop plants-their significance as source of food, feed, fuel and raw material for various industries. Crop seasons and classification of crops according to seasons.<br><br>To understand the basic concepts of Soils-their formation, classification, physical and chemical properties and |

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| | | | manures and fertilizers-essential plant nutrients, uptake of N,P & K by important crops, methods of manure & fertilizer application, composition of bulky organic manures, concentrated organic manures, green manures and various types of inorganic fertilizers,<br><br>To learn about Irrigation and drainage-importance of water, quality of irrigation water; sources methods and measurement of irrigation water, disadvantages of excessive soil moisture necessity and methods of drainage.<br><br>The students will be able to understand cultivation of important crops in the state such as wheat, rice cotton, sorghum, maize, groundnut, rape seed & mustard, chickpea, pigeonpea, tobacco, berseem, potato and sugarcane. Acquaintance with horticultural crops such as cabbage, cauliflower, onion, garlic, cucurbits, root crops, peas, tomato, brinjal, banana, apple, mango, litchi, citrus, guava.<br><br>The students will be able to understand the concepts of introductory economics-Factors of production, exchange, different types of markets; pricing, bank and credits, law of diminishing returns, elementary rural sociology, place of agriculture in five year plans, statistics relating to agricultural production.<br><br>The students will be able to explain of main breeds of animals such as cows, buffaloes, goats, sheep and poultry. Elementary physiology and anatomy of cow and buffaloes. Characteristics of milch cattles. Care of animal, poultry management, principles of nutrition, common medicines.<br><br>The students will be able to learn types of iron and steel used in agricultural implements; different types of plough, mechanical devices, their management and cost. Water lifting devices, tillage, different methods of ploughing. Power transmission through belts, pullies, gears, chaff, cutter, cane crusher. Necessity for drainage, damage to soil due to excess moisture, land development, prevention and formation of acidic and alkali soils. |
| **6** | Principles of Agronomy | 2+1 | The students will be able to understand the Principles of agronomy as a science and its scope.<br>The students will be able to quantify and explain the plant growth and development, environmental effects on growth, ideal plant type, tillage, seed quality, sowing, crop density and spatial arrangement, crop nutrition, organic manures and fertilizers, irrigation and drainage, The students will be able to understand weed management, distribution of crops, cropping systems, selection of crops and varieties for multiple cropping, crop yield contributing characters;<br><br>The students will be able to understand the organic farming-concept, practice and scope in India. Crop production in dry lands, salt affected, acidic, flood affected, waterlogged and eroded areas. |
| **7** | Rural Sociology & Educational Psychology | 2+1 | The students will be able to explain the concepts, methods, tools, characteristics of rural society and people; rural – urban continuum and differences, Rural social structure: interaction, processes, institutions groups.<br><br>The students will be able to understand rural social stratification: status, roles, class, castes etc. Panchyati Raj and Block Development Organizations as rural peoples participative agencies for planned development, Specific, programs for rural area upliftment/ employment: JRY, IAT, EAS, MWS, IRDP, GKY, DWCRA, TRYSEM, DPAP, DDP, NSAP, Land reforms, etc. Council for Advancement of peoples Action and Rural Technology |

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| | | | (CAPART). National Fund for Rural Development (NFRD), NGOs/Voluntary Sector.<br><br>The students will learn about Conceptual /Clarifications on educational psychology, Psychology of individual differences; MA & IQ; the gifted, Slow Learner and Socially disadvantaged child. Learning and motivation, mental hygiene and adjustment, guidance and counselling. |
| **2nd Semester** | | | |
| **8** | Fundamentals of Soil Science | 2+1 | The students will be able to understand soil as a natural body and medium for plant growth; soil compounds and soil plants relationship; soil forming rocks and minerals; weathering and processes of soil formation;<br><br>The students will be able to explain physical properties of soils – texture, structure, density and porosity, soil colour, consistence and plasticity, soil reaction pH and its measurement, soil acidity and alkalinity, buffering, effect of pH on nutrient availability, soil colloids – inorganic and organic; silicate clays: constitution and properties; humic substances nature and properties; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and influence on soil properties, transformation of organic and inorganic constituents of soil; biological nitrogen fixation; recycling of organic wastes in soils – Urban and industrial wastes.<br><br>Students will be able to describe Soil water retention, dynamics and availability; soil air composition and dynamics; source, amount and flow of heat in soils; soil temperature and plant growth; soil survey and classification, soils of India.<br><br>Students will be able to describe soil pollution – behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution. |
| **9** | Fundamentals of Horticulture | 2+1 | To learn about fundamentals of horticulture: its definition and branches; importance and scope; horticultural and botanical classification; climate, soil and distribution of fruit crops.<br>Students will be able to learn the techniques of propagation and nursery raising; principles of orchard establishment and management. flower bud differentiation and pollination; causes of unfruitfulness, pollinizers and pollinators.<br><br>Students will be able to explain environmental and soil factors affecting vegetable production, kitchen gardening; garden types and parts; care and maintenance of ornamental plants; lawn. making; knowledge of landscaping of rural and urban areas; exposure to important medicinal aromatic plants, spices and condiments, use of plant bio-regulators in horticulture, Post Harvest Technology-Principles and Practices. |
| **10** | Elementary Plant Biochemistry | 2+1 | Students will be able to understand recapitulation of basic chemistry and biology, water, pH and buffer, Cellular constituents: Structure and function – amino acids and protein, carbohydrates, lipids and biomembrances and nucleic acids;<br><br>Students will be able to explain enzymes-function, properties and mechanism, metabolism of cellular |

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| | | | constituents: Central Metabolic Pathways: Degradative path ways – glycolysis, hexose monophosphate pathway, degradation of starch, sucrose, other sugars, fatty acids and acylglycerols, proteins and amino acids; Biosynthetic pathways – photosynthesis, formation of sucrose and starch, Kreb's cycle and electron transport chain;<br><br>To learn Nitrogen and sulphur cycles; Nitrogen fixation, assimilation of ammonia; Synthesis of DNA, RNA and proteins; Secondary metabolites – structure, function and metabolism |
| **11** | Weed Management | 1+1 | Student will learn weed control, costs to society from weeds, classification of weeds. Ecology of weeds: Reproduction (seed production, seeds essmination, seeds germination, vegetative reproduction), geopraphics, distribution, factors influencing weed distribution, weed succession of uncultivated sites, competition between crops and weeds. Concepts of prevention, eradication and control.<br><br>Students will be able to manage weeds by controlling different methods: Physical, cultural, biological, chemical, integrated weed management.<br>Students will get exposure to herbicides: basic concepts, polar vs. Non-polar, Esters, Salts, acids, etc. surfactant chemistry. Factors influencing foliage active herbicides: reaching the target plant, spray retention, absorption into leaf, translocation, factors influencing soil applied herbicides: microbiological effect, soil absorption, photo-decomposition and volatilization, spray of herbicides. |
| **12** | Element of Genetics | 2+1 | Students will get exposure to the historical aspects of Pre mendelian and post-Mandelian concepts of heredity, mendelian principles of heredity, Probability and chi-square.<br><br>Students will learn concepts of *Cell* plant cell and animal cell, chromosome structure. Cell division mitosis, meiosis, variation in chromosomes polytene chromosome, Lampbrush chromosomes. Dominance relationship gene interaction. Multiple alleles, plelotropism and pseudoalleles. Sex determination and sex linkage, sex limited and sex influenced traits. Linkage, Crossing over mechanism, Chromosomes mapping, structural changes in chromosomes: Deletion and Duplication, Translocation and diversion, "Numerical changes in chromosomes, chemical basis of heredity".<br><br>Students will learn the gene concept made of replication of genetic material, transcription and translational mechanism of genetic material. Gene regulation and operon concept. Mutations: chemical and physical mutagens, mode of action of mutagens. Extranculear inheritance. Polygene and quantitative inheritance. Introduction to plant tissue culture. |
| **13** | Introductory Entomology | 2+1 | Students will be able to understand the scope of Entomology, brief history of entomology in India, insects as Arthropods and its relationship with phylum Annelida and other classes of Arthropoda, origin in insects major points related to dominance of insects in Animal Kingdom.<br><br>Students will learn external morphology and anatomy of grass hopper; body segmentation, integument, thorax and abdomen, antennae, legs and wings and their modifications, generalized mouth parts and their modifications, Alimentary, Circulatory, Excretory, Respiratory, Reproductive and nervous systems, major sensory organs like simple and compound eyes chemoreceptors, endocrine glands; basic embryology and post embryonic development, basic groups of present day insects with special emphasis to orders and families of agricultural |

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| | | | importance like Orthoptera; Tetigonidae, Gryllidae, Gryllotalpidae, Acrididae, Dictyoptera; Mantidae, Blattidae; Isoptera; Hemiptera; Pentatomidae; Coreidae; Cimicidae, Cicadellidae, Delphacidae, Lophophidae, Aleurodidae; Aphididae; Coccidae; Thysanoptera, Coleoptera. Carabidae, Meloidae, Coccinellidae, Bruchidae, Chrysomelidae, Curculionidae, Cerambycidae; Diptera; Culicidae Cephritidae, Agromyzidae, Muscidae; Lepidoptera, Pleridae; Papilionidae, Hespirlidae, Sphingidae, Noctuidae, Artilidae, Pyralidae, Saturnidae, Bombycidae; Hymonoptera. Tenthredinidae, Braconidae, Chalcididae, Trichogrammatidae. |
| | Introductory Plant Pathology | 2+1 | Students will be able to understand the importance of plant diseases, scope and objectives of plant pathology concept of plant disease, of cause of plant disease, inanimate causes and plant viruses.<br>Students will be able to explain classification of plant diseases. Definition and terms, parasites, pathogens biotropls, heribiotrphs, necrotraph, pathogenicity, pathogene is virulence, infection primary infection, inoculum, invasion and colonization, inoculation potential, symptoms, incubation period, disease cycle, disease syndrome, single cycle disease, multiple cycle, single cycle period, multiple cycle disease, alternate host collateral host, predisposition, biotype, symbiosis, mutualism, antagonism.<br><br>Students will be able to explain history of plant pathology with special reference to Indian work. Pathogenesis and parasitism, Koch's postulate. Effect of pathogenesis on the plants, morphological changes, physiological changes, symptom of plant diseases. Development of identies. Principles and methods of plant disease management.<br><br>Students will be able to understand the basic concepts of avoidance, exclusion, eradication, disease resistance and therapy. Methods of plant disease management. Genera morphology, characters of fungi and somatic structure, reproduction of various structure.<br><br>Students will learn Basic and different methods of classification of fungi, taxonomy and nomenclature. Study of selected genera, *Plasmodiophora, spongospora (myconycota), Synchitrum, Thyseoderma, pythiym phytophothora, albugo selerophthora, periosdocrospora and percnosi on (Mastigomyccinal); Taplirina, Erisyphe, Claviceps, Sclerotinia (Ascomycocina), Puccinia Melarapsora, Uromyces, Ustillgo, Tilletia, Neovosain, Splacelothera, Telyposporium (Besidicmycotina); Collectotrichum Alternate Cercospora, Fusarium, Helmilthosporium, Pyricularia, Seletorian. Rhizoctonia, Phyllostica, Phoma (Deuteromycotina*). General morphological and cultural characters of prokaryotes (bacteria), basic methods of classification taxonomy and nomenclature. Nutrition and effects of physiochemical factor on growth, reproduction and life cycle genetics and variability.<br><br>Students will be able to understand the importance and general original characters of morcoplasns, spiroplasma and fastidions bacteria. Reproduction nomenclature and classification physical architecture and chemical composition of viruses and viroids, nomenclature and criteria for identification, multiplication, transmission and infective nature. General morphological characters, life cycle and reproduction of nematodes, behaviour in soil and nematodes as vectors for other plant pathogens. Classification and general identifying characters of phanerogamic plant parasite reproduction and life-cycle. |
| **15** | Microbiology | 1+1 | The student will learn microbial world history- History of microbiology prokaryotic and eukaryotic microbes, |

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| | | | their cell structure, genetics distribution in nature and importance in agriculture, microorganisms in soil fertility and crop production; carbon, nitrogen, phophorus and sulphur cycles, plant microbes association symbiotic associative and a symbiotic nitrogen fixation, Azolla and mycorrhiza iodegradation of agricultural chemicals pesticides, herbicicks and agricultural organic wastes.<br><br>The students will learn microbiology of milk and milk products, rural microbiology and silage production; Microbes in human welfare biofertilizers, biopesticides, waste treatment and recycling; composting, ethanol production, antibiotic production, Human and plant pathogenic microbes |
| **3rd Semester** | | | |
| **16** | Vegetable Production | 2+1 | Students will be able to understand the importance of vegetables in human nutrition and national economy, factors effection vegetable productivity viz. light, temperature, moisture, oxygen, $CO_2$ mineral nutrients, soil reaction, disease and insect pasts; types of vegetable farming; types of classification of vegetable viz, botanical, classification, based on col: mandlness, parts used duration of crop; weed management, use of bioregulation seed production, harvesting and marketing.<br><br>Students will be able be understand the cultivation practices vis. time of sowing nursery management, transplanting, sowing/planning distance, recommended cultivars seed rate, manure and fertilizers doses, harvesting, storage, physiological disorders, diseases and insect pests and their control measure of various vegetable crops namely potato, tomato, onion, garlic, okra, sweet corn pea, beans, cucurbitaceous crops-pumpkin, bottle gourd, sponge gourd, ridge gourd, pointed gourd, bitter gourd, cucumbers etc. |
| **17** | Irrigation Water Management | 2+1 | Students will be able to know the water resources of India, source of irrigation, irrigation water demand, supply and resources development of irrigation, soil moisture and its characteristics soil water potential, retention and movement of soil water. Water intake and infiltration. Importance of water in plants life, plant water status, absorption, transportation and transpiration, moisture sensitive stage, water availability and nutrient up take. Scheduling of irrigation based on soil moisture status. Physiological stages of crop and meteorological parameters, irrigation under limited water supply conditions. Methods of irrigation; surface irrigation, flooding, furrow, border and basin irrigation. Irrigation; drip and sprinkler irrigations.<br><br>Students will be able to explain water stress and plant grows effect of water stress on physio-morphological characteristics and productivity of plant, deficit irrigation and strategy for optimizing yield. Water quality standards and its suitability for irrigation, water use efficiency, agronomic technique to boost water use efficiency, factors affecting water use-efficiency.<br><br>Students will be able to understand irrigation management in soils with low intake rate, saline and alkali soil, soil with shallow ground water table and in poorly declined soil. Water requirement of crops, factor affecting the water requirement of crops, method of determining water requirement, effective rainfall, anti-transpiration and potential evapotranspiration and consumptive use. Irrigation of principal crops critical stages of crops, depth and schedule of irrigation, reducing irrigation requirement of major crops. |
| **18** | Principles of Plant Breeding & Breeding of | 3+1 | The students will get exposure to historical development of plant breeding plant breeding concept, nature and role of plant breeding major achievements and future prospects, genetics in relation of plant breeding, modes of |

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| | Field Crops | | reproduction, self-incompatibility and male sterility. Plant Breeders materials domestication, centres of origin, centres of density acclimatization and components of genetic variation and heritability.<br><br>Student will be able to explain breeding methods in self-pollinated crops: Introduction, selection pure line theory, multilane varieties, hybridization techniques and handling of segregating populations, Hardy-Weinberg law, Methods of breeding cross pollinated crops system of mating heterosis and inbreeding depression development of inbred lines and hybrids and synthetic varieties, breeding methods in asexually propagated crops, clonal selection and hybridization polyploidy in relation to plant breeding, mutation breeding methods, uses nature of gene mutation mutagenic agents, induced mutation in plant breeding, breeding for important biotic and abiotic stresses, and use of biotechnology implant breeding, procedure for release of new varieties.<br><br>The students will learn concepts of crop systematic, species relationship, floral biology and inheritance of economically important characters, breeding objectives development of varieties with desired yield, adaptability, stability, disease and pest resistance and quality (Physical, chemical, nutritional) and marketing Important varieties along with parentage and characteristics, future thrust area in varietals improvement in crops like wheat, rice, make, soybean, field-pea, pigeon pea, urd bean and rapeseed mustard, sunflower, groundnut, sorghum, sugarcane, potato, cotton and tobacco. |
| **19** | Soil Fertility and Nutrient Management | 2+1 | The students will get exposure to the history of plant nutrition and soil fertility, soil fertility and productivity, problems of soil fertility in India, plant growth and development, factors affecting plant growth; essential plant nutrients, their role and deficiency and toxicity symptoms; Ion exchange phenomena in soil and its role in plant nutrient availability; movement of nutrients from soil to plant roots, their uptake and translocation.<br>The students will be able to explain chemistry of soil nitrogen- Nitrogen cycle, mineralization and immobilization, properties and use of inorganic and organic nitrogenous fertilizers in crop production. Chemistry of phosphorus in soil, phosphate fixation and availability chemistry of potassium in soil, potassium fixation and availability; properties and use of phosphorus and potassium fertilizers, chemistry of calcium, magnesium and sulphur in soil, their sources and usage; soil fertility evaluation and fertilizer recommendations; biofertilizers; integrated nutrient management ; methods and time of application of fertilizers, efficient of fertilizers. |
| **20** | Agri. Marketing and International Trade | 2+1 | Students will be able to understand he concepts of marketing, human needs and marketing the marketing mix, the marketing strategy, product planning, promotion Physical distribution and pricing, marketing and different levels of development, function of prices and role of price in economic development, marketing planning and organizational elements of marketing mix, Concept of market segment, market segmentation, basis of market segmentation, Types of markets, classification and characteristics of agricultural market.<br><br>Students will be able to explain demand for farm products; determinants of consumer behaviour, consumers of farm products factors affecting demand and consumption of farm products; supply of farm produces; product decision and strategies, product life cycle and new product development, characteristics of farm firm, farm products and farm production, spatial and temporal distribution of farm products, marketed and marketable surplus, factors affecting supply of marketed surplus and marketable surplus of farm products;<br><br>Students will be able to describe women's role in agricultural produce marketing; pricing and promotion |

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| | | | strategies market structure, determination of price under alternates market structures, price movement overtime seasonal cyclical and trend marketing communication, advertising, publicity, personnel selling and cales promotion; Marketing function, exchange function's buying and rolling physical function storage, transportation and processing; facilitating functions- packaging, branding, financing, market information, grading etc.<br><br>Management of marketing functions, marketing channels; stages of marketing, selection and management of marketing channels for farm products; meaning and components of marketing cost, price spread and market margins, Marketing efficiency, concept and measurements of marketing efficiency;<br><br>Students will be able to understand the role of government in Agricultural marketing, public sector institutions. CACP, FCL, CWC, DMI, Far price shops, Exim Bants etc. The concept and importance of inter-regional and International trade; emerging scenario of international trade in Agricultural commodities; basic theories of international trade; concept of terms of trade and BOP, implications of new GATT agreement (WTO). |
| **21** | Field Crops I (Kharif) | 2+1 | Students will be able to get exposure of origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices yield of kharif crops.<br><br>Students will be able to take information for cereals-rice, maize, sorghum pearl millet and finger millet; pulses – pigeon pea, mungbean and urdbeans oilseeds groundnut, sesame and soybean; fibre crops cotton, jute and sunhemp; and forage crops sorghum, maize, cowpea, cluster bean and napier. |
| **22** | Crop Diseases and their Management | 2+1 | Students will be able to understand and explain wheat disease rusts, loose nut, kernalbunt, powdery mildew, alternaria blight, yellow ear rot, ear cocile, Rice disease blast, brown spot, bacterial blight, sheath blight khaira and tungro; Maize disease stalk rots, downy mildews, leaf spots and Heininthosporium leaf sports; Sorghum disease smuts. Grain mold, anthracites and strgaa; Bajra disease downy mildews and ergot; Sugarcane disease redrot, smut, and with Groundnut disease early and late leaf sports, Sclerotium stem rot, seedling rot and seedling blight; Sunflower disease Sclerotinia stem rot and Alternaria blight; mustard disease. Alterniaria blight, white rust, downy mildew, Sclerotinia stem rot, and bacterial rot; soybean disease Rhizoctonia blight, pod blight, seed rot, bacterial pustule seedling blight and mosatic; pigeonpea diseases Phytophora blight, wilt and sterility mosaic; Gram diseases Wilt, grey mould and Ascochyea blight; Lentil disease rust and wilt; Cotton disease anthocnose; vascular wilt, and black gram; Tobacco diseases damping off early and late blight, black scarf, common scab, bacterial wilt and virus diseases; Tomato diseases damping off, late and early blight, wilts root knot and virus diseases; Brinjal diseases Phomopsis blight, fruit rot, Sclerotimia rot, bacteria wilt and rot knot, Chilies diseases anthracnose and virus diseases, vegetable crucifer diseases damping off, Downey mildew, and black not, vegetable cucurbit diseases powdery mildew and rust, Bean diseases anthracnose, blights, and virus diseases; Mango diseases Mango malformation. Powdery mildew and bacterial blight; Apple diseases scab, colar rot, powdery mildew; fire blight, stem black and brown, pink diseases, Papaya diseases stem and foot rot, leaf curl, and mosaic, Citrus diseases canker, anthracnose, citrus decline and virus disease; Peach and pear disease leaf curl, brown rot, and scab; Guava wilt, anthracrose and stem canker. |
| **4th Semester** | | | |
| **23** | Economic Entomology | 2+1 | Students will be able to explain how insects become pest economic importance of insects, classification of pests, principles and methods of pest control, viz, physical mechanical, cultural, legal, genetical chemical. Biological, |

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| | | | principles and methods of insecticidal applications.<br><br>Students will be able to understand the concepts of apiculture, sericulture and lac cultivation with special reference to equipment used insect pests and diseases, production and marketing. |
| **24** | Introduction to Plant Biotechnology | 1+1 | The students will get exposure to the introduction: History of Plant tissue culture and biotechnology, scope and importance of agricultural biotechnology, Gene technology, Tissue and cell culture: Media, various modes of culture and their application. Organ culture cell suspension culture, Callus culture, Micro-propagation methods.<br><br>Students will be able to explain organogenesis and embryogenesis, their significance, Anther culture; haploid production, diploidization and their significance, Proto plasts isolation, fusion, somatic hybridization and hybrids, Somaclonal variation and its use in crop improvement, Germplasm storage and cryopreservation, Secondary metabolite production, Students will be able to understand introduction to genetic engineering and genetechnology. Gene transfer methods: Physical Chemical and Agrobacterium dependent methods, Generation of transgenic plants and their identification, Molecular markets, RGLP, RAPD, Simple sequence repeats etc, Role of biotechnology in crop improvement. |
| **25** | Field Crops II (Rabi) | 2+1 | Students will be able to get exposure of origin geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rabi crops.<br><br>Students will be able to take information for cereals wheat, barley and triticale; pulses chickpea, lentil, peas, frenchbean; Oil seeds, rapeaseed and mustard, sunflower, safflower and linseed; sugar crops sugarcane and sugarbeet, Regional medicinal and aromatic crops such as mentha, lemon grass, citronella, palma rosa, Isabgol and posts, potato and tobacco, Forage crops berseem, Luceme and Oat. |
| **26** | Agriculture Co-operation, Finance and Busi. Mgt. | 2+1 | Students will be able to understand the concepts of cooperation- Meaning, significance under Indian agricultural conditions, objectives principles of cooperatives.<br>Students will be able to explain agricultural cooperation in India credit marketing consumer and multi- purpose cooperatives, farming cooperatives, processing cooperatives, cooperative warehousing, role of ICA, NCU, NCDC, NAFED etc.<br><br>Students will be able to explain about women cooperatives, Agriculture finance meaning, scope and significance, credit needs of Indian agriculture, economic principles in capital acquisition and use decisions, preparation and analysis of financial statements, balance sheet and income statement, cost of credit, Access for women to agricultural credit facilities. Agricultural credit market- institutional and non-institutional sources of credit, cooperatives credit system.<br><br>Students will be able to describe commercial banks and regional rural banks, NABARD and AFC, problems and issues in institutional agricultural credit system. Business management environment of agricultural business, tasks of a professional manager, management system and processes, types of management decisions, decisions, decision making techniques and processes, organizational culture and management ethics. |
| **27** | Insect Pest and their Management | 2+1 | Students will be able to explain nature and extent of damage, life cycle seasonal history, host range, distribution and management of the major insect pests attacking field drops; Cereals, pulses, oilseeds, fiber, sugar crops, |

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| | | | Horticultural crops; brinjal, okra, potato, tomato, cole crops, leguminous vegetables, cucurbits, chillies sweet potato, leafy vegetables, onion and garlic, colocasia, yarn. Fruit crops (tropical/sub tropical); jack fruit, papaya, coconut and date palm, mango, citrus, litchi, banana, guava, peach, poar, plum, apricot, chestnut, almond. Plantation and garden crops: marcptics, spices and condiments.<br><br>Students will be able to get information of stored grain and household pests; Locust and other major polyphagous insects, Rodents and mites of agricultural importance. |
| **28** | Fruit and Plantation Crops | 2+1 | Students will be able to understand the importance and scope of fruit and plantation crop industries in India Cultivation practices of important fruit and plantation crops with reference to their origin, soil and climatic requirements; botany, important cultivars, plant propagation practices, resources and planting.<br><br>Students will be able to learn care and management in respect of irrigation, nutrition and other cultural operations including training and pruning, nutrient deficiencies of fruit plant and their collection, inter cropping, major cultivation problem and their control measures, harvesting, yield, storage and marketing; application of plant bioregulators; post-harvest and technology of plantation crops.<br><br>Students will be able to describe management of major insect- pests and disease, principles and methods of evaluation of fruit trees, project formulation and evaluation, commercial orchard. |
| **29** | Livestock Production | 2+1 | Students will be able to get exposure to the place of livestock in the national economy, efficient livestock development programme of government of India.<br><br>Students will be able to get information about importance of exotic and Indian breeds of cattle, buffalo, sheep, goat and swine. Measures and factors affecting livestock fertility, reproductive behavior like estrus, parturition, farrowing, milk secretion, milking of animal and factors affection milk yield and composition of milk.<br><br>Students will learn selection and breeding of livestock for higher milk and meat production. Feeding and management of calves, growing of heifers and milch animal and other classes and types of animals. Housing principles, space requirement for different species of livestock. Disease control and measures of measure livestock diseases, sanitation and care. Breeding feeding and production records. |
| **30** | Rainfed Agriculture | 1+1 | The students will get exposure to history of rainfed agriculture, magnitude of its problem and delineating criteria for rainfed and drylands, soil and climatic conditions prevalent in rainfed area.<br>The students will be able to explain water stress in relation to crop productivity, concept of crop productivity and plant type for rainfed farming areas and crop improvement for efficient water use, drought resistance in crop plants.<br><br>Students will be able to understand the concepts of efficient utilization of water through soil and crop management practices; reducing water losses through mulching and use of anti-transpirants, their kinds, mode of action and effect on crop yield. Increasing water storage by reducing run off and increasing infiltration through mechanical and cultural measures, water harvesting techniques, watershed management. Efficient management of rainfed crops; land preparation, seeding and crop density, selection of efficient crops and their varieties, alternate |

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| | | | cropping and land use strategies, soil fertility management and fertilizer use techniques, weed control and interculture operation, mid season correction for mitigating the aberrant weather, agro techniques for hilly tracts. |
| **5th Semester** | | | |
| **31** | Poultry Management | 2+1 | Students will be able to get exposure to important Breed characteristics of poultry, their methods of rearing, breeding, feeding and management. Incubation hatching and breeding, vaccination and prevention of diseases.<br><br>Students will be able to explain about preservation and marketing of eggs, its economics and keeping quality. Broiler production and rearing, hatchery management. |
| **32** | Mushroom Cultivation | 1+1 | Students will be able to get exposure first record of cultivated edible fungi, definition of mushrooms, present scenario of mushroom cultivation uses nutritional and medicinal values of mushrooms, general morphological features and important characters for identification of different edible mushrooms and biological backgrounds for mushroom breeding.<br><br>Students will be able to explain definition of spawn and their types, methods of spawn production raising cultures, preparation of spawn media/master culture/commercial grade spawn, characteristics of good spawn, storage of spawn. Cultivation of Agricus species: Students will be able to understand the concept of compost and it's formulations, preparation of compost using short and long methods of composting, turning schedules, compost microflora and different temperatures zones. Spawning and methods of spawning. Preparation of casing mixture and its sterilization, identification, isolation and management of different diseases, pests and competitors/moulds. Methods of harvesting mushrooms, after care of harvested fruit bodies, after care of beds and crop rooms on rumination of crop. Cultivation of Pleurotus, Volvareilla, Lentinus and Auricularia sp: Types of substrate, substrate preparation and it's sterilization; spawn and methods of spawning, spawn run and cropping, harvesting and packing, processing of mushrooms: Different methods- canning, dehydration, freeze drying and bringing etc. |
| **33** | Elementary Crop Physiology | 2+1 | Students will be able to get exposure to introduction to plant physiology, plant cell an introduction, laws of thermodynamics, diffusion and osmosis.<br><br>Students will be able to understand concept of water potential, cell water relations, absorption of water, transpiration, stomatal physiology, ascent of sap, ion uptake and metabolic utilization of mineral ions, deficiencies of mineral ions in plants, photosynthesis, respiration, fat metabolism, physiology of growth and development, growth regulators, physiological parameters influencing the productivity of major cereal, pulse and oilseed crops. |
| **34** | Farm Machinery and Power | 2+1 | Students will be able to understand the concepts of sources of farm power including non-conventional sources, farm mechanization, tillage, primary and secondary tillage equipment, specialized tillage tools, seeding and fertilizer machinery, specialized sowing and planting machine, inter culture equipment, plant protection equipment, harvesting and threshing machinery, chaff cutter.<br><br>Students will be able to get information for estimation of operating cost of farm equipment. Basic engine types, parts of I.C. engine, working of different engine systems, types of tractors, working of different tractor systems |
| **35** | Farm Mgt. and Natural | 2+1 | Students will be able to understand meaning, concept, objectives, nature and scope of farm management. |

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| | Resource Economics | | Meaning and definition of farm, structure and characteristics of farm business. Students can explain different types of farms and factors determining types and size of farm.<br><br>Students will be able to explain basic principles of farm management factor – factor and product-product relationships, law of equlmarginal returns and law of comparative advantage. Students will understand meaning and concept of cost, types of cost and their importance in farm management decision making. Concepts of farm returns.<br><br>Students will be able to analyse farm business and various measures of efficiency.<br><br>Students will understand importance of farm business records and accounts, inventory balance sheet. Profit and loss accounts of farm.<br><br>Students will be able to explain status of farm inputs land, labour, capital. Farm planning and budgeting meaning and importance of farm plan and farm budget, partial and complete budgeting, formulation of farm plan and budget. Concept, subject matter and importance of natural resources economics.<br><br>Students will be able to Classify natural resources and explain the basic terms ecosystem, biomass, biosphere, reserves, rate of use, environment, pollution etc. and concepts of natural resources of economics-ecology.<br><br>Students will understand natural resources management and conservation, issues in natural resource use of management the benefit cost approach to natural resource problems.<br><br>Students will be able to explain time element in decision making and benefit cost analysis. The basic theory of natural resource economics efficiency in private market economy, externalities in natural resource use and alternative solution thereof,<br><br>The students will understand important issues in economics and management of land, water and forest resources and the environment. Natural resources administration and policy formulation. |
| **36** | Fundamentals of Extension Education and Rural Development | 2+1 | Students will be able to understand meaning, concept and process of extension education, objectives, principles and philosophy of extension.<br><br>Students will be able to explain history of extension work. Education-formal and non-formal. Components of behaviour-knowledge, attitude, skills and motivation.<br><br>Students will understand Principles and steps in teaching learning process, learning situation, Implications of teaching. Concept need and steps in programme planning. Students will be able to use principles of programme planning, programme planning process.<br><br>Students will understand concepts of Panchayati Raj Institute, reorganization and its role in programme planning. |

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| | | | Extension evaluation its meaning, principles, steps, techniques and criteria.<br>Students will be able to analyse Critically various extension programme.<br><br>Students will understand meaning and importance of rural leadership, Types, selection and qualities, training of leadership.<br><br>Students will be able to explain meaning of administration, public administration and extension administration. Coordination and team work. Organization POSDCORB, organization and management of NES and reorganized extension system. Rural development programme: an over view of CD programme before 1952, agricultural/rural development programme ADP, LAAP, CADP, HYVP, SFDA, hill area development programme, integrated tribal development project.<br><br>Students will be able to prepare integrated dryland farming project.<br><br>Students will be able to understnd integrated child development scheme, IRDP, TRYSEM, JRY, DWCRA, *mahila uthan yojana, Sunishchit rojgar yojana.* Role of voluntary organizations in rural development, women in agriculture and rural development. |
| **37** | Post-Harvest Mgt. & Processing of Fruits and Vegetables | 2+1 | To study the importance of Post-harvest management for fruits and vegetable<br>To learn total production and consumption pattern<br>To understand the Post harvest losses in fruits and vegetables<br>To learn about Maturity and ripening process<br>To understand the biochemical changes after harvesting<br>To learn the quality management for fresh marketing and processing<br>To study Storage of fruits and vegetables – ambient, low temperature and controlled atmosphere storage system<br>To learn about Packaging of fresh and processed products<br>To learn about Transportation system, mode of marketing, sorting, grading and handling<br>To study the Pretreatment of fresh produce for marketing and processing<br>To study the general principles and methods of preservation and preparation of jam, marmalade, tomato products, pickles and chutney, drying fruits and vegetables, fruit beverages, juices, squashes, nectars, cordials, by products of fruits and vegetables processing industries such as vinegar, cider<br>To study about Canned fruits and vegetable products, frozen fruits and vegetables<br>To study about government<br>policies, regulation and specifications for fresh and processed products<br>To learn about the export promotion agencies and their role in export of fresh and processed products. |
| **38** | Practical Crops Production – I | 0+2 | Students will be able to understand the complete Practical acquaintance relating to scientific production techniques of major field crops of the season (kharif) including sowing weeding hoeing fertilizer and manure application, harvesting etc. |
| **6th Semester** | | | |
| **39** | Farming System and Sustainable Agriculture | 2+1 | Students will be able to recycle of agricultural and industrial organic wastes; wastelands and their management; reclamation and management of acidic, saline and sodic soils, soil erosion; extent, type and effects; soil |

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| | | | conservation techniques, watershed mgt.; application of remote sensing for assessment of soil and water resources.<br><br>Students will be able to utilise mulching, wind breaks, water harvesting, tied ridging, strip cropping. Permeable contour line barriers and water ponds. |
| **40** | Conservation and Management of soil and water resources | 1+1 | Students will be able to understand different soil resources of India; distribution of waste land problem soils; water resources of India and their utilization in crop production; soil tilth management and relationship with tillage; tilth requirement of different crops; soil impedance layers and their improvement; management of soil water energy state of water in soil and availability to plants; management of soil moisture under different climates; water harvesting techniques, effect of water quality on soil and plants; soil aeration problems and management; soil thermal regimes in relation to crops and their optimization.<br><br>Students will be able to recycling of agricultural and industrial organic wastes; wastelands and their management; reclamation and management of acidic, saline and sodic soils, soil erosion; extent, type and effects; soil conservation techniques, watershed mgt.; application of remote sensing for assessment of soil and water resources. |
| **41** | Ornamental Horticulture | 2+1 | Students will be able to explain importance of ornamental gardening in human life, theory and practice of landscape and formal garden for various places, identification, use of ornamental plants for the beautification of private and public places, styles of gardens, formal, informal etc.<br>Students will be able to understand different concepts of landscape and town planning, ornamental plants for rural and urban areas, indoor gardening, post culture; bonsai, hanging baskets etc.<br><br>Students will be able to understand principles and practices involved in growing ornamental annual and perennial plants, planning and layout of various parts of garden, herbaceous and shrubbery borders, lilly pots, rock gardens etc. cultivation of important ornamental plants, rose, gladiolus, chrysanthemum, tuberose, orchids, authurium, gerbera, dahlia, fern, palms, cycades, cacti etc. Post-harvest technology, project formulation and evaluation. |
| **42** | Environmental Science | 2+1 | **Students will be able to understand Introduction to Environmental Sciences for following heads:**<br>▪ Definition, scope and importance (the multidisciplinary nature of environmental sciences)<br>▪ Need for public awareness on Environment, Role of individual in Environmental protection<br>**Students will be able to explain Natural Resources (Renewable and Non-renewable Resources):**<br>▪ Natural Resource conservation: concepts<br>▪ Freshwater resources: use and over-exploitation of surface and ground water, conflict over water, hydroelectric projects, problems, traditional methods of harvesting of freshwater resources.<br>▪ Mineral resources: use and exploitation, environmental effects of extracting mineral resources, Lime stone quarrying in Uttaranchal<br>▪ Food resources: World food problems, changes caused by agriculture and overgrazing, effect of modern agriculture, fertilizer operated problem, water logging, salinity.<br>▪ Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.<br>▪ Land resources: Land as a resources, land degradation, landslides, soil crosion and desertification. |

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| | | | **Ecosystems:**<br>▪ Concept, structure, and components of an ecosystem.<br>▪ Abiotic and biotic variables.<br>▪ Ecosystem function, trophic levels, energy flow, food chain, food web, Ecosystem, homeostasis.<br>▪ Examples of ecosystems (aquatic: pond, lake, river)<br>▪ Terrestrial ecosystem: Forest, mountain<br>▪ Ecological succession.<br>**Biodiversity and its conservation:**<br>▪ Introduction:- Definition, genetic, species and ecosystem diversity.<br>▪ Bio-geographical classification of India<br>▪ Values of biodiversity: 5 Es (Esthetic (Aesthetic), Economic, Environment, Ethical, Emotional.<br>▪ Biodiversity at global, national and local levels.<br>▪ India as a mega diversity nation, hot spots of biodiversity.<br>▪ Himalayan wildlife: Habital losspoaching of wildlife, man-wildlife conflicts, and conservation.<br>▪ Threatened categories as per IUCN.<br>▪ Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.<br>**Students will be able to understand the concepts of Applied environmental science** Environmental Pollution<br>▪ Definition, causes, effects and measures of Air pollution.<br>▪ Water pollution and thermal pollution.<br>▪ Marine pollution.<br>▪ Noise and radioactive pollution.<br>▪ Solid waste and their management (municipal, industrial (hazardous and non-hazardous), problems of solid waste disposal in Uttaranchal and integrated Solid Waste Management (ISWM).<br>▪ Environmental hazards in Himalayas (floods, river, blockades, cloud burst, landslides, earthquakes).<br><br>Students will be able to explain Environmental problems and Environmental Protection<br>▪ *Anthropogenic* and natural environmental problems.<br>▪ Environmental ethics; issues and possible solutions.<br>▪ Climate change, global warning: causes, effects and mitigation (national and international efforts)<br>▪ Ozone layer depletion: causes, effects and mitigation. (national and international)<br>▪ Environmental Protection Act 1986<br>▪ Air (Prevention and Control of pollution) Act, Water (Prevention and control of Pollution) Act.<br>▪ Wildlife Protection Act 1972<br>▪ Forest Conservation Act 1980<br>▪ The Biological Diversity Act 2002<br>▪ Issues involved in enforcement of environmental legislation, public awareness, Article 48A and 51A<br>▪ Automobile Emission standards (Eco/Bharat), Ecomark<br>**Human Population and the Environment:**<br>▪ Population growth, variation among nations, population explosion Family Welfare Programme.<br>▪ Environment and human health. |

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| | | | ▪ Role of Information Technology in environment and human health.<br>**Sustainable Development:**<br>▪ Definition, concepts and currencies<br>▪ Sustainable development of agro-ecosystem (organic farming)<br>▪ Sericulture, floriculture, bee keeping<br>▪ Sustainable development of hydroenergy in Uttaranchal<br>▪ Traditional Ecological knowledge (TEK) |
| **43** | Silviculture and Agro Forestry | 2+1 | Students will be able to understand Introduction basic terms, concepts and scope, national and global need, growth and development of trees and forest stands growth and developmental stages and growth measurements, factors affecting tree and stand growth, plant succession kinds and causes, natural and artificial regeneration establishment and care of tree nurseries tending operations cleaning, weeding, thinning, pruning.<br><br>Students will be able to explain cultural operation classification, regeneration and crop characteristics of major Silvicultural systems, basic concepts of rotation, sustainable yield management and multiple use, establishment of forest stands/crops and agroforestry-selection and management of tree and crop species i.e. planting density, geometry and Silviculture, comparison among various land uses-mixed farming, multiple cropping and agroforestry, Interactions between components of agroforests for various resources and productivity. Problems, choice and management of agro-forestry systems in various agro-climatic zones. |
| **44** | Seed Production and Processing Technology | 2+1 | Students will be able to understand the concepts of Seed, its importance in green revolution difference between grain and seed, concept of seed quality, steps involved in seed production. Seed technology, its objectives and its role in increasing agriculture production. Seed industry in India.<br>Students will be able to explain development of seed programmes, general principles of seed production. Seed replacement rate, multiplication rate, Breeder's, foundation and certified seed, maintenance of genetic purity, Nucleus and breeders seed production of newly released and established varieties of self-pollinated crops, viz, Rice, Wheat Soybean/chickpea, Pigeonpea, Rapeseed and Mustard etc.<br><br>Students will be able to know maintenance of nucleus and breeder's seed in cross pollinated crop varieties, inbreds and non-inbreds, maintenance of seed of established varieties. Foundation and certified seed production of maize inbreds, single and double cross hybrids. Hybrid seed production of Sunflower, Sorghum, pearlmillet and Rice using male sterility systems. Latest released hybrids of Maize, Sorghum, Bajra and Rice their characteristic feature, seed production of Wheat, Rice, Oats, Soybean, Gram, Urd, Moong, Sunflower, Pigeonpea etc. seed certification, its concepts, roles and goals, seed certification ageneies, certified and truthfully labeled seeds.<br><br>Students will be able to explain seed processing, storage and marketing, Miniumum seed certification standards for self and cross-pollinated crops. Field and seed inspections objectives, general principles and methods, Seed sampling and seed testing for analytical purity, varietal identification through electrophoreses, Grow out test for cultivar purity, seed legislation and seed law enforcement including IPR, PBR in India, Record developments in seed. |
| **45** | Practical Crops | 0+2 | Students will be able to understand the complete Practical acquaintance relating to scientific production technique |

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| | Production – II | | of major field of the season crop(s) including sowing weeding, hoeing, fertilizer and manure application, harvesting etc. |
| **7th Semester** | | | |
| **46** | General Economics | 2+0 | The students will be able to understand Nature and scope and subject matter of economics and also approaches to economic analysis and nature of economic theory.<br>The students will be able to state the basic terms and concepts of economics<br>The students will be able to state the various theories related to consumer behavior such as equi-marginal utility, indifference curve, diminishing marginal utility.<br>The students will be able to define law of demand and understand the concept of price, income and cross elasticities.<br>The students will be able to explain factors of production i.e. land, labour, capital and enterprise and also understand and input-output relationships.<br>The students will be able to describe law of variable proportions and laws of scale.<br>The students will be able to understand the concepts of cost.<br>The students will be able to describe Law of diminishing marginal returns.<br>The students will be able to explain the Law of supply.<br>The students will be able to explain the theories of rent, wage, interest and profit.<br>The students will be able to understand the concepts of various types of markets and also Price determination and forecasting under them.<br>The students will be able to understand the concepts of National Income and also approaches of measuring national income.<br>The students will be able to explain theories of population.<br>The students will be able to describe the concept and types of inflation.<br>The students will be able to understand barter system of exchange and its problems.<br>The students will be able to understand the concept of money and explain quantity theory of money.<br>The students will be able to tell the various types of banks and their function.<br>The students will be able to explain the basic feature of various economic systems,<br>The students will understand the concept of international trade.<br>The students will be able to specify special characteristics of agriculture and its role in economic development.<br>The students will be able to explain the role of women in Indian Agriculture. |
| **47** | Breeding and Improvement of Farm Animals | 1+1 | Students will be able to understand reproductive systems of farm animals. Qualitative and quantitative inheritance and effect of environment on them. Various qualitative and quantitative traits of livestock. Weinberg law, variation, its measures, genetic, phenotypic and environmental variances.<br><br>Students will be able to explain heritability and repeatability, its measurement and uses. Selection its genetic effect, selection for dominant and recessive gene and quantitative traits, selection differential, response to selection, generation interval and annual rate of gain.<br><br>Students will be able to explain Genetic correlation and correlated response. Basic of selection, individual, family, progeny, pedigree and combined selection. Methods of selection for one or more traits random, |

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| | | | independent culling level and selection index. Inbreeding its consequences, inbred lines, line breeding, inbreeding, coefficient and relationship coefficient, out breeding – various types of our crossing and cross-breeding, species hybridization and development of new breeds. |
| **48** | Principles of Animal Nutrition | 2+1 | Students will be able to understand Introduction to expanding field of nutrition, chemical composition of animal and its food, digestive systems and processes of farm animals. Digestion, absorption and metabolism of carbohydrates, lipids and proteins in protein content in various classes of feeds. Concept of essential amino acids for non-ruminants and protein quality of feeds.<br>Students will be able to explain the absorption and metabolism of essential minerals and vitamins; symptoms of their deficiencies; minerals and vitamin content of various classes of feeds. The nutritive evaluation of feeds for energy and protein, digestibility of feeds values of feeds, nutrient requirements of farm animals for maintenance, growth reproduction and lactation. Growth stimulating substances. |
| **49** | Element of Food Technology | 2+1 | Students will be able to understand the scope and importance of food technology in Indian economy. Handling, transportation and storage of food grains, fresh milk, meat, fish and eggs; physical, chemical and nutritional characteristics of food grains – fresh meat, fish, milk and eggs; role of milling and size reduction in food processing;<br><br>Students will be able to explain use of low temperatures in processing and storage of food grains, fresh milk, meat, fish and eggs; Drying and dehydration of food grains and concentration and evaporation of milk; Food fermentations and their application in food processing.<br><br>Students will be able to know the role of food additives in the processing of food grains, milk, meat, fish, eggs and their products; Food irradiation and its application in extending shelf life of food grains, meat, fish, eggs and their products; Food packaging and its functions; By product's utilization and disposal of food industry wastes; quality control, total quality assurance (TQA) and various systems of TQA. |
| **50** | Human Food and Nutrition | 2+1 | Students will be able to understand different trends in food production and consumption in India. Role of agricultural scientists and food technologist in meeting national nutritional requirements. Definition of human nutrition, nutrient, nutritional care, health, nutritional status and good nutrition.<br><br>Students will be able to explain food and its functions and functional classification. Calorific value of foods and its measurement. Digestion and absorption of various nutrients present in foods. Energy and nutrient needs of human body. Recommended dietary allowances for various age groups and classes of individuals.<br><br>Students will be able to know common nutritional problems in India and their causes. Specific nutritional deficiencies and disorders including protein calorie malnutrition, nutritional anaemias, vitamin deficiencies, obesity, atherosclerosis. Clinical symptoms and diagnosis of deficiency disorders. Important food groups and their role in the management of deficiency disorders and diseases. Food habits and their effect on regional balance. Balanced diet and its formulation.<br>Students will be able to understand the food born infections and food hygiene. Effect of processing on the nutritional value of foods. Applied nutritional programme in country, nutritional policies of government. Food fortification, enrichment and restoration, supplementary feeding programmes for vulnerable groups. State, |

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| | | | national and international agencies dealing with nutritional programmes. |
| **51** | Soil Taxonomy, Survey and remote sensing | 2+1 | Students will be able to explain types of soil survey, morphological, physical and chemical properties used in distinguishing and classifying soils.<br><br>Students will be able to understand principles of soil taxonomy, classification system. Soils of India and their classification. Advantages of taxonomic classification of soils. Remote sensing introduction, definition, concept, principles, importance, scope, types, merits and demerits and its application in agriculture and soil classification. |
| **52** | Production Technology of Medicinal and Agromatic Plants | 0+2 | Students will be able to know importance and scope of medicinal and aromatic plants, geographical distribution of species, botanical description, management of nurseries, climate and relation to medicinal and aromatic plants, improved varieties, soil and land preparation, intercultural practices, irrigation and insect-pest management, post-harvest techniques, harvesting processing, storage and herbage/constituent yield.<br><br>Students will be able to know the following medicinal and aromatic plants.<br>*Medicinal Plants:* Sarpagandha, poppy, sadabahar, digitailis, dioscora, solanum, brahmi, isabgol, senna, aloe, neem, cinchona and Ipecac.<br>*Aromatic Plants:* Essential oils: Mints-menthol mint, pepper mint, Spearmint, bergamot mint; Aromatic grasses lemon grass, palmarosa, citronella, vetiver; Ocimum, geranium, pachauli, dill (Sowa), Cinamon, pine, eucalyptus, sandalwood, liquorice<br>*Flower perfume:* lavender, rose, rosemary, jasmine |
| **8th Semester** | | | |
| **53** | Rural Agriculture Work Experience | 0+20 | Students will be able to learn and understand different below mentioned topics each student will have a choice to opt any of the four components given below. He/she will submit his/her work in form of a report and present the results in the seminar.<br>i. Agro-based Industries – Seed processing plants and industries, fruit preservation industries, food processing industries etc.<br>ii. Plant clinics<br>iii. NGO<br>iv. Socio economic studies<br>v. Apiculture<br>vi. Sericulture<br>vii. Mushroom Cultivation<br>viii. Attachment with agriculture Departments<br>ix. Attachment with Agriculture research institutes/organizations/agencies. |

## Bachelor in Physiotherapy (B.P.T.)

**Programme Summary**

Duration: 4 years + 6 months internship

**Eligibility**

10+2 from the CBSE/ICSE/ State boards or intermediate or pre university examination (2 years) or any other examination recognized and equivalent to any of the above, with at least 50% marks in aggregate or in PCB.

**Program outcomes:**

- The aim of the course is to provide comprehensive, individually focused training that prepares the students for providing a quality Physiotherapy care to the patients.
- Demonstrate sufficient understanding of knowledge in Physiotherapy.
- Able to integrate theoretical knowledge with clinical assessment.
- Develop the ability to collect history, perform relevant clinical assessment and frame appropriate electrotherapeutic and exercise therapy management for the patients.
- Demonstrate clinical decision making ability and provide appropriate patient care.
- Develop effective communication with patients, family, colleagues and students.
- Promote health education and improved quality of life through the practice of the profession.
- To carry out research and publications towards upliftment of the field of Physiotherapy.
- Actively engage in lifelong learning activities.
- Work effectively in various inter professional collaborative settings like hospitals, Rehabilitation Centers, Special Schools, Educational Institutions, Health and Fitness Centers, Geriatric Centers, Ergonomic Consultant in Corporate Sectors, Private Consultation, Home Care Services, Industrial Sectors, Sports Management, Fitness Consultant.

**Course outcomes:**

| S.No. | Course code | Course name | Maximum marks | Course outcomes |
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| **1st Year** | | | | |
| 1 | BP-101 | Human Anatomy | 70+30 | To understand about the structure of human body.<br>To learn about the scope of anatomy in the field of Physiotherapy.<br>Classification of bones, joints, and muscles<br>Structure of skin, layers of skin.<br>To learn about the axis and planes of body on which the movement occur.<br>To understand about the structure of pectoral region, arm, forearm, hand, gluteal region, thigh, leg, ankle and foot.<br>To know about the shoulder joint, elbow joint, wrist joint, hip joint, knee joint, ankle joint, sacro iliac joint, Temporomandibular joint and their movements.<br>To learn about the para vertebral muscles, intercostals muscles, Brain, parts of brain, Spinal cord, Cerebrospinal fluid, IIIrd and IVth ventricles, Cerebellum, muscles of face and neck.<br>To understand about thorax, heart, lungs, esophagus, abdomen and abdominal organs like Diaphragm, stomach, kidney, liver, uterus, structure of male and female reproductive organs<br>To understand about the blood supply and nerve supply of all the bones, muscles and joints and other soft tissue structures.<br>To understand the course of blood vessels, veins and nerves in the human body.<br>To understand about the clinical aspects regarding the joints, bones and all soft tissue structures. |
| 2 | BP-102 | Human Physiology | 70+30 | To understand fundamentals of cell structure and function.<br>To acquire knowledge about physiology of muscle function, sliding filament theory, types of contractions, muscle fatigue.<br>To know about the composition of blood, formation and functions of RBC, WBC, Plasma, and blood groups.<br>To learn about the blood coagulation time, bleeding time, clotting time, blood pressure, cardiac cycle and cardiac output, examination of ECG<br>To attain knowledge about respiration, mechanism of respiration, muscles performing respiration, volume and capacities of lung, and gaseous exchange.<br>To know about the digestive system, gastric juices performing digestion, enzymatic activity of juices, absorption and metabolism of food.<br>To understand about the structure and function of endocrine glands, hormones and their effect on every system of the human body.<br>To know about the function of kidney, urine formation, normal and abnormal urine output, constituents of urine, micturition, and kidney function tests.<br>To attain knowledge about the neuron, reflex arc, normal and abnormal reflexes, sympathetic and parasympathetic nervous system, sensory and motor areas. |
| 3 | BP-103 | General, clinical and Social | 70+30 | To acquire knowledge about the nature and fields of Psychology, scope of Psychology in Physiotherapy.<br>To obtain knowledge about behaviour and experience. |

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| | | Psychology | | To get information about motivation, types of motivation, learning theories, nature of emotion and relationship with autonomic nervous system, Gestalt's theory of learning.<br>To know about memory, its types, and causes of forgetting.<br>To get information about Nature of attention, factors deterring attention; nature of perception, principles of perceptual grouping; illusions and Hallucinations.<br>Mental mechanisms and their role in health and disease.<br>Psychological reaction of patients to physical illness, reaction to loss, death, bereavement. Emotional needs and Psychological factors in relation to unconsciousness handicap.<br>To know about intelligence tests – their uses; how the test is standardized Intelligence Quotient (I.Q.) general intelligence and special intelligence.<br>To understand the concept of Personality, types, measurement of Personality with the help of various Questionnaire |
| 4 | BP-104 | Biochemistry | 70+30 | To understand the concepts of Biochemical organization of human cell.<br>Learn experimental evidences for proteins and physiotherapeutic significance of structural proteins. To know about the biochemical asspects of hemoglobin, connective tissue, muscle tissue and nervous tissue, protein, carbohydrate and lipid metabolism. |
| 5 | BP-105 | Basic principles of Physiotherapy | 70+30 | To study the definition, branches and scope of Physiotherapy in day today's life.<br>It includes general knowledge of electrotherapy modalities with reference to current and magnetism, conductors and non conductors, light, heat and cold, and exercises like active and passive exercises, resistive exercises.<br>It gives knowledge about wax therapy, pulleys, gym ball, fundamental positions, walking pattern. |
| 6 | | Laboratory course 1 | 70+30 | |
| 7 | | Laboratory course 2 | 70+30 | To learn about physiologic examinations like blood sampling, clotting time, bleeding time, platelet count, RBC and WBC count |
| **2nd Year** | | | | |
| 1 | BP201 | Exercise Therapy | 70+30 | To understand the principles and techniques of relaxation and its principles.<br>To learn the use of suspension for treatment. Use of various techniques like PNF, Hydrotherapy their principles for treating various conditions.<br>To learn evaluation methods – Principles – techniques of muscle testing, goniometry, limb girth and length, posture, chest expansion and hand function.<br>To learn various soft tissue manipulations.<br>Learning the normal gait pattern and correction of gait abnormalities.<br>To learn the various techniques of mobilization, 7.strengthening and stretching along with their principles.<br>To learn the basic concepts of various types of co-ordination exercises, breathing exercises ADL, hand function.<br>To learn the different types of traction, and its uses.<br>To learn the history of yoga and various types of asana along with the advance yoga therapy and its therapeutic utilities. |
| 2 | BP202 | Electrotherapy | 70+30 | Learning the basic of all low frequency current modalities like, TENS, muscle stimulator, di-dynamic and |

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| | | and Actinotherapy | | sinusoidal currents,their indications and contra indications.<br>To learn the nature, indications and contra indications of various medium frequency current modalities like IFT and Russian currents.<br>Learning the physiological and therapeutic effects of high frequency currents and their uses for various conditions, modalities are SWD and MWD.<br>Learning the use of various radiations for treatment purpose like, UVR, IRR and LASER.<br>To learn the therapeutic uses of Ultrasound, its physiological effects, indications and contra indications.<br>To learn about various thermotherapy techniques like, paraffin wax bath, contrast bath and moist heat therapy for treating various conditions.<br>To learn about various diagnostic techniques like biofeedback, SD curve, NCV and EMG to know about the condition of muscles and nerves and use the information to treat the conditions.<br>To learn the various advanced techniques of treatment like combination therapy, long wave, and treating some conditions using techniques of cryotherapy. |
| 3 | BP203 | Biomechanics and Kinesiology | 70+30 | Introduction to kinesiology, learning fundamental concepts of COG,LOG, planes, axis and starting positions.<br>To learn about body musculature, all joints, reflexes, muscle tone and all neuromuscular functions.<br>Fundamentals of anatomical levers, pulleys, and principles of motion.<br>Fundamental principles of force and work- Force and its magnitude, direction, point of application, components of muscular force, components of external force, graphic representation of force, true force and the resistance arms of the lever, the confused affects of two or more forces.<br>Principles of Stability, covering all the joints.<br>Application of Kinesiology to Locomotion, Biomechanics of all phases of gait cycle.<br>Evaluation of exercise for conditions like kyphosis, lordosis, scoliosis etc for corrective purposes. |
| 4 | BP204 | Pathology microbiology | 70+30 | Introduction to etiology and classification of diseases.<br>To learn various types of inflammations.<br>Introduction to wound and its healing.<br>Learning various degenerative and metabolic disorders of bone, tumors, and fractures.<br>To learn the pathology of CNS diseases and peripheral nerve diseases.<br>Diseases of respiratory, CVS, and musculoskeletal system.<br>Introduction and Historical background of microbiology<br>Discovery of micro organisms.<br>To learn the contribution of various scientists in the field of microbiology.<br>To learn the chemotherapy basics and vaccination.<br>To learn the microbial structure, function and culture media.<br>To learn about main pathogens and human body immunity, antigen antibody reaction.<br>Types of infections. |
| 5 | BP205 | Pharmacology | 70+30 | Learning definition of Pharmacology and its scope in Physiotherapy.<br>To learn Dosage forms & Modes of Drugs administration, drug absorption, metabolism and Biotransformation. |

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| | | | | Basic concepts of drug toxicity, allergy and drug resistance.<br>Learning pharmacodynamics, drug potency and drug antagonism.<br>To learn the pharmacology and physiotherapeutic role of following Pharmacodynamics agents.<br>General and local anesthetics, anxiolytics, anticonvulsants, sedatives, antihistaminic agents, anti inflammatory analgesic agents, neuro-muscular blockers and muscle relaxants.<br>Introduction to drug classification, effects and side effects of some drugs. |
| 6 | | Laboratory course 1 | 70+30 | To learn about various types of exercises, manipulations, mobilization, joint range by goniometry and learning various yoga asana. |
| 7 | | Laboratory course 2 | 70+30 | To learn the practical application of various modalities for different conditions , learning indications and contraindications, and to learn what are the precautions to be taken in an electro lab and how to work with patients and modalities. |
| 8 | | Laboratory course 3 | 70+30 | Evaluation and assessment of various joint motions posture and gait. To evaluate various soft tissues. |
| **3rd Year** | | | | |
| 1 | BP-301 | Clinical Orthopedics | 70+30 | Basic introduction to orthopedics, general idea about terminology, deformity, diseases of bones, joints and soft tissues<br>Clinical features, investigations and treatment of bone and joint infection<br>General diseases of bones and joints like RA, AS, gout, rickets etc<br>Regional diseases of ligaments , menisci and tendons<br>Types, features, complications and surgical management of fractures<br>Diseases of spine<br>Regional conditions like deformities of hand, foot etc, tennis elbow, VIC etc<br>Clinical features, assessment, types and treatment of leprosy, CP, PNI, polio and amputation |
| 2 | BP-302 | Clinical neurology and psychiatry | 70+30 | Review the anatomy and physiology of nervous system.<br>Clinical features and management of congenital disorders.<br>To study in detail the clinical features , investigation and treatment of brain vascular diseases like stroke and head injury.<br>Features, assessment and treatment of spinal cord disorders like tumors, syringomyelia, etc.<br>To know about the demyelinating and degenerative diseases and their treatment like GBS, Parkinon's etc<br>To study about the cranial nerves and their diseases.<br>To know about the nerve and muscle diseases and their management.<br>To understand some of the psychiatric disorders like MR, schizophrenia etc. |
| 3 | BP-303 | Clinical cardiothoracic conditions | 70+30 | To review the basic anatomy and physiology of heart and lungs.<br>To understand the basic principles of cardiothoracic assessment and investigations.<br>To study the thoracic cage deformities.<br>Common conditions of cardiovascular system like cardiac failure, CHD, IHD etc.<br>To know the common cardiac surgeries, types of incisions, pre and postoperative management<br>Common respiratory diseases like asthma, TB, etc.<br>Thoracic surgeries like thoracoplasty. |
| 4 | BP-304 | General | 70+30 | To understand the concepts of medicine and general medical conditions |

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| | | medicine , skin and pediatrics | | Learn clinical features, assessment and medical management of heart diseases, respiratory diseases, digestive system diseases, kidney and genitourinary system, blood diseases, skin and pediatric diseases |
| 5 | BP-305 | General surgery, obg, gyne, ent and plastic surgery | 70+30 | To study the clinical features, pathology and management of hemorrhages, about anesthesia and pain relief.<br>General and plastic surgery procedures and their management.<br>To understand the anatomy and physiology of ear, nose and throat and their diseases.<br>To know about some obs and gynecological disorders and their management. |
| 6 | BP-306 | Disability, prevention and rehabilitation | 70+30 | To understand the basic terminologies in rehabilitation<br>To know the ethics in hospital and work<br>To understand the interdepartmental relationships, with patients, family members and community<br>To know the basic philosophy of rehabilitation and its use in some conditions<br>To know the social and vocational problems and how to deal with them |
| 7 | | Lab course 1 | 70+30 | Demonstration and practice of general orthopedic examination.<br>Discussion of common orthopedic appliances and instrument. |
| 8 | | Labcourse 2 | 70+30 | Demonstration and practice of neurological examination.<br>Discussion about investigations in neurology like CT,MRI etc |
| **4th Year** | | | | |
| 1 | BP 401 | PT in Orthopedics | 70+30 | Detailed study on causes, types and management of fractures. With detailed study on assessment, investigations of fractures and dislocations of upper limb, lower limb and spine.<br>Detailed assessment, diagnostic test, management of Soft Tissue Injuries of upper & lower limb.<br>Degenerative and infective conditions of joints<br>Deformities of joints and spinal column with investigations & management.<br>Orthopedic Surgery of upper/lower limb with pre & post rehabilitation.<br>Aamputation causes & management .low back pain with causative factors, tests and its rehab. |
| 2 | BP 402 | PT in Neurology | 70+30 | Evaluation and application of advanced neuro rehab techniques for rehabilitation.<br>Evaluation, assessment of various neurological disorders.<br>Peripheral injuries and neuropathies rehabilitation.<br>Assessment and treatment of paralytic conditions. |
| 3 | BP403 | PT in Cardio thorasic conditions | 70+30 | Detailed evaluation and procedures for cardiac rehab including management in ICU.<br>Physiotherapy management of various cardiac disorders along with management of complications of peripheral vascular problems.<br>Pre and post operative Physiotherapy management of various heart surgeries. |
| 4 | BP404 | PT in Gen. Medical and surgical conditions | 70+30 | Physiotherapy management of systemic diseases, Oedema, Inflammation, Artherosclerosis, Aneurysms, Tumors, Rickets Diabetes, Panniculitis, obesity, Lymphedema, tetanus.<br>Physiotherapy management pre and post operative for all abdominal surgeries.<br>Physiotherapy management of various skin disorders.<br>Physiotherapy management of gynecological conditions including bladder management.<br>Physiotherapy management of ENT disorders.<br>Skin grafting and flaps, liposuction, mamoplasty, Rhinoplasty & it PT management.<br>Physiotherapy management of various pediatrics neurological disorders.<br>Physiotherapy management of various sports injuries. |

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| 5 | BP405 | Research methodology, biostatistics and computer | 70+30 | Measurement of Central Tendency (mean, median mode).<br>Theory of probability – Definition, Mathematical definition, Law of Probability (Addition and Multiplication theorems).<br>Condition Probability, expectations – expected values or the mathematical expectation, addition and multiplication theorem on expectation.<br>Test-t-test, f-test and $X^2$ – test<br>Correlation and regression line:-<br>Computer: Application, Soft and Hardware, Application in Medicine, Programming etc. Modern concept of Computer Technology in Rehabilitation of persons with disabilities. |
| 6 | | Lab course 1 | 70+30 | Practicals include detailed assessment of all joints with relevant diagnostic tests. |
| 7 | | Lab course 2 | 70+30 | Practicals include evaluation, assessment of various neurological disorders, application of various approaches. |
| 8 | | Lab course 3 | 70+30 | Practical's various techniques for management in ICU, respiratory care techniques of postural drainage. |
| 9 | | Lab course 4 | 70+30 | Practical assessment of various medical & surgical conditions, diagnostic tests techniques for rehabilitation. |

# Bachelor of Commerce

**Programme Code**: 110

**Programme Summary**

Duration: 3 years

**Eligibility**

10+2 in any discipline with minimum 40% marks in aggregate.

**Program outcomes:**

- To demonstrate an advanced, specialized and well-rounded knowledge of the chosen academic discipline.
- To develop aptitude for formulating research problem and data collection and statistical planning.
- To acquire knowledge about Corporate accounting and Financial Accounting.
- To develop analytic thinking skills and sound oral and written communication skills so as to be able to communicate ideas effectively.
- Ability to compute taxable income of Individual.
- Ability to analyze financial data for managerial decision-making.
- Knowledge of business laws like contract Act, Sale of Goods Act ,Partnership Act , Negotiable Act.
- Knowledge of emerging field E-commerce and its working pattern.
- To be trained in recombinant in on-line filing return.
- Knowledge about GST and Cost Accounting procedure and technique.
- To gain knowledge of auditing and marketing.
- Understand the concepts of Indian economy & principle of micro economics.
- To integrate an advanced knowledge of ICT practices so as to make the best possible use of electronic sources for academic purposes.
- To develop creativity, sound judgment skills, autonomy, ethical maturity and academic integrity with regards to their chosen disciplines.
- To develop basic computer skills required for study and employment.
- Adapt to recent changes in Marketing, Human Resource, Taxation, Environment and in investment of securities

**Course outcome:**

| S. | Course code | Course name | Credits | Course outcomes |
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| **1st Semester** | | | | |
| 1 | BC-101 | Environmental Studies | 2 | To understand appropriate sociological and technological measures in environment management.<br>To focus on ecosystem services and human well being and livelihoods.<br>To learn basis of problems and solutions in natural resource management<br>To find solutions towards more sustainable societies around the globe.<br>To learn strategies for waste reduction and disposal<br>To contribute meaningfully for analysis of environmental systems planning and management with both a local and global perspective<br>To understand the concept of sustainable development<br>To be able to cope with the impacts of climate change by adopting adaptation and mitigation measures<br>To prepare the students for national and global employability |
| 2 | BC-102 | Financial Accounting | 6 | To provide knowledge on the fundamental of financial accounting.<br>To expose the student to various financial transaction and its current application.<br>Prepare ledger accounts using double entry book keeping and record journal entries accordingly<br>To familiarize the concept of Branch account and its system<br>To introduce the system of Hire Purchasing<br>To provide knowledge on the fundamental of financial accounting.<br>To familiarize the concept of Consignment and joint venture accounting<br>To make the students to learn the various aspects of dissolutions methods<br>Demonstrate the concepts of Tally ERP.9 Software, to create company, journal entries, and financial statement. |
| 3 | BC-103 | Business Organization and Management | 6 | To enlighten with nature and scope of Business Organisation<br>To familiarize the students about various sources of finance<br>To provide knowledge about stock exchange<br>To enable them with office equipments and system.<br>To study about the organizations structures<br>Processes underlying diversity within an organization . |

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| 4 | BC-104 | English Language | 6 | We frequently hear the fashionable phase "good communication skills" widely bandid about these days. The greater the skills in speaking and writing,the grater the chances of success in many aspects of life ranging from friendships to business dealings.<br>Students on completion of this course will be able to enhance their already learnt concepts in grammar like -parts of speech, uses of frequently confused articles , prepositions, common mistakes in writing.<br>They will also become aware of how to write business letters , report writing, paragraphs writing, precis writing and comprehensions. |
| **2nd Semester** | | | | |
| 5 | BC-201 | English Language | 2 | On completion of this course students will reach to the threshold of proficiency in English communication skills. It will not only enable them to pass their examination exeditably but will also help them learn a subject that holds the key to their success in future.<br><br>The significance of clear and effective communication in present age of globalization is self evident.<br>Student at the end of this course will find a difference in their personal and professional interaction.<br>They will become aware of the writing style of business letter ,note making, report writing, job application, cover letter, resume bio data, c.v. |
| 6 | BC-202 | Business Law | 6 | To understand the concepts of business law and its importance.<br>To understand the procedure of application of the business law in various aspects<br>To understand basic knowledge about Indian Contract Act 1872.<br>To know about Partnership act 1932 and LLP act 2008.<br>To know about the basic knowledge of sale of goods act 1930.<br>To know about the basic knowledge of Negotiable Instrument Act 1881 |
| 7 | BC-203 | Business Statistics | 6 | Understand Meaning and concepts of Statistics and different methods of presentation of Statistical data.<br>Classification of different measures of central tendency and variations.<br>Computation of simple correlation and regression which is comparing more than one set of data.<br>Analysis the causes of variations in Time series.<br>Application of statistics in business and economics. |
| 8 | BC-204 | Modern Hindi Language | 6 | **आधुनिक भारतीय भाषाः हिन्दी गद्य का उद्भव और विकास**<br>इस पाठ्यक्रम की समाप्ति पर छात्र हिन्दी गद्य साहित्य के बारे मे सामान्य जानकारी प्राप्त कर सकेंगे।<br>हिन्दी गद्य साहित्य का विभिन्न कालक्रमानुसाार विकास को परिभाषित कर सकेंगे।<br><br>छात्र हिन्दी गद्य की विभिन्न विद्याओं से परिचित हो सकेंगे। |

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| | | | | छात्र हिन्दी गद्य साहित्य के मूर्धन्य साहित्याकार<br>जैसे मुंशी प्रेमचन्द, यशपाल, कृष्णा सोबती, बालमुकुन्द गुप्त, भारतुन्दु हिरशचन्द, हरिशंकर परसाई एवं महादेवी वर्मा तथा इनके कृतियों से परिचित हो सकेंगे। |
| **3rd Semester** | | | | |
| 9 | BC-301 | Company Law | 6 | Classification of different types of Joint Stock Companies.<br>Understanding memorandum of association, Articles of association and Prospectus.<br>Knowledge on share capital, borrowing powers of companies.<br>Awareness about directors, meeting and resolutions passed.<br>Understand winding up of the company. |
| 10 | BC-302 | Income Tax Law and Practice | 6 | To introduce the basic concept of Income Tax.<br>In order to familiarize the different know-how and heads of income with its components.<br>It helps to build an idea about income from house property as a concept.<br>It give more idea about the income from business or profession. |
| 11 | BC-303 | Modern Hindi Language | 6 | **आधुनिक भारतीय भाषाः हिन्दी – हिन्दी**<br>इस पाठ्यक्रम के पूर्ण होने के उपरान्त छात्र<br>आधुनिक भारतीय भाषा (संविधान की आठवीं अनुसूचि में वर्णित 22 भाषा) का सामान्य परिचय दें सकेंगे।<br>हिन्दी साहित्य के आदिकाल, मध्यकाल एवं आधुनिक काल को उनकी प्रवृत्ति के आधार पर परिभाषित कर सकेंगे।<br>भक्तिकालीन प्रमुख कवियों एवं उनकी रचनाओं से परिचित हो सकेंगे।<br>रीतिकाल एवं आधुनिक काल के प्रमुख हिन्दी कवियों, उनकी प्रमुख रचनाओं एवं काल विशेष की प्रमुख प्रवृत्तियों की जानकारी प्राप्त कर सकेंगे। |
| 12 | BC-304 | Computer Applications in Business | 2 | To introduce the students about basics of MS-Office.<br>To provide practical knowledge exposure to MS-Word.<br>To provide practical knowledge exposure MS-Excel<br>To provide practical knowledge exposure MS-Power Point<br>Develop the competence of database management<br>To make them aware about information system concepts and features<br>To provide knowledge about Hardware and Software<br>Enable the students with data processing and modern electronic medium<br>Develop the students about application of information system<br>Create an awareness about security , threats and its protective measures |
| | | Computer Applications in | 2 | Provide basic knowledge about handling the computer |

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| | | Business (Practical) | | Provide knowledge of MSWord, MS Excel And MS PowerPoint<br>Surfing of internet<br>Knowledge about accounting package |
| **4th Semester** | | | | |
| 13 | BC-401 | Business Communication | 6 | To develop Communication skills and overall personality development of the students.<br>To acquire skills in reading ,writing ,comprehension and communication ,as also to use electronic media for Business Communication .<br>The effective use of various types of communication.<br>Develop communication skills for the workplace<br>Techniques to improving your presentation skills. |
| 14 | BC-402 | Corporate Accounting | 6 | Enabling the students to understand the features of Shares and Debentures<br>Develop an understanding about redemption of Shares and Debenture and its types<br>To give an exposure to the company final accounts<br>To provide knowledge on Valuation of Goodwill & Shares<br>Enable the students to understand about amalgamation , absorption and external reconstruction<br>Students can get an idea about internal reconstruction<br>To introduce and develop knowledge of holding companies accounts<br>To make them aware about accounts of banking companies<br>Keep them aware about CashFlow Statement |
| 15 | BC-403 | Cost Accounting | 6 | Aimed to familiarize the concept of cost accounting<br>Helps to gather knowledge on preparation of cost sheet in its practical point of view<br>To facilitate the idea and meaning of material control with pricing methods<br>Develop the knowledge about remuneration and incentives<br>To introduce the concept of overhead cost. |
| 16 | BC-404 | E-Commerce | 3 | Understand the concept of E-Commerce and Describe the opportunities and challenges offered by E-Commerce<br>Able to handle electronic payment technology and requirements for internet based payments<br>Understand the categories of E-Commerceand understand |

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| | | | | the different applications of E<br>-Commerce<br>To understand and identify<br>security issues of E-Commerce<br>Understand the concept of WEB Based BusinessUnderstand the M-Commerce applications. |
| | | E-Commerce (Practical) | 1 | Provide knowledge of Website Development<br>Provide knowledge of online Transactions through E-Commerce sites |
| **5th Semester** | | | | |
| 17 | BC-501 | Principles of Marketing | 6 | To provide understanding of Marketing and the Market driven enterprise to differentiate market.<br>Identify the basic approaches to formulate. Marketing strategy.<br>Identify stages of the Market planning process.<br>To know the overview of Management.<br>To study planning procedure. |
| 18 | BC-502 | Goods and Service Tax (GST) | 6 | It provides Knowledge to students regarding the laws and principal of taxation and custom laws<br>It enhances there capabilities to understand the taxation prevailing in the current economic system<br>It enhance there knowledge of taxation accounting of GST which is necessary for the current market system.<br>Identify the characters of customs duty.<br>Understand about tax Computation. |
| 19 | BC-503 | Principles Of Micro Economics | 6 | Students able to think critically and formulate independent and well considered conclusion about economic issues and policies.<br>Make rational decisions based on rudimentary marginal analysis.<br>Understand market structures and Market power .<br>Understand the demand analysis<br>Students able to understand cost analysis.<br>Students will able to understand knowledge of law of supply and demand. |
| 20 | BC-504 | Entrepreneurship | 4 | Inculcate innovative ideas for their new initiatives.<br>Manage their own/family business in skillful manner with new idea coping with fast changing requirements of the society.<br>Work together collaboratively for the startup of their new business instead of waiting for white collar job.<br>Communicate skillfully with government officials and financial institutes with full confidence. |

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| | | | | Ready their project for new venture after completion of their study. |
| **6th Semester** | | | | |
| 21 | BC-601 | Auditing And Corporate Governace | 6 | This paper gives the knowledge of examines the principles and practices of internal and external auditing<br>The students is capable in understanding the auditing as a component of recurrent and strategic activities, risk assessment, internal control, systems evaluation, forensic accountability, and contemporary audit issues and challenges.<br>Described about the concept of auditing, types and methods of auditing.<br>Acquired knowledge about vouching of cash & credit transaction, verification of assets and liabilities |
| 22 | BC-602 | Consumer Protection | 6 | Students will have a comprehensive understanding about the existing law on Consumer Protection in India.<br>Students will be conversant with major International Instrument on Consumer Protection.<br>Students will be aware of the basic procedure for handling consumer dispute.<br>Students will be able to appreciate the emerging questions and policy issues in consumer law for future research<br>Students able to know the rights of consumer .<br>Should able to know about the Ombudsman. |
| 23 | BC-603 | Indian Economy | 6 | To impart the knowledge about objectives and economic planning in India.<br>Mixes Economy and economic planning, development strategy in India, liberalisation, privatization and Globalisation.<br>Providing exposure to basis of Indian Economy.<br>To create student's ability to suggest of the various economic problems.<br>To know the development process in India after independence.<br>Should able to understand structures of economy.<br>Importance causes and impact of population growth. |
| 24 | BC-604 | Seminar and Comprehensive Viva Voce | 4 | To gain the experience of a interview before they go out seeking jobs in industry.<br>To develop confidence in a face to face interaction in a formal setting. |

**M.Sc. Biochemistry**
**Programme Code: 327**
**Programme Summary**
Duration: 2 years
**Eligibility**
B Sc with CBZ or any other equivalent degree like Biotechnology/ Microbiology/ Biochemistry/ Genetics/ Industrial Microbiology/ MLT with minimum 50% marks in aggregate.

**Program outcomes:**

- To learn chemistry of biomolecules and their biological significance.
- To acquire knowledge of intracellular compartmentalization of cell, plasma membrane, cell signalling, cell cycle, cell division and cell death pathways.
- Understand the basic concepts of animal physiology and its application in clinical Biochemistry.
- To acquire the knowledge of principles of plant Biochemistry and their applications in plant research.
- Introduction to principle and application of fundamental laboratory equipments involved in Biochemical research.
- To learn the concepts of metabolism and its application in prognosis of various diseases.
- To introduce essentials of industrial microbiology and to learn the basic aspects of fermentation and its operational modes.
- To learn basic concepts of nutrition and design of diets in various diseases.
- To learn basic concepts of molecular Biology and its application in various recombinant techniques.
- To learn fundamentals of Clinical Biochemistry and understand its application in diagnostic laboratory.
- To learn detail related to immune response and its regulation immunopathology and transplantations.
- To understand the concepts of Neurobiochemisty and its application in brain research.
- To understand the basics of drug design and application of Biochemistry in drug design.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.

**Course outcomes:**

| | Course code | Course name | Credits | Course outcomes |
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| | | | **1st Semester** | |
| I | SOLS/Biochem/ C001 | Laboratory course 1 | 3 | To impart practical knowledge and hands on training based on courses SOLS/ biochem/C003 and SOLS/ biochem/C004. |
| II | SOLS/Biochem/ C002 | Laboratory course 2 | 3 | To impart practical knowledge and hands on training based on courses SOLS/ Biochem/C005. And SOLS/ Biochem/C006. |
| III | SOLS/ Biochem/C003 | Biomolecules | 3 | To understand the structure, properties and classification of carbohydrates, lipids and proteins.<br>To learn the biological significance of major biomolecules.<br>To acquire knowledge of vitamins and its deficiency diseases.<br>To learn basic concepts of enzymes and its role in metabolism. |
| IV | SOLS/ Biochem/C004 | Cell Biology & Physiology | 3 | To acquire knowledge of Intracellular Compartmentalization of Cell .Their Structure, organization and functions.<br>To acquire the knowledge of blood as connective tissue, the classification and of its various cells, transport of gases through the blood.<br>To learn physiology of digestive system and its relation with cellular metabolism.<br>To learn physiology of excretory system and its application in nitrogen metabolism.<br>To understand physiology of alveolar respiration and cellular respiration.<br>To learn basics of endocrine system, its role in controlling metabolism and various endocrinal disorders. |
| V | SOLS/ Biochem/C005 | Plant Biochemistry | 3 | To acquire the knowledge of photosynthesis including role of photosystems, light reaction, cyclic and noncyclic photophosphorylation, C3 and C4 pathway of carbon reduction and photorespiration.<br>To learn basic concepts of nitrate and sulphate assimilation in plants.<br>To understand chemistry, structure and role of secondary plant metabolites.<br>To understand chemistry and biological importance of plant toxins.<br>To understand various types of stress and changes in plant metabolism in response to stress. |
| VI | SOLS/ Biochem/C006 | Biochemical & Biophysical Techniques | 3 | To learn the concepts of spectroscopy, interaction of light with matter, classification of spectroscopy, Laws governing spectroscopy and their applications in biochemical research.<br>To learn the concepts and classification of chromatography and its application as purification techniques.<br>To acquire the knowledge of principle, classification of electrophoresis and its application as |

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| | | | | separation technique role of electrophoresis in molecular biology and molecular weight determination of biomolecules.<br>To learn the basics of electron microscopy including Scanning and transmission electron microscopy and specific staining of biological materials. |
| **2nd Semester** | | | | |
| VII | SOLS/ Biochem/C007 | Laboratory course - III | 3 | To impart practical knowledge and hands on training based on courses SOLS/ biochem/C009 and SOLS/ biochem/C0010. |
| VIII | SOLS/ Biochem/C008 | Laboratory course - IV | 3 | To impart practical knowledge and hands on training based on courses SOLS/ biochem/C011 and SOLS/ biochem/C0012. |
| XI | SOLS/Biochem/ C009 | Metabolism I | 3 | To understand the basic concepts of bioenergetics including the relation of ΔG and spontaneity of the reaction, standard free energy change and equilibrium constant, Standard free energy change in coupled reactions, high energy compounds in biology and free energy hydrolysis of ATP.<br>To understand different approaches of studying metabolism.<br>To understand role of coenzymes and cofactors in metabolic pathways and mechanism of their action.<br>To understand carbohydrate metabolism its role in energy production and its regulation.<br>To understand Amino acid metabolism its role in excretion and its regulation. |
| X | SOLS/ Biochem/C010 | Metabolism II | 3 | To study in detail about fat metabolism and its role in providing energy and development f obesity.<br>To study in detail about nucleic acid metabolism and its integration with over all metabolism.<br>To study in detail Nitrogen fixation: Inorganic nitrogen metabolism, Assimilation of inorganic nitrogen, Regulation of nitrate assimilation.<br>To learn about biosynthesis and role of plant hormones. |
| XI | SOLS/ Biochem/C011 | Basic & Industrial microbiology | 3 | Exposure to the historical aspects of Microbiology.<br>To learn about bacterial classification concept and various techniques used in it (Morphological, chemotaxonomic and genetic methods Phylogenetic, numerical and polyphasic taxonomy).<br>To appreciate the scope and relevance of microbiology.<br>To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods).<br>To learn factors affecting growth of microbes (Physical and chemical agents).<br>To learn about the basics of virology, mycology and protozoology.<br>Introduction to different industrial microbiology.<br>To be skilled on the basic aspects of fermentation, Operational modes of fermentation (Batch, fed- batch, continuous) and Downstream processing. |

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| | | | | To impart knowledge regarding strategies for strain improvement.<br>To be trained in Industrial production of antibiotics, amino acid, biopolymers, steroids biotransformation, enzymes, alcohol, alcoholic beverages, vitamins, organic acids, ergot alkaloids and bio plastics. |
| XII | SOLS/Biochem/ C012 | Nutritional Biochemistry | 3 | To learn about basic concepts of nutrition including BMR, SDA, calculation of energy requirement of individual.<br>To learn about different components of food including fibers and their importance.<br>To study about food additives and their different roles.<br>To study about antinutreints and their importance in food.<br>To learn basic concepts of obesity, its complication, causes and different procedure to reduce obesity and concept of weight reduction diets.<br>To study about the diseases related to malnutrition and their treatment.<br>To study about starvation and concepts of techniques to study starvation and metabolic changes during the starvation.<br>To study the Role of diet & nutrition in the prevention and treatment of diseases. |
| XIII | SOLS/ Bioem/C013 | Lab Course V | 3 | To impart practical knowledge and hands on training based on courses SOLS/ Biochem/C014and SOLS/ Biochem/C015. |
| XIV | SOLS/ Biochem/C013 | Lab Course VI | 3 | To impart practical knowledge and hands on training based on courses SOLS/ Biochem/E001 and SOLS/ Biochem/E002. |
| **3rd Semester** | | | | |

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| XV | SOLS/ Biochem/C014 | Molecular Biology | 3 | To understand the concepts of Molecular biology.<br>Learn experimental evidences for nucleic acid as carrier of genetic information.<br>To understand the basics of DNA replication in prokaryotes and eukaryotes.<br>To learn about basics of transcription including reverse transcription and inhibitors of transcription.<br>To learn about Basic features of genetic code.<br>To learn about Translation in prokaryotes and eukaryotes including post translational modification and protein localization. |
| XVI | SOLS/Biochem/ C015 | ENZYMOLOGY | 3 | To learn about basics of enzymes and IUB classification.<br>To study about enzyme purification and isolation using various chromatographic techniques.<br>To study about kinetics of enzymatic reaction including mathematical derivation of Michalis menten equation for unisubstrate reaction basics of bisubstrate reaction.<br>To study about the inhibiters both reversible and irreversible derivation of their Michalis menten equation and their role in metabolism.<br>To learn about control of metabolic reactions using enzyme modulation such as allosterism and covalent modification.<br>Applications of enzymes in various industries.<br>To study about multi enzyme complexes and their role. |
| XVII | SOLS/ Biochem/E001 | Methods in Molecular Biology | 3 | To learn about control of transcription and translation in eukaryotes and prokaryotes.<br>To learn about basics of gene pseudogenes, split genes, super gene family, transposons, C-value paradox. Re-association kinetics.<br>To introduce principles and Tools of Gene Cloning.<br>To learn about the strategies and steps of gene cloning.<br>To be trained in **e**xpression of cloned gene in heterologous System( Prokaryotes and Eukaryotes), Basic architecture of an expression vector(pEt, pcDNA3 and cytomegalovirus).Model host systems: *E. coli,* Fungi, Mammalian cell lines, Insect cells, Transgenic plants and animals.<br>To gain knowledge of sequence detection, amplification and modification techniques.<br>Southern, Northern and Western blotting; Probe labelling and hybridization; DNA sequencing (Chemical, enzymatic and automated methods); Sequence assembly for whole genome analysis.<br>To be trained in principle, methods and applications of: PCR and techniques used in genome analysis.<br>To apply RDT production of insulin, drug, vaccines, diagnostic probe of genetic diseases. Gene therapy. |

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| XVIII | SOLS/ Biochem/E002 | Clinical Biochemistry | 3 | To study about the disorders of carbohydrate metabolism including diabetes mellitus, its diagnosis, metabolic disorders and treatment related to Diabetes mellitus.<br>To learn about lipid disorders including hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, abetalipoproteinemia.<br>To learn about Inborn Errors of amnio acid metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, histidinemia.<br>To study about Liver function tests and their role in differential diagnosis of jaundice.<br>To learn about kidney function tests.<br>To learn basics of diagnostic enzymes and their role in diagnosis of different diseases.<br>To study about different disorders related to clotting.<br>To study about prognosis, diagnosis, prevention and treatment of cancers. |
| **4th Semester** | | | | |
| X | SOLS/ Biochem/C016 | Neurobiochemistry | 3 | To study about Classification of muscle fibers and their anatomy, biochemistry of muscle including role of calmodulin.<br>To learn about basics of Neuromorphology including – Organisation of neuron, dendrites and axons. Glial cells – astrocytes, oligodendrocytes, ependymal cells, Schwan cells.<br>To learn about basics of neurophysiology including Generation and conduction of monophasic action potential, salutatory conduction. Synaptic transmission, Neurotransmitters and their action. Blood Brain CSF barrier.<br>To study about transport across the membranes including its role in neurobiochemistry.<br>To study about different neurological disorders. |
| XXI | SOLS/ Biochem/C017 | Immunology | 4 | To introduce the basic concepts of immune system and immunity structure and function of antigen and antibodies.<br>To provide knowledge of antigen antibody responses and Immunodiagnostic techniques: Immunoelectrophoresis, RIA, ELISA, Chemiluminescence immunoassay, Western blotting, Complement fixation test, Immunofluorescence, Flow cytometry.<br>To learn about Complement system, Cytokines and Major Histo-compatibility Complex.<br>To provide knowledge about Humoral and Cell Mediated Immune Response and Regulation:<br>B- cell and T – cell receptor complex, Positive and negative regulation; Immune Response: T -Cell independent and T- Cell dependent defence mechanisms.<br>Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody dependent cell cytotoxicity (ADCC), Macrophage-mediated cytotoxicity.<br>To update knowledge in aspect of Immunopathology and Transplantations including : Rh- blood groupings, |

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| | | | | Hypersensitivity reactions (Antibody mediated type I, anaphylaxis, type II- antibody dependent cell cytotoxicity, type III-immune complex mediated reactions and type IV-delayed hypersensitivity reactions), Immune surveillance, Self tolerance, Autoimmune diseases, Immunodeficiency; Tumor immunology, Immunotherapy of cancer, Immuno toxins; Transplantation: Graft vs. host reaction and rejection; Immunization and Vaccines. |
| | **SOLS/ Biochem/E007** | Drug Design | 3 | This course aims at application of modern *in silico* tools or information technology in different phases of drug discovery and design of new drug candidates by understanding the molecular basis of the interaction of small molecules with their targets.<br>It will present drug development as a process involving target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening.<br>Students would have better understanding on the various stages of drug discovery.<br>They would have studied on the various targets for drug discovery.<br>They would have better understanding on the lead seeking method and lead optimization.<br>They would have learnt the importance of the role of computer aided drug design in drug discovery.<br>Student understands how current drugs were developed by using pharmacophores modeling and docking technique. |
| 19 | SLS/MIC/E004 | Dissertation | 6 | To develop skills for carrying out a small research project and statistically interpret the outcomes and write the thesis. |

# M.Sc. Agronomy

**Programme Code: 352**

**Programme Summary**

Duration: 2 years

**Eligibility**

B.Sc. in Agri/Horti/Forestry with minimum 45% marks in aggregate.

## Programme Outcome:

- To get acquaintance with statistical methods like processing of data, measure of location and dispersion like mean median partition values deviation, kurtosis, coefficient of variation, probability calculation of different types of distribution and test for their goodness of fit, correlation and regression, estimation including concept of population, confidence interval, hypothesis testing, various test of significance, Analysis of variance and covariance. It provides in depth information on different design of experiment like CRD, RBD, LSD and Their analysis with missing plot technique in RBD.
- To learn the principles and practices of Organic Farming for water use efficiency, soil fertility, biofertilizers, crop rotations, control of weeds, disease and insect pest management, inspection, certification, labelling and accreditation procedures for organic farming and their contribution in national economy.
- To learn aerobic and anaerobic methods of composting, vermicompost preparation.
- To develop the skills to treat legume seeds with rhizobium culture, use of azotobacter, azospirrilum and PSB cultures.
- To learn the Weed control by different methods in field crops, herbicide structure factors affecting herbicide selectivity in different situations, calculation of cost benefit ratio, weed control efficiency.
- It provides concepts of soil fertility and productivity, essential plant nutrients & their importance, transformation, it also imparts preparation and use of Farm Yard Manures, commercial manure and fertilizers, fertilizer mixtures, ways to increase fertilizer use efficiency.
- To gain the knowledge for determination for organic carbon, pH, EC in soil and macro and micro nutrients in soils and plants.
- To learn the different methods of irrigating different field crops and managing water as precious element of crop production and increasing water use efficiency. To develop the skill for measurement of soil moisture by different direct and indirect methods.
- To understand the effect of meteorology on crops production and weather forecasting models which are helpful for prediction of Indian weather conditions. To gain the in-depth knowledge and their measurement for solar radiation, energy balance, environmental temperature, temperature profile in air, soil and crop canopy.
- To learn principles and techniques for agronomy of rabi oil seed, kharif oil seed, fibre crops, sugar crops, forage crops, medicinal and aromatic crops along with their estimation for quantitative and qualitative parameters for growth, yield and quality.
- To gain the knowledge and concepts of crop ecology, agriculture systems, ecosystem characteristics, exploitation of solar energy in crops, distribution of temperature improvement of unproductive land through crop selection and management.
- The skills of cropping systems under different land use pattern, farming systems, allelopathic effects, selection of plants for dry land, forage crop production, different indices like LER, CEY etc.
- It gives basic understanding for soil survey, soil taxonomy and use of remote sensing as its application in agriculture and soil classification.

- To become familiarise with storage insect pest, post harvest losses traditional storage structures types of losses in stored grains their effect on quality biochemical changes impotent rodent pest, preventive and curative measures.
- To learn the basic concepts of seed production technology for different self-pollinated and cross-pollinated crops, its importance, seed quality, seed storage, seed testing for purity, viability, moisture and germination, seed certification, processing, distribution & marketing of seeds.
- To gain the practical and theoretical concepts of soil erosion and various soil conservation techniques, watershed management, land use capability classification, alternate land use systems for agroforestry, ley farming and drainage methods.
- To learn the research methodology and techniques for field crops using principles of agronomy.
- To learn in-depth knowledge for analysis of soil and plant samples for micro and macro nutrients. Determination of lime and gypsum requirements, analysis of soil extract and irrigation water.
- To gain the knowledge of grassland ecology, problems and management of grassland, establishment and management of pasture, agroforestry systems, techniques for crop production in agroforestry.
- To explore about response of plant to different stress like drought stress, temperature stress, salinity stress. Problems related to soil, water and air associated with agriculture. To understand the effect of sewage and industrial effluents, pesticides, toxic elements and their remediation / amelioration.

**Course outcome:**

| Sr.No. | Course Code | Course name | Credits (Theory+Lab.) | Course outcome |
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| | | **1st Semester** | | |
| **1.** | SOA/AGRON/C-501 | Statistical Methods and Experimental Designs | 3 + 1 | Students will be able understand Processing of data: Classification and tabulation of statistical data by categories and measurements, graphical and diagrammatic representation-histogram. Frequency polygon, frequency curve and cumulative frequency curves.<br>Students will be able to explain measure of location and dispersion: Mean, median, mode, partition values (quartiles, deciles and percentiles). Range, quartile deviation, mean deviation about mean and median, standard deviation coefficient of variation, moment kurtosis.<br>Students will be able to calculate Probability & distribution: Random experiment, sample space (discrete case only), events mathematical and statistical definition of probability, random variable (discrete and continuous), bermoulli trials, and binomial distn. poision distn. Poision distn as a limiting case of the bionominal distn, normal sistn, properties of the above distributions and fitting with available date, Test for their goodness offit.<br><br>Students will be able to calculate and describe<br>Correlation and regression : Bivariate data, bivariate frequency distn, correlation coefficient, rank correlation, Regression lines, regression coefficients and their relation with correlation coefficient,<br>Multiple regression, multiple and partial correlation coefficients.<br><br>Students will be able to explain<br>Estimation: Concept of population and sample; parameters and statistics: criteria for Good estimator unbiasedness, consistency of population mean and its confidence internal in the normal case.<br><br>Students will be able to understand testing of hypothesis : Null and alternative hypotheses, two type of errors, level of significance, power of the test, one tailed and two tailed tests. |

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| | | | | Students will be able to describe tests of significance: (a) large sample tests for mean & equality of means of two populations (2-tests).<br><br>Students statistic and its use of testing the mean equality of means of two populations (with independent and paired observations) correlation coefficient and regression coefficients. (b) Chi-Square statistics and its use as a test of goodness of fit, independence of attributes (contingency table) with Yates correction, and testing for the variance of a population. (c) Fishers statistic and its use in testing the equality of two variances and homogeneity of means (analysis of variance).<br><br>Students will be able to explain analysis of variance and covariance (ANOVA and ANCOVA) .Analysis of variance and covariance with one way and two-way classifications (one observation per cell). Bartlettin test for testing the homogeneity of variances.<br><br>Students will be able to use different design of experiments : Need : uniformity trials, Principles of experimental design-replication,<br>randomization and local control,<br>(a) Completely randomized, randomized block and Latin square designs and their analysis, missing plot technique in RBD.<br>(b) Simple factorial experiments of the type 22, 33, 24, 32, confounding in factorial experiments.<br>(c) Split-plot experiments. |
| **2** | SOA/AGRON/C-502 | Advances in Soil fertility and Nutrient Management | 2 + 1 | Students will be able to understand concepts of Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.<br><br>Students will be able to describe the Criteria of essentiality of nutrients; Essential plant nutrients - their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.<br><br>Students will be able to understand preparation and use of farmyard manure, compost, green manures, vermicompost, bio-fertilizers and other organic |

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| | | | | concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.<br><br>Students will be able to know about Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.<br><br>Students will be able to understand time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermi-compost and residue wastes in crops. |
| **3** | SOA/AGRON/C-503 | Advances in Weed Management | 2 + 1 | Students will be able to explain weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices.<br><br>Students will be able to understand Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.<br><br>Students will be able to describe herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allele chemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.<br><br>Students will be able to explain weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control.<br>Integrated weed management; cost; benefit analysis of weed management. |
| **4** | SOA/AGRON/C-504 | Principles and Practices of Water Management | 3 + 1 | Students will be able to describe water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states. |

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| | | | | Students will be able to understand soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition.<br><br>Students will be able to explain soil, plant and meteorological factors determining water needs of crops; scheduling, depth and Methods of irrigation; micro irrigation system; fertigation; management of water in controlled environments and poly houses.<br><br>Students will be able to describe water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency.<br><br>Students will be able to know about excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing. |
| **5** | SOA/AGRON/C-505 | Agronomy of Major Cereals and Pulses | 3 + 1 | Students will be able to get exposure for Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of<br>*Rabi* cereals: Wheat and Barley.<br>*Kharif* cereals. : Paddy, Maize, Sorghum, Bajra & Smaller Millets<br>*Rabi* pulses: Gram, Lentil and Pea.<br>*Kharif pulses*: Arhar, Mung and Urd. |
| **2nd Semester** | | | | |
| **6** | SOA/AGRON/C-506 | Agro meteorology and crop Weather Forecast | 2 + 1 | Students will be able to get exposure of Agro meteorology - aim, scope and development in relation to crop environment; composition of atmosphere, distribution of atmospheric pressure and wind.<br><br>Students will be able to explain characteristics of solar radiation; energy balance of atmosphere system; radiation distribution in plant canopies, radiation utilization by field crops; photosynthesis and efficiency of radiation utilization by field crops; energy budget of plant canopies; environmental temperature: soil, air and canopy temperature. |

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| | | | | Students will be able to describe the temperature profile in air, soil, crop canopies; soil and air temperature effects on plant processes; environmental moisture and evaporation: measures of atmospheric temperature and relative humidity vapor pressure and their relationships; evapo-transpiration and meteorological factors determining evapo-transpiration.<br><br>Students will be able to explain modification of plant environment: artificial rain making, heat transfer, controlling heat load, heat trapping and shading; protection from cold, sensible and latent heat flux, controlling soil moisture; monsoon and their origin, characteristics of monsoon; onset, progress and withdrawal of monsoon; weather hazards, drought monitoring and planning for mitigation.<br><br>Students will be able to understand weather forecasting in India - short, medium and long range; aerospace science and weather forecasting; benefits of weather services to agriculture, remote sensing; application in agriculture and its present status in India; atmospheric pollution and its effect on climate and crop production; climate change and its impact on agriculture. |
| **7** | SOA/AGRON/C-507 | Principles and Practices of Organic Farming | 2 + 1 | Students will be able to understand concepts of organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.<br><br>Students will be able to describe organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermin compost, green manures and bio-fertilizers.<br>Students will be able to explain farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.<br><br>Students will be able to know control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.<br><br>Students will be able to describe socio-economic impacts; marketing and export |

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| | | | | potential: inspection, certification, labelling and accreditation procedures; organic farming and national economy. |
| **8** | SOA/AGRON/C-508 | Agronomy of Oil Seed, Fibre & Sugar Crops | 3 + 1 | Students will be able to get exposure for origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of :<br><br>*Rabi* oilseeds - Rapeseed and mustard, linseed, etc.<br><br>*Kharif* oilseeds - Groundnut, sesame, castor, sunflower, soybean etc.<br><br>Fibre crops - Cotton, jute, sun hemp etc.<br><br>Sugar crops - Sugar-beet and sugarcane. |
| **9** | SOA/AGRON/C-509 | Agronomy of Fodder and<br>Forage crops | 3 + 1 | Students will be able to get exposure for adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like maize, *bajra, guar,* cowpea, oats, barley, berseem, *senji,* lucerne etc.<br><br>Students will be able to get exposure for adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasses- lime, Napier grass, *Panicum, Lasiuras, Cenchrus* etc.<br><br>Students will be able to describe year-round fodder production and management, preservation and utilization of forage and pasture crops.<br><br>Students will be able to understand principles and methods of hay and silage making; chemical and biochemical changes, nutrient<br>losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor quality fodder.<br><br>Students will be able to explain economics of forage cultivation, uses and seed production techniques. |

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| **10** | SOA/AGRON/C-510 | Agronomy of Medicinal and Aromatic Crops | 3 + 1 | Students will be able to explain Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according to botanical characteristics and uses.<br><br>Students will be able to describe climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Isabgol, Rauwolfia, Poppy, *Aloe vera*, Satavar, Stevia, Safed Musli, Kalmegh, Asaphoetida, *Nux vomica,* Rosadle etc).<br><br>Students will be able to explain climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium, Levender & Jasmine etc.). |
| **3rd Semester** | | | | |
| **11** | SOA/AGRON/C-511 | Self-study courses to be decided by concern department/college | 3 + 0 | Students will be able to explain cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.<br><br>Students will be able to understand Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.<br><br>Students will be able to describe above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.<br>Students will be able to understand crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system.<br><br>Students will be able to know plant ideotypes for drylands; plant growth regulators and their role in sustainability. |
| **12** | SOA/AGRON/C- | Dryland Farming | 2 + 1 | Students will be able to explain definition, concept and characteristics of dry |

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| | 512 | | | land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture.<br><br>Students will be able to understand soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.<br><br>Students will be able to describe stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.<br><br>Students will be able to get exposure to tillage, tilth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); anti- transparent; soil and crop management techniques, seeding and efficient fertilizer use.<br><br>Students will be able to understand concept of watershed resource management, problems, approach and components. |
| **13** | SOA/AGRON/C-513 | Management of Problem Soils | 2 + 1 | Students will be able to explain problem soils classification and distribution. Nature and properties of saline, alkali and acidic soils.<br><br>Students will be able to describe plant responses to soil reaction, extent of damage to crops, salt tolerance of the crops. Management and improvement of saline, alkali and acidic soils.<br><br>Students will be able to understand excess soil water conditions – sources and occurrences. Rainfall analysis and water balance. Effect of excess soil water on crop growth.<br><br>Students will be able to explain management of excess soil water, water fluctuation and side movements, lowering of water table for successful crop |

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| | | | | production. Degraded soils and their rehabilitation. |
| **14** | SOA/AGRON/C-514 | Modern concept in Crop Production | 2 + 1 | Students will be able to understand the concepts of crop growth analysis in relation to environment; Agro-ecological zones of India.<br><br>Students will be able to explain quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.<br><br>Students will be able to describe effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modelling for desired crop yield.<br><br>Students will be able to explain scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.<br><br>Students will be able to understand integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture. |
| **15** | SOA/AGRON/E-515 | Crop Ecology | 2 + 1 | Students will be able to understand concept of crop ecology, agricultural systems, ecology of cropping systems, principles of plant distribution and adaptation, crop and world food supply.<br><br>Students will be able to explain ecosystem characteristics, types and functions, terrestrial ecology, flow of energy in ecosystem, ecosystem productivity, biomass, succession and climax concept.<br><br>Students will be able to describe physiological response of crop plants to light, temperature, CO2, moisture and solar radiation; influence of climate on photosynthesis and productivity of crops; effect of global climate change on crop production. |

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| | | | | Students will be able to get exposure for exploitation of solar energy in crops; vertical distribution of temperature; efficiency in crop production.<br><br>Students will be able to understand concepts of competition in crop plants; environmental pollution, ecological basis of environmental management and environment manipulation through agronomic practices; improvement of unproductive lands through crop selection and management. |
| **16** | SOA/AGRON/E-517 | Soil Taxonomy, Survey and Remote sensing | 2 + 1 | Students will be able to describe soil survey — definition, objectives, methods, soil mapping units, types and advantages; land capability classification.<br><br>Students will be able to understand morphological, physical and chemical properties used in distinguishing and classifying soils, principles of soil taxonomy, classification systems.<br><br>Students will be able to describe soils of India and their taxonomic classification, Important characteristics, potential and constraints.<br><br>Students will be able to understand the concepts of Remote sensing-introduction, definition, concept, principles, importance, scope, types, advantages and disadvantages and its application in agriculture and soil classification. |
| **17** | SOA/AGRON/E-518 | Storage insect pests and their Management | 2 + 1 | Students will be able to explain introduction, history concepts and significance of management of storage insect pests. Postharvest losses *in toto visà-vis* total production of food grains in India. Scientific and socioeconomic factors responsible for grain losses.<br>Students will be able to describe important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range, biology, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes.<br><br>Students will be able to Understand ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and |

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| | | | | humidity in safe storage of food grains and commodities. Stored grain deterioration process, physical and biochemical changes and consequences. Grain storage- types of storage structures i.e., traditional, improved and modern storage structures in current usage. Ideal seeds and commodities' storage conditions.<br><br>Students will be able to describe important rodent pests associated with stored grains and their non-chemical and chemical control including fumigation of rat burrows. Role of bird pests and their management. Control of infestation by insect pests, mites and microorganisms. Preventive measures-Hygiene/sanitation, disinfestations of stores/receptacles, legal methods. Curative measures-Non-chemical control measures- ecological, mechanical, physical, cultural, biological and engineering. Chemical control- prophylactic and curative-Characteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants. Integrated approaches to stored grain pest management. |
| **4th Semester** | | | | |
| **18** | SOA/AGRON/C-519 | **Thesis** | 0 + 8 | Students will be able to conduct research in field and laboratory in specified crop(s) on different agronomic aspects. |
| **Or in lieu of thesis student can opt for course 520 & 521** | | | | |
| **19** | SOA/AGRON/C-520 | Seed Production Technology | 3 + 1 | Students will be able to explain objectives of seed production technology: Role in increasing agriculture production seed its importance, in green revolution difference between grain and seed. Concept of seed quality, steps involve in seed production. Principles of seed production, concept and factors that affect the seed quality in the growing; processing and distribution of seed, seed replacement rate, multiplication rate, seed industry in India and role of various agencies, important terminology used in seed industry, breeders, foundation, and certified seed, maintenance of genetic purity.<br>Students will be able to get exposure to seed certification: Its concept, role & goal, necessity of seed certification, minimum seed certification standard for self and cross pollinated crops, Field and seed inspections, objectives, general principles and methods. Preparation of field reports, seed certification terms; seed certification agencies, certified and truthfully ladled seeds.<br><br>Students will be able to understand the concepts of nucleus and breeders seed |

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| | | | | production of self-pollinated crops: Viz. Rice, Wheat, Arhar, Gram, Soybean, Rapeseed and Mustard.<br><br>Students will be able to understand maintenance of nucleus and breeders seed in cross pollinated crop varieties: in breds and noinbreds, maintenance of seed of established varieties, foundation, and certified seed production of Maize inbreeds, single and double cross hybrids.<br><br>Students will be able to explain hybrid seed production: of Rice, Maize, Sorghum, and Bajra, and Sunflower using male sterility systems.<br><br>Students will be able to get exposure to latest released hybrids L of Rice, Maize, Sorghum, and Bajra, their characteristic features.<br><br>Students will be able to describe seed testing: Importance of seed testing in production of high quality seed. Techniques of seed testing; Sampling, Sample preparation for seed testing, purity testing, germination test, physiology of seed in relation to viability, vigour & dormancy of seeds, Varietal identification, through electrophoresis. Growth out test for cultivar, purity. Seed legislation and seed law enforcement including IPR, PBR in India. Recent development in seed industry. Genetic aspect of varietal deterioration.<br><br>Students will be able to explain seed processing storage and marketing principle & practices of seed drying and seed separation selecting of sources air and screen seed cleanness physical characteristics utilized in seed cleaning & grading; seed treatment, type of seed treatment, materials & methods of seed packing, factors affecting seed in storage, problems of stored grains pest & methods to avoid the loss. Distribution & marketing of seed. |
| **20** | SOA/AGRON/C-521 | Soil Conservation and watershed Management | 3 + 1 | Students will be able to explain Soil erosion: definition, nature and extent of erosion; types of erosion, factors affecting erosion.<br><br>Students will be able to describe soil conservation: definition, methods of soil conservation; agronomic measures - contour<br>cultivation, strip cropping, cover crops; vegetative barriers; improved dry farming practices; mechanical measures - bunding, gully control, bench |

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| | | | | terracing; role of grasses and pastures in soil conservation; wind breaks and shelter belts.<br><br>Students will be able to understand watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping systems for watershed areas.<br><br>Students will be able to explain land use capability classification, alternate land use systems; agro-forestry; ley farming; *jhum* management - basic concepts, socio-ethnic aspects, its' layout.<br><br>Students will be able to describe drainage considerations and agronomic management; rehabilitation of abandoned *jhum* lands and measures to prevent soil erosion. |
| **21** | SOA/AGRON/C-522 | **Seminar** | 0 + 1 | Students will be able to present the classical and innovative work related to agronomy. This will be helpful for developing their presentation skills for research activities. |
| **22** | SOA/AGRON/E-524 | Agrostology and Agroforestry | 2 + 1 | Students will be able to understand the concepts of agrostology: definition and importance; principles of grassland ecology: grassland ecology - community, climax, dominant species, succession, biotype, ecological status of grasslands in India, grass cover of India; problems and management of grasslands.<br><br>Students will be able to explain importance, classification (various criteria), scope, status and research needs of pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.<br><br>Students will be able to describe agro forestry: definition and importance; agro forestry systems, agrisilviculture, silvipasture, agrisilvipasture, agrihorticulture, aqua- silviculture, alley cropping and energy plantation.<br>Students will be able to get exposure crop production technology in agro-forestory and agrostology system; silvipastoral system: meaning and importance for wasteland development; selection of species, planting methods and problems of seed germination in agro-forestry systems; irrigation and manuring in agro-forestry systems, associative influence in relation to above ground and |

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| | | | | underground interferences; lopping and coppicing in agro-forestry systems; social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics. |
| **23** | SOA/AGRON/E-525 | Stress Physiology | 2 + 1 | Students will be able to explain the response of plants to abiotic stresses: Abiotic stresses affecting plant productivity. Basic principles of a crop improvement programme under stress. Interactions between biotic and abiotic stresses.<br><br>Students will be able to understand drought stress: Physiological, biochemical and molecular mechanism, strategies to alleviate drought stress, signal transduction mechanism, Drought in relation to MAS and QTL, Role of ROS/ antioxidants, ABA, Cytokinin and other hormones.<br><br>Students will be able to know temperature stress (high and low): Tolerance mechanisms-role of membrane lipids in temperature tolerance. Functions of regulatory proteins.<br>Students will be able to describe salinity stress: Species variation in salt tolerance. Salinity effects at – Cellular and whole plant level, tolerance mechanisms. Salt tolerance in – Glycophytes and halophytes, breeding for salt resistance.<br><br>Students will be able to explain heavy metal stress: Aluminium and cadmium toxicity in acid soils. Role of phytochelatins (heavy metal binding proteins). |
| **24** | SOA/AGRON/E-526 | Soil, Water and Air pollution | 2 + 1 | Students will be able to explain soil, water and air pollution problems associated with agriculture, nature and extent.<br><br>Students will be able to describe nature and sources of pollutants — agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings.<br><br>Students will be able to get exposure of sewage and industrial effluents — their composition and effect on soil properties/health, and plant growth and human beings; sol as sink for waste disposal.<br><br>Students will be able to describe pesticides — their classification, behavior in |

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| | | | | soil and effect on soil microorganisms.<br>Students will be able to explain toxic elements their sources, beha<br>effect on nutrientsavailability, effect on plant and human health.<br><br>Students will be able to explain pollution of water resources due t<br>nutrients and pesticides from soil; emission of greenhouse gases<br>dioxide, methane and nitrous oxide.<br><br>Students will be able to understand the concepts of remediation/<br>contaminated soil and water; remote sensing applications in moni<br>management of soil and water pollution. |

**M.Sc. Biotechnology**
**Programme Code**: **328**
**Programme Summary**
Duration: 2 years
**Eligibility**
B. Sc with CBZ or any other equivalent degree like Biotechnology/ Microbiology/ Biochemistry/ Genetics/ Industrial Microbiology/ MLT with 50% marks in aggregate.

**Program outcome**
Programme outcome of M. Sc Biotechnology is to produce competent biotechnologist's who can employ and implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society. Students will exhibit contemporary knowledge in Biotechnology and students will be eligible for doing jobs in various sectors of pharmaceutical and biotechnological industry.

Biotechnology teaches about biological sciences with engineering technologies that manipulate living organisms and biological systems to produce products that advance healthcare, medicine, agriculture, food, pharmaceuticals and environment control. Biotechnology is a fundamental area of applied science that utilizes living cells and cellular materials to create pharmaceutical, diagnostic, agricultural, environmental, and other products to benefit society.

The Master of Science in Biotechnology is designed to provide specialised scientific learning along with skills training to help students explore various career paths in agriculture, health care, forensics, industrial processing, and environmental management. Students will be provided hands on learning into the functioning of the biotechnology industry. Students will have to undertake an Industry Project in their second year of the programme.

- To develop skills for general Biotechnology techniques like DNA isolation, Protein isolation, Electrophoresis Plant tissue culture techniques, polymerase chain reaction, transformation and vast knowledge of Genetic Engineering, plant and cell culture, cell biology and Biochemistry .
- To understand fundamentals of biochemistry including carbohydrates, lipids, proteins nucleotides, enzymes ,acid-base chemistry and bioenergetics.
- To acquire knowledge of intracellular compartmentalization of cell , plasma membrane, cell signalling ,cell cycle ,cell division and cell death pathways.
- Understand the concepts of Molecular biology and Molecular Genetics.
- To gain knowledge r DNA technology and Bioinformatics.

- Introduction to principle and application of fundamental laboratory equipments related to Biotechnology like electrophoresis, centrifugation, plant tissue culture techniques, ELISA, RIA.
- To be trained in recombinant DNA technology like DNA isolation, Restriction Digestion, polymerase chain reaction and Transformation.
- To learn fundamentals of Bioinformatics, Bioprocess technology and animal cell culture.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.

## Course Outcome

| | Course code | Course name | Credits | Course outcome |
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| **1st Semester** | | | | |
| 1. | S0LS/BT/C 001 | Cell Biology, Developmental Biology & Biophysics | 3 | To understand Intracellular Compartmentalization. Their Structure, organization and functions. To learn about the Structure and Functions of plasma membrane.<br><br>To understand the molecular aspects of of Cell Signaling, Protein sorting Cell Cycle and Cell Division Cell Death Pathways. To understand the basics of cancer biology. |
| 2. | S0LS/BT/C 002 | Biological & Radiotracer Techniques | 3 | On completion of the course, students are able to Understand:<br>1. Safety measures in laboratory, handling and care of instruments<br>2. they will demonstrate a broad understanding of life science technologies.<br>3.They will demonstrate ability to plan and execute experiments, and analyze and interpret outcomes.<br>4.Demonstrate understanding of selected Basic Principles & Concepts about biological techniques like microscopy, centrifugation, electrophoresis and basics of radioactivity. |
| 3. | S0LS/BT/C 003 | Molecular Biology & Genetics | 3 | To understand the concepts of Molecular Biology and Genetics. To study the chemical & physical properties of nucleic acids. Learn experimental evidences for nucleic acid as carrier of genetic information. To understand DNA replication, transcription, translation in Prokaryotes and Eukaryotes. To study the basic features of genetic code. To understand the regulation of gene expression in Prokaryotes and Eukaryotes. To impart knowledge about DNA damage and Repair mechanism.<br><br>To understand basic principles and exceptions of Mendelian inheritance. To learn the concepts of Linkage, crossing over and recombination. To gain knowledge about the organelle inheritance. To make students understand the role of the X and Y chromosomes in determining sex and how they are inherited. |
| 4. | S0LS/BT/C 004 | Biochemistry | 3 | Study of the classification, nomenclature, structure, general properties and functions of Carbohydrates, Lipids, Proteins and Nucleotides and Enzymes. Understanding of carbohydrate, protein, lipid, purine and pyrimidine biosynthesis, metabolism and regulation in the body. |
| 5. | S0LS/BT/C 005 | Laboratory course I | 3 | To impart practical knowledge and hands on training based on courses S0LS/BT/C 001 and S0LS/BT/C 002. |
| 6. | S0LS/BT/C 006 | Laboratory course II | 3 | To impart practical knowledge and hands on training based on courses S0LS/BT/C 003 and S0LS/BT/C 004. |
| **2nd Semester** | | | | |
| 7. | S0LS/BT/C 007 | Immunology | 3 | To introduce the basic concepts of cells and organs of the immune system and immunity. To study the structure and function of antigen and antibodies. To learn about Major Histocompatibility Complex, antigen processing and presentation, complement system and cytokines. To provide knowledge about Humoral and Cell Mediated Immune Response: B- cell |

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| | | | | and T – cell receptor complex. Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody dependent cell cytotoxicity (ADCC). To give an overview of hypersensitivity and autoimmunity. Transplantation: Graft vs. host reaction and rejection; Immunization and Vaccines. To provide knowledge of antigen-anibody interaction and Immunodiagnostic techniques: RIA, ELISA, Western blotting, Immunoprecipitation, Immunofluorescence. |
| 8. | S0LS/BT/C 008 | Microbiology & Microbial Genetics | 3 | Exposure to the historical aspects of Microbiology. To learn about bacterial classification concept and various techniques used in it (Morphological, chemotaxonomic and genetic methods Phylogenetic, numerical and polyphasic taxonomy). To appreciate the scope and relevance of microbiology. To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods). To learn factors affecting growth of microbes(Physical and chemical agents)To understand the concepts of Microbial Genetics: Gene transfer mechanisms, Transformation (Competence factor, natural and artificial transformation mechanism), Conjugation ($F^+$ X $F^-$ mating, Hfr, Hfr X $F^-$), Transduction (Mechanism of generalized and specialized transduction) and Phage genetics including regulation of lytic and lysogenic cycle. |
| 9. | S0LS/BT/C 009 | Molecular Endocrinology & Enzymology | 3 | To learn isolation and purification of enzymes and enzyme assay. To understand large scale production of enzymes, immobilization of enzymes. To understand the concept of artificial enzymes and ribozymes. To study the mechanism of action of some important enzymes. To understand mechanism of hormone action, hormone-receptor interaction. To study biosynthesis, control of secretion & physiological actions of Thyroid, Pancreatic, Steroid, Androgens, Estrogens and various plant hormones. |
| 10. | S0LS/BT/C 010 | Biomaths, Biostats, Computers Programming & applications | 3 | To study relation of Life Science with mathematics. Importance of statistics in biomedical research. To study various aspects of biomaths and biostats. To understand the concept of mean, mode, median, range, mean deviation, standard deviation, standard error, skewness & kurtosis, correlation & regression, chi square test, f-test, t-test. Introduction to computers. Applications of common packages, Microsoft office: Microsoft word, Microsoft excels and Microsoft PowerPoint. |
| 11. | S0LS/BT/C 011 | Laboratory course I | 3 | To impart practical knowledge and hands on training based on courses S0LS/BT/C 007 and S0LS/BT/C 008. |
| 12. | S0LS/BT/C 012 | Laboratory course II | 3 | To impart practical knowledge and hands on training based on courses S0LS/BT/C 009 and S0LS/BT/C 010. |
| 3rd Semester | | | | |
| 13. | S0LS/BT/C 013 | Bioinformatics, Legal Biotechnology & Bio Business Management | 3 | An ability to function on multidisciplinary teams.<br>An ability to design and conduct computational experiments.<br>An understanding of professional and ethical responsibility.<br>A knowledge of contemporary issues.<br>To offer the importance of intellectual property rights for the technologies.<br>To learn about the project management and entrpreneurship. |

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| 14. | S0LS/BT/C 014 | Recombinant DNA Technology & Genomics | 3 | Development of an ability to design and conduct genetic engineering experiments, as well as to analyze and interpret data and construction of DNA and cDNA libraries.<br>Development of research aptitude and technical skills to secure a job in genetic engineering labs.<br>Understand genome complexity, genome organization and genome analysis.<br>Learn Whole genome Sequencing, accessing whole genome sequence databases.<br>Learn various methods of gene expression profiling.<br>Learn the procedures involved in RT-PCR, Northern hybridization, microarrays, proteomics etc., Learn procedures involved in assigning gene functions.<br>Learn bioinformatics tools in genomics research.<br>Learn strategies for gene identification, allele mining, etc. |
| 15. | S0LS/BT/E 001b | Research Methodology: Tools & Techniques | 3 | To develop understanding of the basic framework of research process.<br>To develop an understanding of various research designs and techniques.<br>To identify various sources of information for literature review and data collection.<br>To develop an understanding of the ethical dimensions of conducting applied research. |
| 16 | S0LS/BT/E 002b | Plant Biotechnology | 3 | Learn about tools and techniques of recombinant DNA technology and plant transformation methods.<br>Learning vectors used for plant transformation, Engineering plants for biotic stress like insect pests and diseases.<br>Engineering plants for abiotic stress. Engineering plants for herbicide tolerance. Engineering plants for shelf life and nutritional quality.<br>Gaining knowledge on biosafety, risk assessment and regulation of transgenic plants in India. |
| 17 | S0LS/BT/C 015 | Laboratory Course I | 3 | To impart practical knowledge, hands on training and demonstration of based on courses S0LS/BT/C 013 and S0LS/BT/C 014. |
| 18 | S0LS/BT/E 003 | Laboratory Course II | 3 | To impart practical knowledge, hands on training and demostration of based on courses S0LS/BT/E 001b and S0LS/BT/E 002b. |
| **4th Semester** | | | | |
| 19 | S0LS/BT/SS004 | IPR, Patenting & Bioethics | 3 | To introduce students to Intellectual Property Rights and Patenting in biology.<br>Gain an understanding of the basic concepts of Patents, Trademarks, Copy rights, Geographical indications and Patent data base.<br>Understand the historical background, importance and levels of Biosafety at laboratory and industrial scale. |
| 20 | S0LS/BT/C 016 | Environmental Biotechnology & Bioprocess Engineering | 3 | Explain the importance of microbial diversity and of molecular approaches in environmental microbiology and biotechnology.<br>Describe existing and emerging technologies that are important in the area of environmental biotechnology;<br>Describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling.<br>Plan a research career or to work in the biotechnology industry with strong foundation about |

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| | | | | bioreactor design and scale-up.<br>Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems |
| 21 | S0LS/BT/C 017 | Cell & Tissue Culture | 3 | Pursuing research related to animal cell and tissue culture at national and international level.<br>To contribute in industries related to animal cell culture as scientists.<br>Develop skills for application of tissue culture techniques in plant breeding and horticulture.<br>To get knowledge about the plant tissue culture and transgenic plants.<br>Analyze the role of major, minor, micro nutrients, vitamins and growth hormones in plant tissue culture.<br>Identify the major and minor factors that contribute towards in vitro growth of explants. Find out the different modes of plant regeneration.<br>Produce callus culture, suspension cultures and secondary metabolites with theoretical background.<br>Mass multiply virus free plants through in vitro techniques.<br>Produce haploid plants through anther, ovule and ovary culture.<br>Employ various in vitro techniques for crop improvement and conservation.<br>Design a plant tissue culture laboratory. |
| 22 | S0LS/BT/E 004c | Immunotechnology | 3 | Account for the structure and function at the molecular and cellular level of the immune defense.<br><br>Account for polyclonal, monoclonal and humanized antibodies and production of these describe immunization/vaccination, immunological disease and immunotherapy assess health problems with an immunological background.<br>Develop approaches for immune intervention; discuss immunological techniques and their applications in biotechnical industry.<br>Evaluate and assess current and evolving concepts in immunological developments including immunetechnology, immunotherapy (cancer and stem cell) and immunoprophylaxis. |
| 23 | S0LS/BT/C 018 | Laboratory Course | 3 | To impart practical knowledge, hands on training and demonstration based on courses S0LS/BT/C 016 and S0LS/BT/C 017 |
| 24 | S0LS/BT/E 005 | Dissertation | 6 | Gain knowledge to identify the research problem, formulating a research proposal, methodically implementing the research, recording the results through experiments, interpreting the results and deriving a solution for the research problem. |

## M.Sc. Botany

**Programme Code**: 329

**Programme Summary**

Duration: 2 years

**Eligibility**

B Sc with CBZ with minimum 45% marks in aggregate.

## Program Outcomes:

1. Understanding the general character, structure, reproduction, nutrition and phylogeny of Fungi; general history, structure, reproduction, nutrition, economic importance of bacteria, cyanobacteria, virus, phytoplasma; and structure, reactions, mechanism of antigens and antibodies.
2. To study about the general habit, thallus structure, classification, phylogeny, salient features, life cycle and alternation of generation, physiology and biochemistry, economic importance of several groups of algae, and morphology, structure, reproduction, phylogeny, ecology and fossil-general account of several bryophytes.
3. To study about history, origin, classification, distribution, morphology, life history of various pteridophyte, gymnosperms and study about the fossil plants.
4. To know about the origin of population, species concept, taxonomic hierarchy, features of ICBN, taxonomic tools, evidences, classification, herbarium, gardens, plant exploration and taxonomic study of dicotyledons and monocotyledons families.
5. To know about the seed germination, seedling growth, mobilization of food reserves, shoot development, cell division and cell communication, cambium functions, leaf growth, root development, reproduction, male gametophyte, female gametophyte development, pollination, seed development and fruit growth, latent life dormancy and senescence and progrmmed cell death (PCD).
6. To know about the plant resources, world centers of primary diversity domestication of plants, origin, evolution, botany, cultivation, cytotaxonomy and economic importance of food crops, forage and fodders, fibres' crops, medicinal and aromatic plants, ornamental plants, NWFPs, IPR, ethnobotany, green revolution, principles of conservation and strategies for conservation.
7. To know about the dynamic cell, plasma membrane, mitochondria and chloroplast, nucleus, chromatin organization, principles of inheritance, structural and numerical alterations in chromosomes, genetics of prokaryotes and eukaryotic organelles, gene structure and expression, genetic recombination and genetic mapping, mutations and nuclear DNA content.

8. To know about the role of plant breeding, hybridization, heterosis, breeding for resistance to diseases, physiological races, role of mutation in crop improving and evolution, plant breeding work in India, maintenance of collection, bio-statistics and its application in life science.
9. To know about functional aspects of plant cell structure, energy flow, biologically important molecules, membrane transport and translocation of water and solutes, photophysiology and photosynthesis, respiration and lipid metabolism, nitrogen fixation, and phytohormones and sensory photobiology.
10. To know about the Vegetation organization, Vegetation development, Ecosystem organization, Global biogeochemical cycles; mineral cycle, Ecosystem stability, Biological diversity, Climate and vegetation pattern of the world, soil, air, water and soil pollution, climate change, fire as an ecological factor, Ecological management, Remote Sensing, and application of remote sensing.
11. To know about the forest, forestry, man, essential elements of forest ecology, Forests and trees, Wild Life, Forest conservancy and Potential Productivity, Forest Conservation and Management, Environmental Impact Assessment.
12. To know basic procedure in diagnosis of plant diseases, Seed Pathology, Nursery disease, Plantation disease, Important disease of cash crops, Various forms and Role of Mycorrhiza in Forestry, Diseases of cereals, Millets, vegetables and fruit trees.
13. To know about the Different types of microscopes, Sources of Timber, Physical features of wood, Gross features of wood, Ultra structure of wood, Natural defects of wood, Criteria and methods of assessment of wood quality.
14. To know about the basic concept, history of conservation biology, origin and evolution of organism, Patterns of biodiversity, Uses of biodiversity, Threats to biodiversity, Global environmental problems, Extinction to species, Environmental Impact Assessment, Conservation of Biological diversity, Survey and monitoring of biological resources, Conservation of energy resources, Conservation of biological resources, Protected Area Network, Ecosystem restoration, National Forest Policy.
15. To know about the basic concepts, principles and scope of Biotechnology, Plant cell and tissue culture, Organogenesis and adventive embryogenesis, Somatic hybridization, Applications of plant tissue culture, Recombinant DNA technology, Genetic engineering of plants, Microbial genetic manipulation, Genomics and proteomics, and bioinformatics.
16. To know about the Environmental Management, EIA Planning and Significance, Environmental Management and Natural Resources, Environmental policy and environmental management system, Basic concept of ecosystem and community, Biodiversity and conservation, Protected areas concept and purpose, Renewable Energy Production and Management, Biofuel plants, oil crops and Biofuel plantation, Carbon sequestration and carbon pools.
17. To know about the introduction of seed pathology, seed borne pathogens, seed borne fungi, Nature of seed infection, Longevity of seed borne pathogens, Epiphytology of seed borne diseases, Detection of seed borne pathogens, Study of seed borne diseases of certain crops, Control of seed borne pathogens.

## Course outcome:

| S.No. | Course code | Course name | Credits | Course outcomes |
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| | | | **1st Semester** | |
| 1 | **SLS/BOT/C001.** | **Mycology and Microbiology -Theory** | 03 | 1. To know about the History of Mycology in India and abroad, General characters of Fungi: Substrate relationship in fungi; Cell ultra structure; unicellular and multicellular organization, nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual); Recent trends in the classification.<br>3. To know about the Phylogeny of Fungi; General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; Fungi in industry, medicine and as food. Mycorrhizae; Fungi as biocontrol agents.<br>4. To know about the Symptoms, causal organisms of plant phogens belonging to various fungal classes i.e. Mastigomycotina, Zygomycotina, acomycotina, basidiomycotina and deuteromycotina.<br>5. To know about the brief history of Microbiology, the diversity of micro-organisms, microbial growth, Archaebacteria and Eubacteria: General account; ultra structure, nutrition and reproduction; biology and economic importance; cyanobacteria- classification, salient features and economic importance.<br>7. To know about the Viruses: Characteristics; isolation and purification of viruses; chemical nature, replication, Transmission of viruses; economic importance, Phytoplasma: General characteristics and role in causing plant diseases. (e.g. sandal spike disease, sesamum phyllody, little leaf of brinjal).<br>8. To know about the Immunology: Structure of antigens and antibodies, antigen- antibody reaction, Mechanism of antigen-antibody reactions. Vaccines and toxoids, Hypersensitivity. |
| 2 | **SLS/BOT/C002** | **Phycology and Bryology - Theory** | 03 | 1. To know about the, morphology, structure and Economic Importance and life cycle pattern of Algae.<br>2. To know about the general characters, classification morphology, anatomy and Economic Importance and life cycle pattern of Bryophytes,<br>3. To learn about the ecology and significance of lower plants. |
| 3 | **SLS/BOT/C003** | **Pteridology, Gymnosperms and Palaeobotany - Theory** | 03 | 1. To Know about the ecology and significance of pteridophytes and gymnosperms.<br>2. Study and impart knowledge about the history, origin, classification of past and present distribution, economic importance, morphology and anatomy of syllabus mentioned pteridophytes and gymnosperms plants.<br>3. To Know about the some fossil plants related to pteridophytes and gymnosperms.<br>4. To Know about the different types of fossil and their mode of preservation. |
| 4 | **SLS/BOT/C004.** | **Taxonomy and Diversity of flowering plants - Theory** | 03 | 1. Origin of intra- population variation: Population and the environment; ecads and ecotypes; Evolution and differentiation of species- various models.<br>2. The species concepts; taxonomic hierarchy, species, genus, family and other categories; principles used in assessing relationship, delimitation of taxa and attribution of rank.<br>3. Salient features of the International Code of Botanical Nomenclature.<br>4. Taxonomic evidences and Taxonomic tools: anatomy, palynology, embryology, phytochemistry, histological, |

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| | | | | cytological, phytochemical, serological, biochemical and molecular techniques.<br>5. Systems of angiosperm classification: Phenetic versus phylogenetic systems; cladistics in taxonomy; major systems of classification (Bentham and Hooker, Hutchinson, Cronquist) and their relative merits and demerits.<br>6. Herbarium and Botanical gardens: General account.<br>7. Plant exploration in India with reference to North west and Uttarakhand Himalaya.<br>8. Status of flowering plant diversity in Garhwal Himalaya.<br>9. A study of the following families and their relationships:<br>a. Dicotyledons:, Magnoliaceae, Berberidaceae, Fumariaceae, Violaceae, Meliaceae, Apiaceae, Sterculiaceae, Tiliaceae, Geraniaceae, Combretaceae, Asteraceae, Campanulaceae, Ericaceae, Primulaceae, Asclepiadaceae, Convolvulaceae, Verbenaceae, Scrophulariaceae, Oleaceae, Amaranthaceae, Chenopodiaceae, Loranthaceae, Urticaceae, Juglandaceae, Fagaceae and Salicaceae.<br>b. Monocotyledons: Hydrocharitaceae, Orchidaceae, Amaryllidaceae, Arecaceae, Araceae, Lemnaceae, Poaceae and Cyperaceae . |
| 5 | **SLS/BOT/C005** | **Laboratory course- I** | 03 | Based on theory paper Mycology and Microbiology (SLS/BOT/C001) and Phycology and Bryology.<br>(SLS/BOT/C002). |
| 6 | **SLS/BOT/C006** | **Laboratory course- II** | 03 | Based on theory paper Pteridology, Gymnosperms and Palaeobotany (SLS/BOT/C003) and Taxonomy and Diversity of flowering plants (SLS/BOT/C004). |
| **2nd Semester** | | | | |
| 7 | **SLS/BOT/C007.** | **Plant development and Reproductive biology**<br>**-Theory** | 03 | 1.To Know about the seed germination and seedling, hormonal control of seedling growth, seed dormancy and breaking methods of seed dormancy and bud dormancy, senescence and programmed cell death ( PCD) , seed development and fruit growth.<br>2. To Know about the floral parts microspogenesis and megasporogenesis, organisation of embryo sac, pollen pistil interaction, methods of pollination and fertilization, endosperm and embryogenesis and polyembrony, apomixis, embryo culture.<br>3. Understand the scope & importance of anatomy.<br>4. To Know about the various tissue systems root apex meristem and shoot apex meristem, secondary xylem and leaf growth.<br>5. Understand about the normal and anomalous secondary growth in plants and their causes. |
| 8 | **SLS/BOT/C008** | **ResourceUutilization, IPR and Ethnobotany - Theory** | 03 | 1. To know about the plant resources: Concept, status, utilization and concerns, World Centers of Primary Diversity of domesticated plants.<br>2. To know about the Origin, evolution, botany, cultivation, Cytotaxonomy and uses of Cereals and millets (wheat, paddy, maize), Legumes (soybean, black gram and cowpeas), Sugar cane and starches (sugarcane, beetroot, potato, sweat potato, cassava), Forage and fodder crops, Fibre crops, medicinal and aromatic. |

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| | | | | 3. To know about the Important firewood and timber yielding plants and non- wood forest products (NWFPs) such as bamboos, gums, tannins, dyes, resins, beverages.<br>4. To know about the Intellectual Property Rights, Concept, History, Protection of IPR; Patent- requirements, procedures and limitations; International convention on Biological Diversity.<br>5. Ethnobotany: Concept, linkage with other sciences, tools of ethnobotanical studies, world and Indian perspective with special reference to the Himalayas.<br>6. To know about the Green revolution: Benefits and adverse consequences, Plants used as ornamentals and avenue trees.<br>7. To know about the Principles of conservation: Extinction; Status of plants based on International Union for Conservation of Nature (IUCN) and Strategies for conservation: *In situ* conservation; Protected areas in India- sanctuaries, national parks and biosphere reserves. |
| 9 | **SLS/BOT/C009.** | **Cytogenetics and Molecular biology -Theory** | 03 | 1. To know about the dynamic cell: Structural organization of the plant cell; specialized plant cell, Cell wall: structure and functions; biogenesis, growth, Plasma membrane: structure models and functions; sites for ATPases, ion carriers, channels and pumps, receptors.<br>2. To know about the Mitochondria and chloroplast: Structure, genome organization, gene expression, Nucleus: structure, nuclear pores, nucleosome organization. 6. Ribosomes: Structure, cytoprotein synthesis.<br>3. To know about the Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, euchromatin and heterochromatin, specialized types of chromosomes; polytene, lampbrush, B-chromosomes and sex chromosomes.<br>4.To know about the Principles of inheritance: Mendelian laws along with molecular explanations, Exceptions to Mendelian laws, lethal alleles and Gene Interactions.<br>5. To know about the Structural and numerical alterations in chromosomes: Origin, occurrence, production and meiosis of haploids, aneuploids and euploids, induction and characterization of trisomics and monosomics.<br>6. To know about the Genetics of prokaryotes and eukaryotic organelles: genetic recombination of phage; genetic transportation, conjugation ant transduction in bacteria, cytoplasmic male sterility.<br>7. To know about the Gene structure and expression: Genetic fine structure, cis-trans test; fine structure analysis of eukaryotes, introns and their significance, regulation of gene expression in prokaryotes and eukaryotes. DNA damage and repair mechanism, defects in DNA repair; Initiation of cancer at cellular level, proto-oncogenes and oncogenes.<br>8. To know about the Genetic recombination and genetic mapping: Recombination; independent assortment and crossing over, linkage groups, genetic markers, construction of molecular maps.<br>9. To know about the Mutations: Spontaneous and induced mutations; physical and chemical mutation, molecular basis of gene mutation; mutations induced by transposons, and Nuclear DNA content; C-value paradox; Cot curves. |

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| 10 | **SLS/BOT/C010.** | **Plant breeding and Biostatistics -Theory** | 03 | 1. To know about the role of plant breeding - historical aspects and genetic basis: mode of reproduction in relation to breeding methods, breeding techniques; method of plant breeding in relation to self-pollinated and cross pollinated plants.<br>2. To know about the Hybridization: Interspecific and inter generic; pure line; back cross hybridization; self-incompatibility system.<br>3. To know about the Heterosis: Its genetic and physiological basis, Breeding for resistance to diseases, physiological races, Role of mutation in crop improving and evolution.<br>4. To know about the Plant breeding work done in India with special reference to potato, paddy, wheat and sugarcane, Maintenance of collection, registration of varieties, seed production, testing, certification and distribution<br>5. To know about the Bio-statistics and its application in life sciences, Methods of representation of statistical data and measurements of central tendencies, correlation, regression, curve fitting and ratio of variation, Probability and use of binomial trials. |
| 11 | **SLS/BOT/C011.** | **LABORATORY COURSE- I** | 03 | Based on theory paper Plant development and Reproductive biology (SLS/BOT/C007) and Resource Uutilization, IPR and Ethnobotany (SLS/BOT/C008). |
| 12 | **SLS/BOT/C012** | **LABORATORY COURSE - II** | 03 | Based on paper Cytogenetics and Molecular biology (SLS/BOT/C009) and Plant breeding and Biostatistics (SLS/BOT/C010). |
| **3rd Semester** | | | | |
| 13 | SLS/BOT/C013 | Plant physiology and Biochemistry -Theory | 03 | 1.To know about the metabolic activity and life cycle of the plant from germination through growth and development.<br>2. Know importance and scope of plant physiology.<br>3.Understand the plants and plant cells in relation to water-osmosis, imbibition, guttation, diffusion and water potential and the movement of sap and absorption of water in plant body, transpiration-structure and function of stomata, plant nutrition and essentiality and mechanism of absorption.<br>4. Understand the process of photosynthesis particular light and dark reaction, photorespiration, respiration particular emphasis on aerobic and anaerobic respiration.<br>5. to learn about enzymes structures, properties and their mechanism, nitrogen metabolism, plant growth regulators, photoperiodism and vernalization. |
| 14 | SLS/BOT/C014 | Ecology and Remote Sensing-theory | 03 | 1. To understand the principles and dynamics of community and population ecology.<br>2. To learn interspecies and intraspecies relations.<br>3. To find out the linkages in biogeochemical cycles.<br>4. To be able to cope with the impacts of climate change and global efforts.<br>5. To understand plant response to different pollution.<br>6. To understand the concepts, methodologies and applications of Remote Sensing in natural resource management<br>7. To prepare the students for National and Global Employability. |

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| 15 | **SLS/BOT/E001B** | **FOREST ECOLOGY -Theory** | 03 | **1.** To know about the Forests, forestry and man: Definition, forests in geological ages, forests in prehistoric era, shifting cultivation, forests in historical time, scientific forestry, forest policy, natural forest policy, private forest policy, panned forest development, forestry education in India.<br>**2**. To know about the Essential elements of forest ecology: Extent and boundaries, physical features, geology, river system, soil, land-use pattern, role in country's economy, forests and wild lands.<br>**3.** To know about the Forests and trees: Locality factors of the forests, forest influences, forest composition, stand structure, dynamics and growth, classification, forest types and their distribution, species diversity.<br>**4**. To know about the Wild Life: Species and distribution, Sanctuaries, Biosphere reserves, wild life and recreation.<br>**5**. To know about the Forest conservancy and Potential Productivity: Soil, Water relation and nutrition, soil erosion and conservation, potential productivity of forests, site quality evaluation.<br>**6.** To know about the Forest Conservation and Management: Impact of deforestation on soil and water, Role of fire: type, extent and cause of fire, fuel load, fire and different forest types of Himalaya, Forest resource management and forest resource information system, Forest cover in India-State of Art, Ground inventory. Application of Remote Sensing and Geographic Information System (GIS) in Land cover mapping. Vegetation and forest type maps.<br>**7.** To know about the Environmental Impact Assessment: Maintenance and conservational policies such as Joint Forest Management (JFM) and Agroforestry in the region. |
| 16 | **SLS/BOT/E002A** | **PLANT HEALTH MANAGEMENT -Theory** | 03 | 1. To study about Basic procedure in diagnosis of plant diseases, Significance of plant diseases, Seed Pathology, Seed borne fungi. Disease transmitted through seeds.<br>2. To know about the Biodeterioration of seed in storage and Control of seed borne fungi, to study about the Nursery disease: Important disease of nursery plants, to learn the Plantation disease: Plantation disease of Chir pine, Eucalyptus, Sal, Teak, Shisam, Populus, Acacia (Catechu).<br>3. To learn the important diseases of cash crops: Sugarcane, Potato and Ginger, how plants defend themselves against pathogen, Control of crop and forest disease. Treatment of wounds.<br>**4.** To know about Introduction and various forms of Mycorrhiza. Role of Mycorrhiza in Forestry, diseases of vegetables, fruit trees, cereals and Millets. |
| 17 | **SLS/BOT/C015.** | **LABORATORY COURSE -I** | 03 | Based on theory paper Plant physiology and Biochemistry (SLS/BOT/C013) and Ecology and Remote Sensing (SLS/BOT/C014). |
| 18 | **SLS/BOT/E03.** | **LABORATORY COURSE- II (Based on elective papers)** | 03 | LABORATORY COURSE- II: based on theory paper Forest Ecology (SLS/BOT/E001B) and Plant Health Management (SLS/BOT/E002A). |
| 19 | **SLS/BOT/E002C** | **APPLIED PLANT ANATOMY -theory** | 03 | 1. To study about the different types of microscopes, their working and utility.<br>2. To study about the Sources of Timber. Importance of knowledge of wood structure.<br>3. To study about How wood is formed: Cambium and its derivations, secondary growth, juvenile wood and mature |

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| | | **Self Study Paper (qualifying paper)** | | wood, Physical features of wood visible on the cross surface of log, sapwood and heart wood, growth rings and growth marks, colour, luster, odour and taste, weight, grain, texture.<br>4. To study about the Gross features of wood visible on longitudinal surface of wood, Ultra structure of wood and techniques: Electron microscope, ultra structure of cell wall, micro- fibril angle.<br>5. To study about the Natural defects of wood: Reaction wood, Knots, Silica content and other defects due to stress, Defects of timbers to utilization.<br>6. To study about the Wood structure in relation to properties and uses, Criteria and methods of assessment of wood quality in plantation grown timbers, viz: Eucalyptus and Poplar for pulp and timber. |
| **4th Semester** | | | | |
| 0 | SLS/BOT/C016 | Conservation Biology (Theory) | 03 | 1. To know about the basic concept, history of conservation biology and origin, evolution of organism; genetic plasticity a factor in evolution; the invasion of unoccupied ecological niches.<br>2. To know about the global and regional patterns of biodiversity, Distribution, Gradients, Magnitude of biodiversity, Hotspots, keystone species, effects of species deletion and addition on maintenance of biodiversity and uses of biodiversity, biodiversity based products and industries, wild relatives of cultivated plants, scientific role of biodiversity.<br>3. To know about threats to biodiversity, Global environmental problems, Extinction to species,Red and Green Data Books.<br>4. To know about Environmental Impact Assessment (EIA), Conservation of Biological diversity, Survey and monitoring of biological resources,People participation, biodiversity registers and their maintenance.<br>5. To know about the Conservation of energy resources, biological resources, Strategies, Designing Networks of Protected Areas; Restoration of endangered species, Challenges for the future.<br>6. To study about the Protected Area Network with special reference to Uttarakhand and India, International efforts for conserving biodiversity , Ecosystem restoration, Strategies and plans for restoration,<br>7. To learn about the National Forest Policy, Wildlife (Protection) act, Forest (Conservation) Act, Environment (Protection) Act, and Biodiversity Act. |
| 21 | **SLS/BOT/C017.** | **Biotechnology and Genetic Engineering of Plants and Microbes - theory** | 03 | 1. To know the genome organization in higher organisms.<br>2. To know the steps involved in recombinant DNA technology.<br>3. To Know the the construction of DNA and cDNA library and their applications.<br>4. To Know the development of an ability to design and conduct genetic engineering experiments, as well as to analyze and interpret data.<br>5. To Know the development of research aptitude and technical skills to secure a job in genetic engineering labs.<br>6. To develop skills for application of tissue culture techniques in plant breeding and horticulture about the plant tissue culture and transgenic plants.<br>7. To know about principles and Tools of Gene Cloning, strategies and steps of gene cloning.<br>8. To gain knowledge of sequence detection, amplification and modification techniques, DNA synthesis and sequencing (Chemical, enzymatic and automated methods); Sequence assembly for whole genome analysis.<br>9. To know about the principle, methods and applications of: PCR and techniques used in genome analysis, DNA fingerprinting,various molecular markers for genomics and proteomics. |

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| 22 | **SLS/BOT/E 005B.** | **Environment Management with Reference to Western Himalaya -theory** | 03 | 1. To understand appropriate sociological and technological measures in environment management.<br>2. To focus on ecosystem services and human well being and livelihoods.<br>3. To learn basis of problems and solutions in natural resource management.<br>4. To find solutions towards more sustainable societies around the globe.<br>5. To learn strategies for waste reduction and disposal.<br>6. To contribute meaningfully for analysis of environmental systems planning and management with both a local and global perspective<br>7. To prepare the students for national and global employability. |
| 23 | **SLS/BOT/E 005D.** | **Seed Pathology -theory** | 03 | 1. To study about Introduction, terminology and historical development, seed health and its importance, and kinds of seed borne pathogens: fungi, bacteria, viruses, viroides and nematodes.<br>2. To learn the types of damage caused by the seed borne fungi to seeds and crops, nature of seed infection.<br>3. To know about the systemic infection through flower, fruit and seed stock. Penetration through seed coat, natural openings and inflicted openings.<br>4. To study about longevity of seed borne pathogens, factors influencing longevity, detection of seed borne pathogens, objectives of seed health testing. testing methods for seed borne fungi, seed borne bacteria, seed borne viruses and seed borne nematodes.<br>**5.** To understand seed borne diseases of certain specific crops, cereals, millets, pulses, oil crops, fibre crops, and vegetable and timber crops.<br>6. To study about the control of seed borne pathogens: selection of seed production areas, crop management, seed treatment, certification, plant quarantine and disease resistance. |
| 24 | **SL/BOT/C018** | **Laboratory Course - I** | 03 | Based on paper Conservation Biology (SLS/BOT/C016) and Biotechnology and Genetic Engineering of Plants and Microbes (SLS/BOT/C017). |
| 25 | **SLS/BOT/E006** | **Laboratory Course - II** | 03 | Based on theory paper Environment Management with Reference to Western Himalaya (SLS/BOT/E 005B) and Seed Pathology (SLS/BOT/E 005D). |

## M.Sc. Chemistry

**Programme Code: 330**

**Programme Summary**

Duration: 2 years

**Eligibility**

B Sc with CBZ/ PCM with 45% marks in aggregate. Course contents: Organic chemistry, analytic chemistry, inorganic chemistry, physical chemistry, spectroscopy and chromatography, etc.

**Program outcome (PO):**

- To have sound knowledge about the fundamentals and applications of chemical and scientific theories.
- Every branch of Science and Technology is related to Chemistry.
- An ability to apply knowledge of important laboratory techniques, methods, and instrumentation.
- An ability to design and execute new chemical experiments, good laboratory practice and proper handling of chemical to successfully complete a research project.
- Easily assess the properties of all elements discovered.
- Apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories and in industries.
- Will become familiar with the different branches of chemistry like analytical, organic, inorganic , physical, environmental, polymer and biochemistry.
- Helps in understanding the causes of environmental pollution and can open up new methods for environmental pollution control.
- Develops analytical skills and problem solving skills requiring application of chemical principles.
- Acquires the ability to synthesize, separate and characterize compounds using laboratory and instrumentation techniques.
- An ability to broaden their foundations through activities such as teaching, internships, and fellowships.
- An understanding of professional responsibility and ethics in Chemistry.

**Course outcome:**

| | Course code | Course name | Credits | Course outcome |
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| **1st Semester** | | | | |
| 1 | C001 | Inorganic Chemistry I | 3 | In this paper students are expected to understand the structure of inorganic molecules their reaction mechanism and various theories to understand the transition metal complexes. |
| 2 | C002 | Organic Chemistry I | 3 | This paper provide the knowledge to student of all basic areas of chemistry regarding Nature of Bonding in Organic Molecules, Stereochemistry, Reaction Mechanism: Structure and Reactivity, Aliphatic Nucleophilic Substitution, Aliphatic Electrophilic Substitution. |
| 3 | C003 | Physical Chemistry I | 3 | In this branch of chemistry students know how chemical energy changes to electrical energy and vice versa. How all physical phenomena take place and detailed study of thermodynamics. |
| 4 | C004 | Group Theory & Spectroscopy | 3 | Group theory gives a theoretical knowledge regarding the properties of molecules in various aspects. And the knowledge of spectroscopy prepare to students for data interpretation of various molecules on the basis of obtained data from various technique such as unifying principle, Atomic Electronic Spectroscopy, microwave spectroscopy and infrared spectroscopy. |
| 5 | C005 | Laboratory Course IA | 3 | The main purpose of Qualitative analysis of inorganic radicals and organic mixture to prepare the students as a chemist in industry or a lab and provide the knowledge regarding to follow proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals. |
| 6 | C006 | Laboratory Course IB | 3 | In this lab course students are expected to understand the technique of chromatography, organic synthesis and practical's related to conductometry and electrochemistry. |

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| **2nd Semester** | | | | |
| 7 | C007 | Inorganic Chemistry II | 3 | In this paper students are expected to understand the colors and magnetic behavior of transition metal complexes, structure of silicates and inorganic compound related to borane and carbonyls |
| 8 | C008 | Organic Chemistry II | 3 | To understand the Mechanism and characteristics of different aromatic electrohpilic, aromatic nucleophilic substitution and free radicals reactions. Addition and elimination reactions providing the knowledge regarding organic synthesis and generating new molecules. Pericyclic reactions gives the ultimate knowledge regarding green chemistry and provide key for formation of ecofriendly organic molecules. |
| 9 | C009 | Physical Chemistry II | 3 | In this branch of chemistry students know how chemical energy changes to electrical energy and vice versa. How all physical phenomena take place and detailed study of thermodynamics. |
| 10 | C010 | Spectroscopy & Separation Methods | 3 | Part-A-Spectroscopy is provide a fundamental tool for organic molecular structure and give desirable knowledge for interpretation of data regarding the techniques such as Raman Spectroscopy, Nuclear Magnetic Resonance Spectroscopy and molecular Electronic Spectroscopy.<br><br>Part-B- Separation techniques are play an important role in separation of Natural occuring and synthetic organic molecules or components such as HPLC, GLC and ion exchange chromatography. |
| 11 | C011 | Laboratory Course IIA | 3 | I-Qualitative and Quantitative analysis of metal ions involving volumetric and gravimetric method, various organic synthesis and physical experiments at PG lavel provide the knowledge regarding to follow proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals. |
| 12 | C012 | Laboratory Course IIB | 3 | In this lab course students are expected to understand the technique of quantitative analysis of organic compounds, inorganic preparations and pH-metry and potentiometry related experiments. |
| **3rd Semester** | | | | |
| 13 | C018 | Organic Synthesis & Photochemistry | 3 | This paper will be able to student design the new organic molecules |

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| | | | | and give analytical tool regarding synthetic chemistry under various topics-Disconnection approach of organic molecules, protecting groups of various functional groups, one group and two group disconnections and photo chemistry developed a new approach regarding green chemistry and design new molecules under topics-determination of reaction mechanism and photochemical reactions. |
| 14 | E002 | Bioorganic, Bioorganic & Bio Physical Chemistry I | 3 | This branch of chemistry is very much related to living being that how any metal ion or group is important to human body and functions of different metalloproteinase in our body. |
| 15 | E006 | Organometallic reagents and Organic Synthesis | 3 | In this paper students basically understand the application of transition metal in organic synthesis and concepts related to oxidation, reduction and rearrangement reactions. |
| 16 | E005 | Spectroscopy & Solid State | 3 | Spectroscopy is basic tool for understanding analytical techniques. In this semester areas to be covered are UV, IR and ORD CD which will give student complete understanding of establishing chemical structure of organic molecule. |
| 17 | C016 | Laboratory course- Organic IIIA | 3 | This lab provide knowledge to the students of Qualitative Analysis Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid), using TLC for checking the purity of the separated compounds. Preparation of derivatives and spectral analysis. |
| 18 | C017 | Laboratory course- Organic IIIB | 3 | The main purpose of this experimental paper is to Students will be able to and understand how to calculate limiting reagent, theoretical yield, and percent yield. how to engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents. how to dispose of chemicals in a safe and responsible manner. how to work effectively as a member of a team. how to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration and thin-layer chromatography. |

| 4th Semester | | | | |
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| 19 | C027 | Natural Product Chemistry | 4 | I- Natural products compounds primarily of plant origin with vivid chemical structure. To establish their structure by using chemical degradations will be main focus of this subject. Chemical degradation studies will make students to revive basic organic chemistry already being studied by them thus will enable them to understand completely basic concepts of chemistry. Compounds belonging to alkaloids, steroids, flavanoids, porphyrins and carotenoids of varied structure and pharmacological activity will be taught to the students.<br><br>II- Students are expected to learn basic Chemistry of natural occurring compounds. |
| 20 | E009 | Spectroscopy | 3 | Spectroscopy is basic tool for understanding analytical techniques. In this semester areas to be covered are nuclear magnetic resonance both proton and carbon and mass which will give student complete understanding of establishing chemical structure. Students are expected to understand basic concept about spectroscopy. |
| 21 | E010 | Bioinorganic, Bioorganic and Biophysical Chemistry II | 3 | This branch of chemistry is very much related to living being that how any metal ion or group is important to human body and functions of different metalloproteinase in our body. |
| | E013 | Heterocyclic Chemistry | 3 | Hetero cyclic chemistry is the branch of organic chemistry which contain hetero atom. In this paper students are expected to understand their nomenclature, method of preparation and their chemical reactions. Besides hetero cyclic compounds have manifold application in pharmacy, medicine, agriculture and allied fields. |
| 23 | C025 | Laboratory Course Organic IVA | 3 | I- Natural products chemistry has produced enormous results and made great contributions to human health and industry, only a fraction of natural resources have been rigorously studied. This course provide the basic knowledge of extraction methods of following products:<br>a) caffeine from tea leaves<br>b) casein from milk<br>c) lactose from milk<br>d) nicotine dipicrate from tobacco |

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| | | | | e) limonene from citrus fruits<br>II- Chromatography is an important biophysical technique that enables the separation, identification, and purification of the components of a mixture for qualitative and quantitative analysis. Chromatography techniques provide the basic knowledge to the students regarding qualitative analysis of natural products. |
| 24 | C026 | Laboratory Course IV B | 3 | 1. Subject spectroscopy is basic tool for understanding analytical techniques. In this semester areas to be covered are nuclear magnetic resonance both proton and carbon and mass which will give student complete understanding of establishing chemical structure of known and unknown compounds which are synthesized /isolated compound.<br>2. To give the practical knowledge of spectroscopic methods & spectrophotometric (UV/VIS) ds having wide applications**.** estimations to the students.<br>3 Students are expected to understand basic concept of both the techniques so as they are able to analyses the compounds |

# M.Sc. Forestry

**Programme Code: 333**

**Programme Summary**

Duration: 2 years

**Eligibility**

B.Sc.(Agri.) / B.Sc.(Horti.) / B.Sc. (Forestry) degree or equivalent degree with four years duration.

**Program outcome**

- To study the concepts and methods of growth & development of forest tree species along with their modern nursery techniques .
- To learn about various methods to measure various dimensions of forest trees, area etc using different advanced tools along with modern remote sensing techniques.
- To study about various wood based raw materials, their physico-chemical analysis, wood based industries, finished products, non-timber forest products and their industries.
- To learn about different ecological aspects of forest, resources, productivity, forest ecosystems and biodiversity.
- To study about the usefulness of various statistical methods & tools in forestry researches, thesis, technical bulletins etc.
- To learn about forest based economics, tools techniques, tangible/intangible services, their market values and eco-development planning.
- To study about various diseases, insect -pest of forest tree species nursery, forest fire, adverse climatic factors, biological control of disease-insect -pest and other modern techniques.
- To study about different forest policies, laws, procedures, conservation acts, wild life act, forest rules.
- To learn about various concepts/aspects of forest genetics, breeding, tree improvement, resources, improvement techniques, polyploidy, GMOs etc.
- To study remote sensing, its use, tools, techniques for assessment of forest, resources, disease, fire, natural calamities, distribution of species.
- To learn about various Agroforestry systems, concepts, importance, implications and researches at national/international level.
- To study of concepts of soil and water management in Agroforestry, interpretation of meteorological data and bio-geochemical cycling with productivity.
- To study about different crops, inter-crops, agroclimatic/ecological zones in India, cropping patterns, designs, productivity etc.
- To learn about various economic aspects of Agroforestry schemes /projects, their socio-economic analysis, budgeting, marketing, enterprize, pre-post harvesting techniques, benefits in Agroforestry.
- To Study about different fruit, trees, woody elements and shrubs, their importance, agro-climatic distribution, improvement aspects and productivity.

- Study of eco-zonation and choice of Agroforestry systems, their components, integration and management techniques along with modern research tools.
- To study about concept, distribution, development & planning of watershed.
- To learn about various aspects and concepts of wood, water relations, physico-chemical aspects, seasoning & preservation techniques, factors affecting utilization etc.
- To Study about various aspects of forests, their importance, interaction with humans, livestock, farming systems, forest rights, climate change, biodiversity management etc.
- To know about history/future aspects of global climate change w.r.t.forests, agriculture, aquatic and other biotic ecosystems.
- To study about planning establishment, resources, importance and management of seed orchards, their types, genetic and silvicultural aspects.
- To acquire detailed knowledge about specific subject and topic and discipline.

**Course outcome:**

| | Course code | Course name | Credits | Course outcome |
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| | | | **1st Semester** | |
| 1 | SAS/For/C001 | Advanced Silviculture | 3 | To explore the silviculture in advanced form. Expend the way of treating the forest crop by improved and advanced techniques.<br>To understand the ecosystem concepts, forest composition and forest structure.<br>Productivity and vegetation forms of India, major forest division of world, regeneration of species in even and uneven aged stand. Silviculture of important trees.<br>Expand the knowledgeable of modern nursery techniques and tools. |
| 2 | SAS/For/C002 | Forest Biometry | 3 | The aims of the Biometry to Measurement of trees and stand; diameter (crops), girth, height, volume, tree form, taper equations, bark thickness, crown width and crown length determination of age and volume of felled as well as standing tree.<br>This module is designed to introduce statistical ideas for data collection and analysis that are suitable for the modern biological scientist.<br>Biometry is the application of mathematics and statistics to problems in the agricultural, environmental, and biological sciences.<br>Knowledge to design efficient experiments and surveys, to identify appropriate statistical techniques for the analysis of the data collected, to complete simpler analyses using a common statistical computing package, to interpret the output produced by these analyses, and to evaluate the results from statistical analyses presented in scientific papers. |
| 3 | SAS/For/C003 | Advanced Forest Management | 3 | Knowledge of forest ecology and silviculture principles to understand how forests and forested watersheds respond to natural disturbances or management activities.<br>Understanding of the social and political context of forestry and be able to describe current policies, laws, and regulations governing the management of forest lands.<br>Understanding valuation of Forest products. |
| 4 | SAS/For/C004 | Forest Industries & Forest Products Chemistry | 3 | To study Wood based industries relation to Indian economy.<br>To study wood chemistry and details about wood's extreneous components.<br>An idea about types of wood based industries in India. For example Pulp & paper, rayon, composite wood etc.<br>To study the wood saccharification and destructive distillation process and their products as well as by-products. |
| | SAS/For/C005 | Forest Ecology & Biodiversity Conservation | 2 | To Acquire knowledge of forest ecosystems through - Forest population Estimating abundance based on counts, Estimation of demographic parameters- delectability and demographic rate parameters, analysis of age frequencies.<br>Estimating survival, movement. |

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| | | | | Population viability analysis (PVA).<br>Help the students to amass the knowledge about forest community and level of disturbances and their impact on ecology - through Forest community dynamics, structure and analysis: Estimation of community parameters- estimation of species richness, estimating parameters of community dynamics.<br>Modern methods of data acquisition and summary classification and description, vegetation- environment relations, and successional processes. Predictability of vegetation pattern.<br>Spatial and temporal scale of community based analysis. Multivariate data analysis with applications to plant community.<br>Forest Productivity and Ecology of Forest landscapes: Will help the students to acquire knowledge about patents and international rules regarding IPR through - Spatial heterogeneity and hierarchy issues in ecology, Concept of biodiversity, Biodiversity zones species richness and endemism, state of biodiversity in India.<br>Conservation of natural resources (hotspot areas, wildlife sanctuaries, national parks, biosphere reserves).<br>Global warming and forests. Green House Effect and its consequences. Ozone depletion. Conservation laws and acts.<br>Forest genetics resources of India: timber and non timber species. Survey-exploration and sampling techniques. Documentation and evaluation of forests genetical resources (FGR), Conservation, in situ and ex situ of gene resources. Biological diversity and its significance to sustainable use. Handling and storage of FGR.<br>Intellectual property rights. Quarantine laws and FGR |
| | Practical | | 1 | Students will learn the tool to explore and dimensions of ecology through - Study of forest community structure and its successional status; estimation of productivity of forest ecosystem; trip to different regions of the state to study forest vegetation; collection and preservation of specimen.<br>Methods of vegetation analysis. Measurement of biomass and productivity. Quantification of litter production and decomposition.<br>Visit to national parks, wildlife sanctuaries, botanical gardens and arboreta. |
| | SAS/For/C006 | General Statistical Methods & Research Methodology | 2 | Linear and non-linear regressions, parabolic, exponential, power and logarithmic functions. Estimation and Testing of Hypotheses Concept of point and interval estimation, estimators and estimates, properties of good estimators- unbiasedness and minimum variance, testing significance of correlation and regression coefficients, analysis of variance (ANOVA) –one way and two way classification with single and more than one cell frequency. |

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| | | | | Design of Experiments**:** Principles of experimental designs.<br>Sampling-Theory and Applications**:** Why sample? Simple Random Sampling (with and without replacement), Stratified Random Sampling, Double sampling, Multistage sampling, Cluster sampling, Multivariate Statistical Techniques, Multivariate Analysis of Variance, Principal Component Analysis, Factor Analysis, Cluster Analysis, Selection of research problems considering National Forestry Policy- Writing project proposal, Generation of Research questions, Stating objectives of research study, Proposing hypotheses.<br>Planning for literature survey, Use of computer based literature, Planning for field work, Sampling and Enumeration exercises in the field and recording of the data and use of statistical tools. Interpretation of data and deriving inference and conclusions.<br>Preparation of thesis/ dissertation/research project report.<br>Writing of scientific articles and technical bulletin, Monitoring and evaluation methods. |
| | Practical | | 1 | Fitting of probability distributions, Computation of correlations and regressions, Tests of significance –t,F,z, $X^2$, Exposure to statistical packages SPSS and GENSTAT for ANOVA, multivariate analysis. Laying out of designs in the field (i) Fan design (ii) Latin Square, (iii) Randomized block design, (iv) Split plot design, (v) Row-Column designs and (vi) Scattered block. Data analysis of the above designs. |
| | | | **2nd Semester** | |
| | SAS/For/C007 | Forest Resource Management & Economics | 3 | Understand the concept of microeconomics related to forest Demand – Supply analysis of Forest Product Analyses the method for valuation of Non-market product Method and implementation of Forest certification SWOT Analysis Use of Operation Research Tools. |
| | Practical | | 1 | Application demand -supply concept Evaluation of ecosystem services use of computer programming technique for evaluation. |
| | SAS/For/C008 | Forest Protection | 2 | To study about Important diseases and insect pests of nurseries, plantations, standing trees and their management. Assessment of losses due to diseases, insect pests, vertebrate pests, adverse weather, forest fires and weeds.<br>Insect pests and mycoflora of seeds of forest trees and their management, Biodegrdation of wood- microscopic and chemical effects of white rot, brown rot, soft rot and wood discoloration Heart rots- factors affecting heart rots, damage caused, compartmentalization of decay in trees and management of heart rots.<br>Role of mycorrhiza in tree health.<br>Theories of natural regulation of insect populations.<br>Wildlife damage in nurseries, plantations and their management.<br>Weed problems in nurseries, plantations and their control.<br>Adverse climatic factors, acid rains and air pollutants in relation to forest tree health. |

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| | | | | Biological control of insect pests and diseases of forest trees. Molecular tools for developing disease resistance in trees. |
| | Practical | | 1 | Collection, identification and preservation of important insect pests and disease specimens of forest plants Detection of insect infestation and seed borne mycoflora.<br>Assessment of losses due to diseases, insect pests etc.<br>Habitat management of vertebrate pests.<br>Laboratory tests for estimating decay resistance in wood. Fire control methods and devices. Familiarization with the meteorological and plant protection equipments.<br>Application of pesticides and bio-control agents in the management of insect pests, weeds, diseases in nurseries and plantations.<br>Extraction of spores of arbuscular mycorrhizal (AM) fungi from soil and assessment or mycrorrhizal root colonization. |
| | SAS/For/C009 | Forest Policy, Law & International Convention | 3 | Will help the students to study the legal aspect of forestry through- Forest policy- Relevance and scope; National Forest Policy- 1894, 1952 and 1988; General principles of criminal law; Indian Panel Code, criminal procedure code; Indian evidence act as applied to forestry matters; Forest laws; Indian Forest Act- 1927, general provision and detailed study; Forest Conservation Act 1980, Wildlife Protect Act 1972,<br>To understand the Important Forest Rules and Guidelines, Important case studies and landmark judgments. |
| | SAS/For/C010 | Forest Genetics and Tree Improvement | 3 | To study Population Genetics- Selection definitions, Hardy Weinberg equilibrium, complete elimination of homozygous receive trees, partial selection against recessives, selection favouring recessive (against dominants), selection for genes with additive effects, "Fitness and Fisher's Fundamental Theorem". Selection for and against heterozgotes, selection in small populations, how to increase selection pressure, mutation, migration and isolation.<br>To learn about Tree Breeding- Variation in trees, importance and its causes. Natural variation as a basis for tree improvement. Geographic variation, ecotype, clinal races and land races. To study Selection and management, selection of forest trees – selection criteria; plus tree selection, breeding methods selection and genetic gains species and provenance selection.<br>To study Quantitative genetics – General principles and practical application in forest tree improvement, heritability, general and specific combining ability.<br>To learn about Controlled crossing systems and designs- purpose, self pollination, crossing system with unknown father, crossing system with known father, crossing plans, complete dialect, modified diallaled, partial diallaled, factorial. To study about Seed orchards- Types of seed orchards, planning and design, establishment, management, |

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| | | | | harvesting.<br>To study Progeny trials – Definitions and importance types of progeny, crossing systems, experimental designs, cultivation techniques, evaluation, records etc.<br>To learn Genotype – environment interaction.<br>Planning and strategies of a tree improvement programme. Breeding trees for specific purpose (Pest, disease and adverse environment). To explore Species and racial hybridization and its application. |
| 2 | SAS/For/C010 | Forest Genetics and Tree Improvement-Practical | 1 | To study Numerical analysis of population genetics questions, To study Plus tree selection, variation analysis in a forest population. Numerical questions on quantitative genetics.<br>To explore pollen viability, végétative propagation techniques, clonal experiments. |
| | SAS/For/C011 | Remote Sensing & Geographic Information System | 3 | The use of aerial photography, satellite imagery and geographic information system for the collection, storage and spatial analysis for geo-referenced forest resources data and information. Acquisition and interpretation of satellite data for forestry purpose. The integration of spatial data analysis system with knowledge-based systems and/ or simulation systems for the development of information/ decision support systems for forest management; satellite system; satellite imageries- techniques, uses and limitation; future prospects of remote sensing in India; software used in remote sensing; GIS versus remote sensing. |
| | Practical | | 1 | Uses of various photogrammetry instruments; recognition and identification of objects on photography; compilation of maps and interpretation. Hands on practice on remote sensing and GIS, software. Digital and visual interpretation of satellite image. |
| **3rd Semester** | | | | |
| | Practical | | 1 | Identification of Agroforestry systems using the classification of Agroforestry.<br>Application of Diagnosis & Design methodology in nearby area to understand need of improvement in existing landuse systems. |
| | SAS/For/C021 | Soil and Water Management in Agroforestry | 1 | Will help to understand Soil and water management- objectives and scope in relation to agroforestry system. Soil and water conservation, land classification and carrying capacity. Irrigation potential and methods. Optimization of waters use in agroforestry systems and dry land farming. Will acquire knowledge about Interpretation of agro-meteorological data for water management. Problem soils and their management, soil organisms and nitrogen fixation. Biogeochemical cycling of nutrients including organic matter decomposition. Nutrients budgeting and soil productivity under different agro-forestry systems. |

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| | Practical | | 1 | To acquire knowledge about the practical aspect of Calculation of water storage and fluxes in the soil. Determination of "in-situ infiltration rate of soils. Measurement and estimation of run-off. To study about Mineral nutrient analysis of soil and plants. Study of biogechemical cycles in agro-forestry systems. |
| 3 | SAS/For/C022 (Theory) | Principles of Crop Production in Agroforestry | 1 | To study about Choice of inter-crops for different tree species, sowing and planting techniques. Planting patterns, crop geometry, nutrient requirements irrigation scheduling, and weed management of field crops pulses, oil seeds, fodders, vegetables, medicinal plants and ornamentals seed production. To learn about Production potentials in multiple cropping in relation to agro climatic conditions. crop combination interactions in crop mixtures. To learn Allelopathy canopy management & Plant protection. |
| 4 | SAS/For/C022 (Practical) | Principles of Crop Production in Agroforestry | 1 | To learn about Measurement of crop growth rates. Study of crop weed association and fertilizer response. Quantitative evaluation of multiple and inter-cropping preparation and application of herbicides field visits. |
| 5 | SAS/For/C023 (Theory) | Economics of Agroforestry Systems | 1 | To know Basic principles of economics applied to agro-forestry. To explore Optimization techniques –Planning, budgeting and functional analysis. Role of time, risk and uncertainty in decision making. To study Financial and socio-economic analysis of agro-forestry projects. To study Principles of financial management and harvesting, post harvest handling marketing of agro-forestry products including benefit sharing. |
| 6 | SAS/For/C023 (Practical) | Economics of Agroforestry Systems | 1 | To conduct Exercises on agro-forestry production relationships. Preparation of enterprise, partial and complete budgets. Application of various methods in formulation and appraisal of agro-forestry projects. To prepare Case studies on harvesting, post harvest management and marketing of agroforestry products. |
| | SAS/For/E010 | Fruit Trees and Shrubs for Agroforestry | 2 | To access the role of fruit tree and shrub species in different agroforestry system. Specific features of multipurpose tree species and their use in agroforestry. Role of woody elements in agroforestry systems. Fruit trees role and relevance in agroforestry. Management of soil fertility, yield and quality under different agroforestry systems. Nitrogen fixing trees and shrubs, specific and generic characters of tree and shrub species used in agroforestry systems. |
| | SAS/For/E010 | Practical | 1 | To excel the field studies for special features of tree, shrub and fruit species for agroforestry. |
| | SAS/For/E011 | Management & Productivity in Agroforestry Systems | 3 | To extend the knowledge of Management and Agro-forestry Systems for Enhancing Resource Use Efficiency and Crop Productivity. Soil and water management is the key to sustainable crop production and food security.<br>Nuclear and isotopic techniques were used to provide crucial information on nutrient and |

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| | | | | water dynamics in agroforestry systems. |
| | SAS/For/E013 | Watershed Management | 3 | Understand the concepts of watershed management and its effect on land, water and ecosystem resources.<br>Analyze public policies and practices of watershed planning.<br>Assess the impact of watershed planning through case studies Develop control and mitigation techniques for watershed problems. |
| | SAS/For/E013 | Watershed Management Practical | 1 | In- field case study and application of engineering to protect and preserve watershed to improve the livelihood. |
| **4th Semester** | | | | |
| 1 | SAS/For/E018 | Wood Seasoning & Preservation | 2 | To understand Wood water relationship and Refractory & non refractory behavior of wood so that best utilization of wood can be done.<br>To study various Wood seasoning methods in detail. To study the different kind of defects of timber and their effect in its utilization.<br>To understand the effect of decaying agencies- fungi, insects, borer etc in wood properties. Detailed study of wood preservation. |
| 2 | Practical | | 1 | Hands-on exercises based on course SAS/For/EO18 |
| 3 | SAS/For/E020 | Forest and People | 3 | To understand the forest and its importance, interaction between forest and people, forests and economy of livestock, forest management and its social and cultural factors, human-wildlife conflicts, gender dimension of forest management, forest and tribal community, common property resource, important right of forests, biodiversity and ethno-botany. |
| 4 | SAS/For/E021 | Global Climatic Changes | 3 | To study about History and future of Earth's climate system.<br>To study the effect & interaction of Ozone depletion and UV radiation with weather.<br>To understand the vulnerability and adaptability of agriculture, forests, aquatic and biotic ecosystems to climatic change.<br>To understand the responses of biotic communities and changes in reproductive biology of flora and fauna. |
| 5 | SAS/For/S001 | Tree Seed Orchards Self Study Course | 3 | To study Importance of genetically improved seed in plantation. Status of seed production among major plantation species. Short term supply of superior seed.<br>To learn about Selection and delineation of seed stands, seed production areas, seed zones, seed ecological zones. Seed orchard: need, evolving seed orchards, containerized seed, hybrid and research seed orchards: first, second and advanced generation seed. Seed orchard genetics: random mating, gamete exchange and parental balance.<br>Estimation of genetic parameters from seed orchards data. Ortet age and its effect on seed production. Importance of progeny testing.<br>Establishment of seed orchards, selection and preparation of orchard site, isolation, |

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| | | | | orchard size, and design.<br>To know about Seed orchard management: roughing, silvicultural practices to increase seed yield. Pest and disease management. Seed collection and record keeping, seed orchard registration and documentation. Importance of seed orchards in gene conservation. |
| 6 | SAS/FOR/C028 | M.Sc. Thesis ( Field Based Work) | 9 | To acquire detailed knowledge about specific subject and topic and discipline. |

# M.Sc. Medical Lab Technology

## Programme Summary

Duration: 2 years

## Eligibility

B. Sc MLT or Medical Microbiology or M Sc in Medical Sciences with minimum 50% marks in aggregate.

**Program outcomes:**

The mission of the Medical Laboratory Technology Program is to promote and maintain standards of quality for the services and the environment necessary for students to achieve their educational goals and to enhance the social, cognitive, and professional skills required for entry level employment as medical laboratory technicians (MLTs) in the healthcare community.

- Competency to perform a full range of testing in the contemporary medical laboratory encompassing pre-analytical, analytical, and post-analytical components of laboratory services, including hematology, biochemistry, microbiology, immunology, histopathology, cytopathology, serology, urinalysis, body fluids, molecular diagnostics, phlebotomy, and immunohematology.
- Learn proficiency to problem-solve, troubleshoot, and interpret results, and use statistical approaches when evaluating data.
- Effective communication skill to ensure accurate and appropriate information transfer.
- Appropriately and successfully collection of blood specimens through venipuncture, capillary puncture and body fluids.
- Identify basic guidelines for safe use of chemicals including proper labeling, protective measures, location and use of SDS, and disposal of hazardous chemicals.
- To gain knowledge of basic theory for primary aspects of the blood bank including antigen, antibody, compliment, agglutination, antiglobulin, ABO-Rh and other common systems, antibody identification, transfusion therapy, transfusion reactions, and hemolytic disease of the newborn.
- Demonstrate proper care and safe use of basic laboratory equipment including the microscope, centrifuge, pipets and glassware.
- Demonstrate proficient operation of instruments used in coagulation testing and demonstrate understanding of instrument maintenance and QC.
- Discuss the role of the phlebotomist and display professional behavior in dealing with patients, their family, and the public.
- Demonstrate integrity as shown by the admission and documentation of errors, recognition of the potential danger of short cuts, and the maintenance of patient and co-worker confidentiality.
- Adapt to stressful and/or new situations by maintaining composure and flexibility without compromising individual integrity.

**Course outcomes:**

| S. No. | Course code | Course name | Maximum Marks | Course outcomes |
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| | | | | **1st semester** |
| **1** | **MMLT 101** | CLINICAL BIOCHEMISTRY | 50+10 | This syllabus has been formulated to impart basics knowledge of biochemistry, apparatus, units, equipment, and volumetric analysis in the Clinical Biochemistry.<br><br>Students will use current biochemical and molecular techniques to plan and carry out experiments.<br><br>Learn the Principles of the assay procedures for biological materials such as Blood sugar, total protein, serum albumin, Serum Creatinine.<br><br>Learn the different profile test such as lipid profile, thyroid profile, liver function, renal function test.<br><br>Able to understand the concepts of Glucose tolerance test, Insulin tolerance test, Xylose absorption test, Analysis of calculi, composition and function of CSF clinical significance of CSF analysis.<br><br>Learn the different techniques used in clinical biochemistry such as Immunochemical techniques, Molecular biology techniques, Protein and enzyme techniques, Centrifugation Techniques, Electrophoretic technique and Chromatographic techniques. |
| **2** | **MMLT 102** | **Biophysics and Human Physiology** | 50+10 | At the end of this course students able to use current Biophysical techniques to plan and carry out experiments. Demonstrate theory and practical skills of human physiology.<br><br>Learn the role of biophysics with relation to Medical Laboratory Technology equipments.<br><br>Learn fundamental of physics, Electricity and magnetism, Thermionic emission and its applications.<br><br>Understand the concepts of history and development of X-ray tubes, high tension generators, control & indicating devices and principles of electronic circuiting.<br><br>Learn the human physiology in details such as mechanism of muscle contraction, Cardiac cycle, mechanism of respiration, digestion and absorption of carbohydrate, fats and proteins, endocrine system, excretory system, reproductive system, skin and its functions, nervous system. |
| **3** | **MMLT 103** | Immunology, Vaccinology and Transplantation | 50+10 | At the completion of this course students able to understand the concepts of Immunology. |

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| | | technology | | Learn the Immune system and immunity, history of immunology, composition and function of cells and organs involved in immune system, Immune responses, active and passive immunization, innate immunity and acquired immunity, determinants of innate immunity.<br><br>Study in details the lymphocytes, their subpopulation, their properties and functions, membrane bound receptors of lymph cells, Helper T cells in immune response. Development and differentiation of B and T cells.<br><br>Learn the hypersensitivity reactions, Defects in immune system, defects in complements, defective phagocyte mechanisms, vaccines and vaccine production, monoclonal antibodies and hybridoma technology. |
| **4** | **MMLT 104** | Medical Microbiology | 50+10 | After successful completion of this course students are expected to be able to:<br><br>Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.<br><br>Understand the structural similarities and differences among various physiological groups of bacteria/archaea.<br><br>Understand the normal microflora of human body, Skin, Respiratory System, Gastrointestinal and Genitourinary tracts. Source of infection, mode of spread and portals of entery.<br><br>Learn the Morphology, staining, culture, biochemical characteristics, lab diagnosis of Streptococci, Corynebacterium Diptheriae, Enterobacteriacae- I (E.coli, Klebsiella and Enterobactor ) , Enterobacteriacae-II (Salmonella, Shiegella and Proteus ),Pseudomonas; Vibriocholerae, Neisseria and Haemophilus etc.<br><br>Learn the General characteristics, morphology and reproduction of medically important fungi.<br><br>To the study of staining procedure of fungi and preparation, storing and processing of samples.<br><br>To the preparation of KOH, Lactophenol, Cotton Blue etc. |

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| **5** | **MMLT 105** | Clinical Hematology and Blood banking technology | 50+10 | After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.<br><br>Learn ABO Blood Group System, its sub-groups, source of antigen, types of antibodies. Rhesus (RH) Blood Group System, its nomenclature and types of antigens, mode of inheritance, blood grouping and cross matching techniques , Coomb's test –direct and indirect test, titration of antibody.<br><br>Understand the concepts of Blood collection- selection and screening of donor, collection of blood, various anticoagulants, and storage of blood.<br><br>Learn Structure, collection and significance of bone marrow. Hemoglobin,its synthesis, functions and degradation. Abnormal haemoglobin and their means of identification and estimation. LE cell phenomenon and various methods of its demonstration , clinical importance .<br><br>Able to demonstrate the Routine Haematological techniques. Use of different anticoagulants , Haemoglobin estimation and standarization , red cells indices , total leucocyte counts , platelets count , blood and bone marrow preparation , staining with leishman stains , MGG and Perl's stain , reticulocyte count , investigation of haemolytic anaemia etc. |
| **6** | **Practical Paper I** | Laboratory course -I | 60+20 | To impart practical knowledge based on theory papers MMLT 101. |
| **7** | **Practical Paper II** | Laboratory course -II | 60+20 | To impart practical knowledge based on theory papers MMLT 102. |
| **8** | **Practical Paper III** | Laboratory course -III | 60+20 | To impart practical knowledge based on theory papers MMLT 103. |
| **9** | **Practical Paper IV** | Laboratory course -IV | 60+20 | To impart practical knowledge based on theory papers MMLT 104. |
| **10** | **Practical Paper V** | Laboratory course -V | 60+20 | To impart practical knowledge based on theory papers MMLT 105. |
| **2nd Semester** | | | | |

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| **1** | **MMLT 201** | Diagnostics Biochemistry and Organ Function Tes**t** | 50+10 | The prime concern of this subject is to learn the Organ function tests- biochemical diagnosis and assessment of diseases of liver, kidney, pancreas, thyroid, muscle and CNS, and adrenals.<br><br>Students will able to learn Enzymes and iosenzymes and their application in various disorders. Disturbances in acid-base balance. Lipoproteins and its disorders. Diabetes and atherosclerosis.<br><br>To learn various biochemical diagnostics such as inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders.<br>Learn cancer cytogenetics and its techniques such as karyotyping, PCR , blot diagnostics, array-based diagnostics, DNA sequencing, genetic profiling, single nucleotide polymorphism,<br>To the study of Chromosomal disorders, autosomal & sex chromosomal and its karyotype analysis.<br>To learn the techniques G-banding, *in situ* hybridization (FISH and on –FISH), and comparative genomic hybridization (CGH). |
| **2** | **MMLT 202** | Histopathology and Morbid Anatomy Technique | 50+10 | This syllabus has been formulated to impart basics knowledge of General Pathology and Cytology of tumors:<br>To learn the Pathology and Cytology of female genital tract. Cytology of normal respiratory tract. Cellular abnormalities due to benign disorders of respiratory tract. Importance of lung cancer screening and accuracy of pulmonary cytology.<br>At the end of the course the students should be able to :<br><br>To the students should be able to diagnose routine and complex clinical problems on the basis of Histopathology (Surgical Pathology) and Cytopathology specimens. |
| **3** | **MMLT 203** | **Cytology and Cytogenetics** | 50+10 | Students able to perform Cytologic Techniques: Preparation of direct or sediment smears, Cytocentrifuge preparation, Preparation cell blocks, Processing of haemorrhagic fluids, Methods of preparation of cell suspensions.<br><br>To learn Enzyme cytochemistry; Acid and alkaline phosphatase and peroxidase. Methods of monoclonal antibody staining in smears<br><br>Learn various different staining techniques for sex chromatin. Direct technique of chromosomal analysis in tumors and karyotyping.<br>To learn working and applications of different types of microscope such as Light microscope, Phase contrast microscope, Electron microscope, Fluorescent microscope.<br>After successful completion of this course students are expected to be able to: Demonstrate theory and practical skills in cytological techniques and their staining procedures. |

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| **4** | **MMLT 204** | **Diagnostic Microbiology and Immunopathology** | 50+10 | After successful completion of this course students are expected to be able to know various culture media and their applications and also understand various physical and chemical means of sterilization , know general immuno techniques and microbial techniques.<br><br>To learn basic about immunology, HLA, Major Histocompatibility Complex (MHC),<br>To learn principles of Immunogenetics applied to MHC. Immunoglobulin and Paraproteins, Complement System,Tumor Immunology, Transfusion Reaction<br>Learn basics principle of Immunohaematology. (Antigen, Antibody, structure of Immunoglobulin Molecule, Immune response, Immune antibodies and factors affectin antigen and antibody reaction).<br>To know about basic genetics, Biochemistry, Characterization and Blood grouping procedure of Rh system. Other blood group ( Lewis, MNSs, KELL, DUFFY and KIDD blood group systems and antibodies). Basic genetics, Biochemistry, Characterization and Blood grouping procedure of ABO blood group system. |
| **5** | **MMLT 205** | **Human Genetics and Human Genome** | 50+10 | After successful completion of this course students are expected to be able to: know about various hereditary diseases, Pedigree analysis, Human genome project. Know General cytostaining-techniques.<br><br>To study History and development of human genetics; organization of the human genome,Genes and chromosome structure, function and inheritance, Repetitive DNA in human genome Alu and SINE repeats, functional organization of centromeres and telomerase and centrosomes.<br>Know about Human genome mapping – genetic mapping, physical. mapping-restriction fragment length, polymorphism, pulse field gel electrophoresis, yeast artificial chromosome, bacterial artificial chromosomes, PI derived artificial chromosomes, expressed sequence tags, sequence-tagged sites. Micro satellites and single nucleotide polymorphism.<br>Learn about various molecular techniques, Inherited human disease-single gene diseases, complete traits. Identification and isolation of disease genes- positional cloning, functional cloning, DNA and cDNA microarrays. Yeast two-hybrid system. Statistical methods for genetic analysis of complex traits, cancer genetics. |
| **6** | **Practical Paper I** | **Laboratory course -I** | 60+10 | To impart practical knowledge based on theory papers MMLT 201. |
| **7** | **Practical Paper II** | **Laboratory course -II** | 60+10 | To impart practical knowledge based on theory papers MMLT 202. |
| **8** | **Practical Paper III** | **Laboratory course -III** | 60+10 | To impart practical knowledge based on theory papers MMLT 203. |
| **9** | **Practical Paper IV** | **Laboratory course -IV** | 60+10 | To impart practical knowledge based on theory papers MMLT 204. |

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| **10** | **Practical Paper V** | **Laboratory course -V** | 60+10 | To impart practical knowledge based on theory papers MMLT 205. |
| **3rd Semester** | | | | |
| **Specialization in Hematology** | | | | |
| **1** | **MMLT 301 (PH)** | **Clinical Haematology (Non-Neoplastic)** | 80+20 | After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.<br><br>Study to the mechanism of Hematopoiesis- origin and development of Blood cells, Role of Erythropoietin in Erythropoiesis, antigen independent and antigen dependent lymphopoiesis, Stages of megakaryocyte development and release of platelet, micro-megakaryocytes.<br><br>Learn about the disorders of Red cell-Anemia, Immune hemolytic Anemia. Structural variants of haemoglobin, pathophysiology of structural haemoglobin variants, sickle cell Anemia with lab diagnosis, thalessemia including Alpha, Beta thalessemia, its pathophysiology and lab diagnosis<br>Learn about the disorders White Blood Cells such as Neutriophilia, Luekemoid reaction, neutropenia, morphologic abnormalities of neutrophils, functional abnormalities of neutrophils, reactive eosinophilic and hyper eosinophilic syndrome, lymphocytosis, infectious mono neucleosis, lymphocytopenia. |
| **2** | **MMLT 302 (PH)** | **Clinical Haematology (Neoplastic)** | 80+20 | At the end of the course the students should be able to:<br>Diagnose routine and complex clinical problems on the basis of clinical hematology. Blood and Bone Marrow examination and various tests related to the neoplasia.<br>Learn about the Molecular genetic of myeloid leukemia's, CBF translocation, RAR translocation, Molecular genetic of lymphoid leukemia's, tel gene translocation,$E_2$A translocation,Molecular genetic of non-Hodgkin lymphomalignancies. |
| **3** | **MMLT 303 (PH)** | **Immunopathology and advance hematology techniques** | 80+20 | After successful completion of this course students are expected to be able to: Know various advanced immunotechniques such as FACS, Flow cytometry, PCR, FISH, Monoclonal antibodies formation.<br>Study Basic Immunohematology: Blood group antigens, red cells membrane structure. Blood group antibody and complements,Erythrocytes antigen and antibody, ABO and Rh system and other red blood cells and antigen and antibody.<br><br>Able to Blood collection, donor registration, donor selection, medical history, phlebotomy and donor reactions.Blood processing test: guideline for blood transfusion and testing, Pre transfusion testing,Artificial blood and blood substitute.<br><br>To learn the different techniques used in immunehematology such as Flow cytometry, its principle and application of flow cytometry. Advance monoclonal antibody testing and procedures. Advance cytogenetic method and their hematologic application. |

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| | | | | To learn the molecular genetic and its application in hematology. |
| **4** | **Practical Paper I** | **Laboratory course -I** | 80+20 | To impart practical knowledge based on theory papers MMLT 301. |
| **5** | **Practical Paper II** | **Laboratory course -II** | 80+20 | To impart practical knowledge based on theory papers MMLT 302. |
| **6** | **Practical Paper III** | **Laboratory course -III** | 80+20 | To impart practical knowledge based on theory papers MMLT 303. |
| **Specialization in Biochemistry** | | | | |
| | **MMLT 301 (BC)** | **Advances in Biochemical Sciences** | 80+20 | After successful completion of this course students are expected to be able to know about Metabolism of Xenobiotics, Salicylate– Poisoning, Heavy Metals-Lead, Mercury, Zinc poisoning and preventive measures.<br>Learn about the biochemical basis of disease, molecular basis of disease, Major classes of genetic disease, diagnosis and treatment, molecular medicine.<br>Learn various Molecular Techniques & Bioinformatics: Polymerase Chain Reaction, Microarray, Blotting; Southern, Northern and Western Blotting, Immunofluorsence and Gel documentation.Gene annotation, DNA sequence data, Homology search of DNA and amino acids; Blasta, Fasta, Human Genome Project, Application in Medical Science. |
| **2** | **MMLT 302 (BC)** | **Intermediary Metabolism & Metabolic Disorders** | 80+20 | At the end of the course the students should be able to: Oxidation and reduction, oxidases, Dehydrogenases, Hydroperoxidases, oxygenases and mono oxygenase.<br><br>Learn about the basics of Carbohydrate Metabolism, metabolism of Glycogen, Glycogenesis, Glycogenolysis, Hormonal regulation, Regulation of Glycogen metabolism<br>Learn about the basics of Lipid Metabolism: Lipid Transport and storage, Plasma Lipoproteins, Apolipoproteins, Lipoprotein metabolism, Clinical Significance of Lipoprotein.<br>Learn about the basics of Amino Acid Metabolism: Amino acids, Biosynthesis and clinical significance of Polyamine, Nitric Oxide, Histamine, Serotonin, Melatonin, Creatinine, Melanin and GABA (Amino by tyrosine). Phenyl ketonurea, Tyrosinimia and other amino acid metabolic disorders. Introduction to nucleic acid metabolism, denovo and salvage pathway and disorders of purine and pyrimidine metabolism. |
| **3** | **MMLT 303 (BC)** | **Diagnostic Enzymology** | 80+20 | This syllabus has been formulated to impart basics knowledge of enzymology and students should be able to know general Characteristics, nomenclature and IUB enzyme classification (rational, overview and specific examples) introduction to the following terms with examples - Holoenzyme, apoenzyme, cofactors, co enzyme, prostletic group, metalloenzyme measurement |

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| | | | | and expression of enzymatic activity, Enzyme assay activity units (I.U. and metal)<br><br>Learn Enzyme Kinetics:Factor affecting enzyme activity enzyme concentration, substrate concentration, pH and temp. Derivation of michoulis maintain equation of unisubstrate reaction km and its significance, Kcat / KM and its importance, measurement of Km and Vmax line linevavarburk and other linear transformation, Bisubstrate reaction. |
| **4** | **Practical Paper I** | **Laboratory course -I** | 80+20 | To impart practical knowledge based on theory papers MMLT 301(BC) |
| **5** | **Practical Paper II** | **Laboratory course -II** | 80+20 | To impart practical knowledge based on theory papers MMLT 302(BC) |
| **6** | **Practical Paper III** | **Laboratory course -III** | 80+20 | To impart practical knowledge based on theory papers MMLT 303(BC) |
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| **Specialization in Microbiology** | | | | |
| **1** | **MMLT 301 (M)** | **General Issues in Clinical Microbiology** | 80+20 | Students able to learn Selection of Diagnostic Tests, Analysis of tests, Test – Verification and Validation, Bioassays of Vitamins and Antibiotics, Sterility test, Endotoxin test, Procedure and significances. Quality in the clinical Microbiology Lab – QC, QA program.<br><br>Learn Statistical Analysis Of Microbiological Data And Research: Introduction to Mean, Mode, Median, Mean deviation, standard deviation, coefficient of variation correlation and Regression analysis.<br><br>Learn Computer applications: Introduction to components of computers, Data storage devices, memory concepts, software and its types, Elementary idea to DOS- Applications of common packages – WINDOWS 3, 1, 95 and 98. |
| 2 | MMLT 302 (M) | **Diagnostic Microbiology** | 80+20 | At the end of the course the students should be able to perform: Biochemical tests for identification of bacteria. Molecular Mechanism of drug resistance, detection of antibacterial resistance, antimicrobial susceptibility testing Cultivation of anaerobic bacteria of medical significance.<br><br>Able to perform various laboratory diagnosis of bacterial diseases – Diphtheria, Tuberculosis, Typhoid, Syphilis, Gonorrhea, Urinary Tract Infections, Food Poisoning.<br><br>Learn about Immunological techniques: - Immuno blotting, ELISPOT, Complement fixation, |

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| | | | | RIA and immuno fluorescence. Hypersensitivity reactions. |
| **3** | **MMLT 303 (M)** | **Instrumentation & Techniques in Medical Microbiology** | 80+20 | After completion of this course students will acquire General Concept for specimen collection and handling. Lab physical Design and Organization – Lab Design with report to safely of air handing system, Mechanical system, walls, floors, ceilings and furniture, Institution. Organization of the Microbiology laboratory.<br>Learn Preparation of stains – Gram, Alberts, Capsule, Spore, Ziehl, Neelsen, Lactophenol Cotton Blue, Preparation of regents used in biochemical analysis.<br><br>Learn basics Instrumentation Techniques: Centrifugation Basic principles and common centrifuges used in Laboratory. (Clinical high speed & ultra, Electrophoresis General Principal, application of Gel electrophoresis, PAGE, Agarose Gel elcetrophoresis Spectroscopy UV – VIS absorption Spectroscopy, Flow Cytometry Principle and application. |
| 4 | **Practical Paper I** | **Laboratory course -I** | 80+20 | To impart practical knowledge based on theory papers MMLT 301. |
| 5 | **Practical Paper II** | **Laboratory course -II** | 80+20 | To impart practical knowledge based on theory papers MMLT 302. |
| 6 | **Practical Paper III** | **Laboratory course -III** | 80+20 | To impart practical knowledge based on theory papers MMLT 303. |
| **4th Semester** | | | | |
| **Project Work** | | **Maximum Marks** | **Course Outcomes** | |
| The project will be based upon the research and actual bench work. | | 400 | To develop skills for carrying out a research project and statistically interpret the outcomes and write the thesis. It will begin form the 3rd semester and will continue through the 4th one. The project report will be submitted at the end of the 4th semester and evaluated. | |

## M.Sc. Microbiology

**Programme Code: 341**

**Programme Summary**

Duration: 2 years

**Eligibility**

B Sc with CBZ or any other equivalent degree like Biotechnology /Microbiology / Biochemistry /Genetics / Industrial Microbiology / Medical Lab Technology with minimum 50% marks in aggregate.

**Program outcome:**

- To develop skills for general microbiological techniques and introduction to bacteriology, virology, mycology, phycology and protozoology .
- To understand fundamentals of biochemistry including carbohydrates, lipids, proteins nucleotides, enzymes, acid-base chemistry and bioenergetics.
- To acquire knowledge of intracellular compartmentalization of cell , plasma membrane, cell signalling ,cell cycle ,cell division and cell death pathways.
- Understand the concepts of Molecular biology and microbial genetics.
- To gain knowledge of Microbial physiology and metabolism.
- To learn detail related to immune response and its regulation immune- pathology and transplantations.
- Introduction to principle and application of fundamental laboratory equipments related to microbiological techniques.
- To be trained in recombinant DNA technology.
- To learn fundamentals of Medical microbiology and understand concept of quality control in medical microbiology laboratory.
- To introduce essentials of industrial microbiology and to learn the basic aspects of fermentation and its operational modes.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.

**Course outcome:**

| | Course code | Course name | Credits | Course outcome |
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| **1st Semester** | | | | |
| 1 | SLS/MIC/C001 | General Microbiology | 4 | Exposure to the historical aspects of Microbiology.<br>To learn about bacterial classification concept and various techniques used in it (Morphological, chemotaxonomic and genetic methods Phylogenetic, numerical and polyphasic taxonomy).<br>To appreciate the scope and relevance of microbiology.<br>To gain knowledge and develop skills of general microbiological techniques (isolation, cultivation and preservation methods).<br>To learn factors affecting growth of microbes (Physical and chemical agents).<br>To get introduced to: Basic bacteriology, general mycology, phycology and protozoology. |
| 2 | SLS/MIC/C002 | Fundamentals of Biochemistry | 4 | To understand fundamentals of biochemistry: Acid-base Chemistry and Bioenergetics. including(Energy generation in biological systems: Phosphorylation ,electron transport chain, Electron carriers, Artificial electron donors, Inhibitors and uncouplers of oxidative phosphorylation, Chemiosmotic theory of ATP synthesis).<br>Classification, nomenclature, structure, general properties and functions of Carbohydrates , Lipids ,Proteins and Nucleotides and Enzymes. |
| 3 | SLS/MIC/C003 | Cell Biology | 4 | To acquire knowledge of Intracellular Compartmentalization of Cell .Their Structure, organization and functions.<br>To learn about the Architecture of Plasma Membrane and Solute Transport (Fluid mosaic model) Solute transport across membranes: Diffusion (Simple and facilitated), Active transport (Primary and secondary), Pumps and transporters, Ion channels (Ligand gated and voltage gated channels), Trans-epithelial transport, Mechanism of regulation of intracellular transport.<br>To provide knowledge of Cell Signalling Cell Cycle and Cell Division Cell Death Pathways. |
| 4 | SLS/MIC/C004 | Molecular biology and microbial genetics | | To understand the concepts of Molecular biology and microbial genetics.<br>Learn experimental evidences for nucleic acid as carrier of genetic information. DNA replication in prokaryotes and eukaryotes<br>Basic features of genetic code; Translation in prokaryotes and eukaryotes.<br>To impart knowledge of Recombination, Transposition (The Holliday model, Double strand break repair model) and DNA Repair mechanism (Photo reactivation, Methyl directed mismatch repair, Very short - patch mismatch repair, Nucleotide excision repair, |

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| | | | | Base excision repair, SOS system).<br>To understand the concepts of Microbial genetics: Bacterial plasmids<br>Gene transfer mechanisms, Transformation (Competence factor, natural and artificial transformation), Conjugation (F+ X F- mating, Hfr, Hfr X F-, and F', mechanism of conjugation and sexduction), Transduction (Mechanism of generalized and specialized transduction, LFT and HFT lysate) and Phage genetics(lambda and M13 phage) |
| 5 | SLS/MIC/C005 | Laboratory course 1 | 3 | To impart practical knowledge and hands on training based on courses SLS/MIC/C001 and SLS/MIC/C002. |
| 6 | SLS/MIC/C006 | Laboratory course 2 | 3 | To impart practical knowledge and hands on training based on courses SLS/MIC/C003 and SLS/MIC/C004. |
| **2nd Semester** | | | | |
| 7 | SLS/MIC/C007 | Microbial physiology and metabolism | 4 | To learn about Microbial Photosynthesis and Inorganic Metabolism. |
| | | | | To study in detail Nitrogen fixation :Inorganic nitrogen metabolism, Assimilation of inorganic nitrogen, Regulation of nitrate assimilation and<br>Sulphur metabolism: Free and bound pathways of assimilation of sulphate into cysteine, Glutathione and its role in sulphur metabolism.<br>To learn in detail about microbial respiration and fermentation.<br>To impart knowledge of<br>Bacterial transport system: Donnan equilibrium, Thermodynamics of various transport systems, Osmosis, Plasmolysis, Osmotic pressure of electrolyte and non-electrolyte transport protein, PEP-PTS system in relation to catabolite repression, ABC transporter, Protein secretion pathways in bacteria and bacterial communication mechanisms in prokaryotes (Pheromones mediated signalling and quorum sensing).<br>To explain the Microbial Stress mechanism and its response. |

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| | SLS/MIC/C008 | Immunology | 4 | To introduce the basic concepts of immune system and immunity structure and function of antigen and antibodies.<br>To provide knowledge of antigen antibody responses and Immunodiagnostic techniques: Immuno electrophoresis, RIA, ELISA, Chemiluminescence immunoassay, Western blotting, Complement fixation test, Immunofluorescence, Flow cytometry.<br>To learn about Complement system, Cytokines and Major Histo-compatibility Complex<br>To provide knowledge about Humoral and Cell Mediated Immune Response and Regulation:<br>B- cell and T – cell receptor complex, Positive and negative regulation; Immune Response: T -Cell independent and T- Cell dependent defence mechanisms.<br>Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody dependent cell cytotoxicity (ADCC), Macrophage-mediated cytotoxicity.<br>To update knowledge in aspect of Immuno pathology and Transplantations including : Rh-blood groupings, Hypersensitivity reactions (Antibody mediated type I, anaphylaxis, type II- antibody dependent cell cytotoxicity, type III-immune complex mediated reactions and type IV-delayed hypersensitivity reactions), Immune surveillance, Self tolerance, Autoimmune diseases, Immunodeficiency; Tumor immunology, Immunotherapy of cancer, Immuno toxins; Transplantation: Graft vs. host reaction and rejection; Immunization and Vaccines. |
| 9 | SLS/MIC/C009 | Biological techniques | 4 | To learn in detail about Principles and applications of Microscopy, Biosensors, Centrifugation**,** Chromatography, Electrophoresis, Spectroscopy and Radiotracer techniques. |
| 10 | SLS/MIC/C010 | Recombinant DNA technology | 4 | To introduce principles and Tools of Gene Cloning.<br>To learn about the strategies and steps of gene cloning.<br>To be trained in **e**xpression of cloned gene in heterologous System( Prokaryotes and Eukaryotes) ,<br>Basic architecture of an expression vector ( pEt, pcDNA3 and cytomegalovirus) .Model host systems: *E. coli,* Fungi, Mammalian cell lines, Insect cells, Transgenic plants and animals.<br>To be able to Identify and study translation product of a cloned gene: HRT and HART techniques.<br>To gain knowledge of sequence detection, amplification and modification techniques. Southern, Northern and Western blotting; Probe labelling and hybridization; DNA sequencing (Chemical, enzymatic and automated methods); Sequence assembly for whole genome analysis.<br>To be trained in principle ,methods and applications of : PCR and techniques used in |

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| | | | | genome analysis |
| 11 | SLS/MIC/C011 | Laboratory course 1 | 3 | To impart practical knowledge and hands on training based on courses SLS/MIC/C007and SLS/MIC/C008. |
| 12 | SLS/MIC/C012 | Laboratory course 2 | 3 | To impart practical knowledge and hands on training based on courses SLS/MIC/C009 and SLS/MIC/C010. |
| **3rd Semester** | | | | |
| 13 | SLS/MIC/C013 | Medical microbiology | 4 | To learn fundamentals of Medical microbiology and quality control in medical microbiology laboratory.<br>To provide knowledge regarding mechanism of pathogenesis(Pathogenicity islands) and antimicrobial chemotherapy.<br>To learn in detail Clinical features , pathogenesis, laboratory diagnosis and preventive measures of :<br>Bacterial diseases (Cholera, Leprosy, Diphtheria, Tetanus, Meningitis, Conjunctivitis, Pneumonia and Gastroenteritis).<br>Viral diseases( Herpes, Chikungunya, Influenza, Measles, Mumps, Hepatitis, HIV, Viral cancer).<br>Protozoal diseases ( Amoebiasis, Giardiasis, Leishmaniasis, Malaria) and Fungal diseases ( Aspergillosis, Cryptococcosis, Candidiasis, Blastomycosis). |
| 14 | SLS/MIC/C014 | Industrial microbiology | 4 | Introduction to different industrial microbiology.<br>To be skilled on the basic aspects of fermentation, Operational modes of fermentation (Batch, fed- batch, continuous) and Downstream processing.<br>To impart knowledge regarding strategies for strain improvement.<br>To be trained in Industrial production of antibiotics, amino acid ,biopolymers ,steroids biotransformation, enzymes ,alcohol ,alcoholic beverages, vitamins ,organic acids ,ergot alkaloids and bio plastics. |
| 15 | SLS/MIC/C015 | Food and dairy microbiology | 4 | To learn the principles of food preservation, contamination and spoilage.<br>To be educated regarding food control agencies ( FDA, EPA, CDC , ISI) and GMP, HACCP system and food safety act and trade regulations.<br>To deliver knowledge of bacterial and nonbacterial infections and intoxications (*Brucella*, *Bacillus*, *Clostridium*, *Escherichia*, *Salmonella*, *Shigella*, *Staphylococcus*, *Vibrio*, *Yersinia*, *Listeria)*, nematodes, protozoa, algae, fungi and viruses.<br>To learn about the structure, functions and Laboratory testing procedures of aflatoxins. |
| 16 | SLS/MIC/E02F | Research methodology | 4 | To develop aptitude for formulating research problem and experimental planning.<br>To learn about data collection and statistical analysis.<br>To be trained in statistical basis of biological assay.<br>To introduce various biological databases (Primary, secondary and composite databases) , |

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| | | | | biological information system( SRS, ENTREZ). Sequence similarity tools (FASTA ,BLAST).Sequence information sources of nucleotide (GenBank, EMBL, EBI, DBJ ,UCSC)and protein sequence information sources (PIR, ExPASY, UniProt KB, SwissProt and TrEMBL)and Phylogenetic analysis.<br>To develop technical writing skills. |
| 17 | SLS/MIC/C015 | Laboratory course -I | 3 | To impart practical knowledge based on theory papers SLS/MIC/E13 and SLS/MIC/E14) |
| 18 | SLS/MIC/E003 | Laboratory course -II | 3 | To impart practical knowledge based on theory papers SLS/MIC/C015 and SLS/MIC/E02F |
| **4th Semester** | | | | |
| 19 | SLS/MIC/E004 | Dissertation | 10 | To develop skills for carrying out a small research project and statistically interpret the outcomes and write the thesis. |

**M.Sc. Pharmaceutical Chemistry**
**Programme Code: 342**
**Programme Summary**
Duration: 2 years
**Eligibility**
B. Sc. in any subject or B. Pharm. Chemistry is not a compulsory subject, student who has any science subject in bachelor course are eligible.

**Program outcome:**

- The programme has been designed to learn relevant advanced skills that are essential in the areas of quality control, drug discovery, drug design and development of high quality pharmaceutical products, medicinal chemistry, pharmacology, modern analytical techniques and provide depth knowledge that enables the students to work more effectively within pharmaceutical industry.
- Focus is laid on study of quality control, separation techniques and the research environments. The course provides training in drug synthesis, drug testing, and development of drugs and validation of analytical methods.
- The curriculum includes lectures, practical's, seminars, project works, lab work, assessments. It enables them to equip with problem solving abilities and in developing analytical skills. Course provides students with latest technologies and with necessary skills to embark upon their career for their life.
- The students are skilled with extensive theoretical and practical knowledge about the various aspects of analysis of drugs, In-vitro evaluation of different conventional and advanced drug delivery systems like tablets, capsules, etc. according to the guidelines, modern analytical techniques which is used in quantitative and qualitative analysis, synthesis of medicinal important agents, isolation of compounds from plant origin.
- Exposure of students to the sophisticated analytical techniques like UV, IR, HPLC, NMR, Mass spectroscopy is an integral part of the curriculum.
- Curriculum also provides extensive learning about herbal drug technology as well as phytopharmaceuticals and nutraceutical.
- Curriculum is dedicated to a project work of industrial and commercial applicability.
- The PG degree in pharmaceutical chemistry enables the students to find jobs in varied sectors. The qualified candidates find jobs in pharmacy companies, drug manufacturing and marketing companies, health departments, laboratories, research organizations (CSIR), biotechnological firms, pest control department, and defence services. The jobs are available as professors, manager, scientist, researcher, patent analyst, quality control assistant. The students can further study for research work.

**Course outcome:**

| S. No. | Course code | Course name | Credits | Course outcome |
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| **1st Semester** | | | | |
| 1. | SOS/PC/C001 | Quantitative Analytical Methods | 3 | Define the concept of pharmaceutical volumetric analysis, its scope and methods of expressing concentration.<br>Course explains the types of acid base, redox, complexometric, Precipitation, non-aqueous solvents and steps involved in gravimetry.<br>Course describes the methods for detection of end point of Acid base titration, precipitation titration, complexometric titration, redox titration and non-aqueous titration.<br>Students estimate various compounds quantitatively along with standardization of titrant.<br>Students determine the normality of the solution by this method. |
| 2. | SOS/PC/C002 | Modern Analytical Methods-I | 3 | The course explains the basic theoretical knowledge of the instrumentation techniques available.<br>Student will deals with different analytical data from different principle instrument.<br>The student will learn theoretical principle, instrumentation and applications of chromatographic techniques like adsorption, partition, paper, TLC, Ion exchange, column, GC, HPLC and Gel electrophoresis.<br>The course explains & interprets theoretical principle, instrumentation and applications of Spectroscopic techniques like UV, IR, Calorimetry, Fluorimetry, AAS, FES, ORD and CD |
| 3. | SOS/PC/C003 | Basic Pharmacology | 3 | Exposure to the historical development of Pharmacology.<br>To learn about general principles of route of drug administration, pharmacokinetics and pharmacodynamics of drugs.<br>To gain knowledge of adverse drug reactions, drug interactions and drug allergy.<br>To learn general concepts of toxicity and studied about general principles, general methods of several bio-assays. |
| 4. | SOS/PC/C004 | Stereochemistry and Reaction Mechanism | 3 | Identify the symmetry elements and symmetry operations in molecules by optical activity.<br>Explain the criteria for chirality and discuss axial, planar and helical chirality.<br>Discuss the methods of determination of relative and absolute configuration.<br>Discuss racemization and Resolution techniques. |

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| | | | | To learn about geometrical isomerism & stereochemistry of olefins.<br>Determine the configuration in E and Z isomers.<br>Discuss Stereochemistry of carbon compounds with no chiral atom<br>Discuss and understand Stereoisomerism of rings, stability of rings, and ease of ring formation.<br>Explain actual shape of six membered rings & its relation to properties & reactivity.<br>To describe mechanisms involving aromatic electrophilic reaction,<br>To learn about mechanisms involving aromatic nucleophilic reactions and benzyne mechanism.<br>To describe mechanisms involving free radical reactions and elimination mechanism.<br>To understand and uses of organic name reactions in organic synthesis with mechanism. |
| 5. | SOS/PC/C005 | Laboratory- I (Pharmaceutical Analysis) | 3 | Define the concept of pharmaceutical analysis, its scope and methods of expressing concentration.<br>Students perform the methods for detection of end point of Acid base titration, precipitation titration, complexometric titration, redox titration and Non-aqueous titration.<br>Students perform assay and standardization of volumetric preparations. |
| 6. | SOS/PC/C006 | Laboratory- II (Pharmaceutical Chemistry) | 3 | Practical skills for the Identification of Organic compounds, mixtures and synthesis of organic compounds. |
| **2nd Semester** | | | | |
| 7. | SOS/PC/C007 | Modern Analytical Methods-II | 3 | To learn about interpretation, theoretical principle, instrumentation and applications of Spectroscopic techniques like NMR, MS, Raman and Molecular Emission. |
| 8. | SOS/PC/C008 | Drug Delivery and Biopharmaceutics | 3 | To acquire knowledge of types, advantages, disadvantages & formulation of oral dosage forms like solution, syrups, suspension emulsion, tablet and capsule.<br>To learn about the quality control of various dosage forms.<br>To understand the importance of<br>Disintegration, Disintegration time and factors affecting disintegration.<br>To learn Dissolution, Dissolution models, factors affecting dissolution rate and co-relation of dissolution with bioavailability.<br>To know how factors affecting drug absorption including physicochemical, biological & Pharmaceutical. |

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| | | | | To provide knowledge of drug disposition, bioavalability and bioquivalance studies. |
| 9. | SOS/PC/C009 | Chemistry of Natural Products | 3 | To understand detailed knowledge about chemistry of medicinal compounds from natural origin.<br>To understand general methods of structural elucidation of medicinally active natural compounds like carbohydrates, terpenoids, and alkaloids.<br>To understand knowledge regarding isolation and purification of medicinal compounds from natural origin like terpenoids.<br>To understand different types of heterocyclic compounds i.e. five membered and six membered heterocyclic compounds & their properties. |
| 10. | SOS/PC/C010 | Medicinal Chemistry | 3 | Helps in correlating between pharmacology of a disease and its mitigation or cure.<br>To understand the drug metabolic pathways, adverse effect and therapeutic value of drugs<br>To know the structural activity relationship of different class of drugs like antibiotics, anticancer, antifungal, antiviral, and anti-malarial agents.<br>To acquire knowledge in the chemotherapy for cancer and micobacterial diseases and different anti-viral and anti-fungal agents.<br>Well acquainted with the synthesis of some important class of drugs.<br>Knowledge about the mechanism pathways of different class of medicinal compounds.<br>To understand the chemistry of drugs with respect to their pharmacological activity. |
| 11. | SOS/PC/C011 | Laboratory-I (Formulation and Evaluation of Pharmaceutical Products) | 3 | To impart practical knowledge based on formulation and evaluation of pharmaceutical products. |
| 12. | SOS/PC/C012 | Laboratory-II (Chemistry of Natural Products). | 3 | To impart practical knowledge based on extraction and isolation of compounds from the different plants. |
| **3rd Semester** | | | | |
| 13. | SOS/PC/C015 | Drug Design | 3 | This course aims at application of modern *in silico* tools or information technology in different phases of drug discovery and design of new drug candidates by understanding the molecular basis of the interaction of small molecules with their targets.<br>Students would have better understanding on the various stages of drug discovery.<br>They learnt and understand about lead moiety, receptors, specific & non-specific |

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| | | | | drug action, drug-receptor interactions and drug metabolism.<br>They would have studied on the various targets for drug discovery. They understand drug metabolism approaches to drug design, concept of isosterism & bioisoterism for modification of lead moiety, metabolite antagonism, stereochemistry & drug action, analog design, and concept of prodrug in drug discovery processes.<br>Students understand drug development as a process involving target selection (receptor), lead discovery using computer-based methods and combinatorial chemistry (CADD).<br>They would have better understanding on the topography of receptor and drug receptor interaction.<br>They would have learnt the importance of the role of computer aided drug design in drug discovery.<br>Explain the various tools used in QSAR studies and how these are applied in the design of drugs using examples. |
| 14. | SOS/PC/E002 | Pharmacodynamic agents | 3 | To understand the chemistry of drugs with respect to their biological activity.<br>To know the structural activity relationship of different class of drugs including cardiovascular system and central nervous system acting drugs. |
| 15. | SOS/PC/E003 | Phytopharmaceuti-cals and Nutraceuticals | 3 | To study in detail historical background, present status and future scope of Phytophrmaceuticals.<br>To learn in detail about classification of crude drug and adulteration and evaluation of drugs.<br>To impart knowledge of general principle of formulation of primary and secondary plant with biogenesis of carbohydrates, lipids, volatile oils and resins.<br>To know how plants and their environmental factors influencing the variability in drug activity.<br>To learn general introduction and uses of Nutraceuticals.<br>To understand the importance of tissue culture and its scope in production of phytopharmaceuticals. |
| 16. | SOS/PC/E004 | Computers | 3 | To learn and understand about history of computer, introduction of computer and operating system and their software.<br>To learn, design and develop C++ Programming.<br>To learn about arrays class and objects, function & function overloading, constructor and destructor, file handling.<br>To understand Internet and its working, the Uniform resource locator(URL), World wide web, HTTP, Internet explorer, PDB, NRL-3D, BLAST & FASTA, |

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| | | | | Special software to align sequences, general DNA sequence data base, protein structure data base, genome project database, human mapping data base. |
| 17. | SOS/PC/C013 | Laboratory –I (Drug Design) | 3 | To impart practical knowledge based on synthesis of drugs. |
| 18. | SOS/PC/C014 | Laboratory-II (Pharmaceutical Technology) | 3 | To perform and understand the various Quality control parameters for different dosage form. |
| **4th Semester** | | | | |
| 19. | SOS/PC/E010 | Herbal Drug Technology | 3 | To learn in detail about herbal drugs, Importance of herbal therapies, Herbal verses conventional drugs, safety in Herbal drugs, toxicity in herbals and interaction.<br>To learn herbals as nutraceuticals, cosmetics and for common ailments like cold, skin infection and diarrhea.<br>To study Analytical profiles of selected herbs- *Brahmi, Arandrographis paniculeta, Aegle marmelos* and *Gymnema sylvestre.*<br>To know the Quality control and quality Assurance of Herbal drugs. |
| 20. | SOS/PC/E013 | Essential of Traditional Medicine | 3 | The main aim of the course is to aware the importance of herbal medicine in traditional medicinal system.<br>To know the traditional medicinal system such as Ayurveda, Sidha and Homeopathy.<br>To understand detailed knowledge about medicinal herbs, management of the quality of the processes, Efficacy of Herbal medicine. Validation of herbal therapies. Safety in herbal drugs. Toxicity in herbal and their interaction. General concept of evaluation and quality control Assessment by drug Regulations. Herbal drug regulation in India.<br>To learn about the various phytoconstituents present in herbal medicine.<br>To learn about various methods of extraction procedure, extraction of specific phytochemical group and treatment of drug residue after extraction. |
| 21. | SOS/PC/E015 | Laboratory I (Herbal drug Technology) | 3 | To perform and understand the extraction of herbal drugs their phytochemical analysis and TLC and paper chromatography. |
| 22. | SOS/PC/C016 | Project /Dissertation | 3 | To learn about how to write and design a project/dissertation by using latest techniques from pharmaceutical research areas and carryout novel research which develops skills & knowledge. |

## M.Sc. Physics

**Programme Code: 343**

**Course Summary**

Duration: 2 years; 4 semesters

**Eligibility**

B.Sc. in PCM/PCB with minimum 45% marks in aggregate.

## Programme specific outcome:

- Understanding the basic concepts of physics particularly concepts in classical mechanics, quantum mechanics, statistical mechanics and electricity and magnetism to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws through logical and mathematical reasoning.
- Learn to carry out experiments in basic as well as certain advanced areas of physics such as nuclear physics, condensed matter physics, nano-science, lasers and electronics.
- Understand the basic concepts of certain sub fields such as nuclear and high energy physics, atomic and molecular physics, solid state physics, Environmental Physics, astrophysics, general theory of relativity, nonlinear dynamics and complex system.
- Gain hands on experience to work in applied fields.
- To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.
- Gain a through grounding in the subject to be able to teach it at college as well as school level.
- Viewing physics as a training ground for the mind developing a critical attitude and the faculty of logical reasoning that can be applied to diverse fields

**Course specific outcome:**

| S.No | Course code | Course name | Credits | Course outcome |
|---|---|---|---|---|
| **1st Semester** | | | | |
| 1 | SOP/FOS/PHY/C001 | Classical Mechanics | 3 | **In this course, the students will learn**:<br>To use Newton's laws of motion to solve advanced problems involving the dynamic motion of classical mechanical systems.<br>To use differential equations and other advanced mathematics in the solution of the problems considered in item 1.<br>To use conservation of energy and linear and angular momentum to solve dynamics problems.<br>To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.<br>Equation of motion in Poisson Bracket form. |
| 2. | SOP/FOS/PHY/C002 | Mathematical Physics | 3 | **In this course, the student will,**<br>Learn about Gradient, Divergence and Curl in orthogonal curvilinear and their typical applications in physics.<br>Learn about special type of matrices that are relevant in physics and then learn about tensors.<br>Get introduced to Special functions like Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions and their recurrence relations<br>Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method.<br>Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms, etc. |
| 3. | SOP/FOS/PHY/C003 | Electrodynamics & Astrophysics | 3 | **In this course the student will,**<br>Learn about Maxwell's equations and their physical significance.<br>Get introduced to equation of continuity and relaxation time, Vector and scalar potentials, Lorentz and Coulomb gauge, electromagnetic energy and Poynting's theorem.<br>Learn the fundamental of electromagnetic wave equations in free |

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| | | | | space, their plane wave solutions.<br>Concept of Retarded potentials, Lienard Wiechert potentials, |
| 4. | SOP/FOS/PHY/C004 | Electronics | 3 | Design and analyze the basic operations of MOSFET.<br>Know about the Power amplifier using BJT and FET in various configuration to determine frequency response and concept of voltage gain.<br>Know about different power amplifier circuits, their design and use in electronics and communication circuits.<br>Know the concept of feedback amplifier and their characteristics.<br>Design the different oscillator circuits for various frequencies. |
| 5. | SOP/FOS/PHY/C005 | Laboratory Course I (Practical –I) | 3 | To impart practical knowledge and hands on training on LCR circuit, Transistorized LCR bridge, UJT, MOSFET NPN and PNP transistor characteristics , DIAC,TRIAC, FET, R.C.coupled amplifier, Hartley oscillator, Colpit oscillator, Wien bridge oscillator. |
| 6. | SOP/FOS/PHH/C006 | Laboratory Course II (Practical –II) | 3 | For each student two seminars are conducted. |
| **2nd Semester** | | | | |
| 1. | **Course Code** | **Course name** | **Credits** | **Course outcome** |
| | SOP/FOS/PHY/C007 | Atomic &, Molecular Physics | 3 | **In this course, students will learn**:<br>**Atomic Spectroscopy:** Fine structure of Hydrogen lines, alkali atom Spectra, penetrating and non penetrating orbits, electron spin orbit interaction. Zeeman Effect, Paschen Back Effect, Hyper fine structure, Stark effect, width of spectral lines, lamb shift<br>**Molecular Spectroscopy:** Rotational spectra of diatomic molecules, non rigid rotator, vibrational spectra enharmonic oscillator explanation of rotational vibrational spectra in infrared, molecular dissociation and calculation of dissociation energy |
| 2. | SOP/FOS/PHY/C008 | Solid State Physics | 3 | **In this course, students will learn:**<br>**Reciprocal lattice**: diffraction waves by crystals,Braggs law,Scattered wave amplitude, Laue equations, Brillouin zones<br>**Crystal Binding and Elastic Constants**: Ionic Crystal, Covalent Crystal, Metals, Hydrogen bonds, analysis of elastic springs<br>**Lattice Vibrations**: Vibrations of crystals with monatomic basis, First |

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| | | | | Brillouin zone, Group Velocity, Long wavelength limit |
| 3. | SOP/FOS/PHY/C009 | Statistical Physics | 3 | **In this course, students will learn:**<br>**Application of classical distribution to the ideal gases:** Helmholtz free energy, Gibb's free energy, entropy and thermodynamic properties, Gibb's paradox, Sakur-tetrode equation.<br>**Black Body Radiation:** Planck's distribution, pressure and energy relationship of photons, black body radiation, Rayleigh Jean's formula, Wein's law, Wein's displacement formula, absorption and emission of radiation, Stefan's law, high temperature measurements. |
| 4. | SOP/FOS/PHY/C010 | Quantum Mechanics | 3 | **In this course, students will learn:**<br>**Matrix Formulation of Quantum Mechanics:** Hilbert space. Dirac bra and ket notation, projection operators, Schrodinger.<br>**Approximation Methods for Bound State**: Time independent perturbation theory for non-degenerate and degenerate systems upto second order perturbation. |
| 5. | SOP/FOS/PHY/C011 | Laboratory Course I (Practical –I) | 3 | Practice different types of wiring and instruments connections of Multivibrator bistable/monostable/Astable, Ionisatin potential of Mercury using gas filled diodes, Michelson interfermeter, Fresnals law,B-H curve amplitude modulation and demodulation, frequency modulation and demodulation, CRO. |
| 6. | SOP/FOS/PHY/C012 | Laboratory Course II (Practical –II) | 3 | Two seminars for each student are conducted. |
| **3rd Semester** | | | | |
| **S.no** | **Course Code** | **Course name** | **Credits** | **Course Outcome** |
| 1. | SOP/FOS/PHY/C013 | Advanced Quantum Mechanics | 3 | **In this course, students will learn:**<br>**Scattering Theory:** Partial wave analysis: asymptotic behaviour of partial waves, phase shifts, scattering amplitude in terms of phase shifts, cross-sections, Optical theorem. Phase shifts and its relation to potential, effective range theory.Breit-Wigner formula for one level and two levels, non-resonant scattering. s-wave and p-wave resonances.<br>**Quantization of wave fields**: The quantization of wave fields, Classical and quantum field equations quantization of non-relativistic |

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| | | | | Schrodinger equation, second quantization, N-representation, creation and annihilation operators. |
| 2. | SOP/FOS/PHY/C014 | Nuclear Physics | 3 | **In this course, students will learn:**<br>**Nuclear Forces and Detectros – Ground state of deuteron, Low energy** neutron-proton scattering and proton-proton scattering, Exchange and tensor forces, G.M. Counter, Electron & Proton Synchrotron.<br>**Nuclear Reactions-** Q-value of nuclear reaction, Bohr's Theory of compound nucleus, Scattering cross section of nuclear reaction (phase shift method), Breit Wigner single level resonance formula for scattering cross section. |
| 3. | SOP/FOS/PHY/E001 | Condensed Matter Physics A | 3 | **In this course, students will learn:**<br>Diffusion, Colour centres, F-Centre, V-Centre, dislocation, Line defects, edge dislocation, screw dislocation, Burger vector.<br>Dielectric and electrical properties of insulators: Macroscopic description of dielectric constants, static, electronic and ionic polarizability of molecules |
| 4. | SOP/FOS/PHY/C015 | Laboratory Course I (General) | 3 | In this course, students perform experiments on e/m by Zeeman effect, G.M.counter, IC- Based Power supply, Absorption spectroscopy by spectrophotometer, optoelectronic devices, FET amplifier |
| 5. | SOP/FOS/PHY/E002 | Electronics A | 3 | **In this course, students will learn:**<br>Number Systems, Boolean Algebra & Basic Logic Gates, Memory Devices & IC-Technology:<br>Logic Gates, Combinational Circuits, Sequential Circuits. |
| 6. | SOP/FOS/PHY/E003 | Laser Physics A | 3 | **In this course, students will learn:**<br>Einstein's coefficients, population inversion, theory of optical resonators, laser modes, spatial and temporal coherence.<br>Types of lasers, Non linear optics, Laser spectroscopy**.** |
| 7. | SOP/FOS/PHY/E004 | High Energy Physics A | 3 | **In this course, students will learn:**<br>Classical Lagrangian Equation, Classical Hamiltonian Equations, Gauge Invariance, Quantization of Dirac field covariant anti commutation relations.<br>Feynman Diagrams and Feynman rules for QED in configuration and |

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| | | | | momentum space, Renormalization of QED |
| 8. | SOP/FOS/PHY/E005 | Astrophysics A | 3 | **In this course, students will learn:**<br>**Superdense Objects:** Mechanism of Mass transfer in Binary Stars. Use of polytropic models for completely degenerate stars<br>**Stellar Evolution**: Abundance of elements in the sun by the method of fine analysis-Stromgren's method, use of weight functions, abundances of elements in normal stars. |
| 9. | SOP/FOS/PHY/E006 | Laboratory Course II (Circuit Design) | 3 | **Circuit Design:** Designing of Combinational, Sequential circuits. |
| **4th Semester** | | | | |
| **S.no** | **Paper Code** | **Paper** | **Credits** | **Course Outcome** |
| 1. | SOP/FOS/PHY/C016 | Computational Physics | 3 | **In this course, students will learn:**<br>Roots of functions, interpolation, extrapolation, Gaussian elimination. Flowchart, C-Programming & algorithms-Problem analysics flowchart of some basic problems, |
| 2. | SOP/FOS/PHY/C017 | Particle Physics | 3 | **In this course, students will learn:**<br>Classification and Properties of Elementary Particles, Conservation Laws and Gauge Invariances, Quark Model.Eight fold way, Quarks as building blocks of hadrons, six quarks ( u,d,s,c,t and b ), Antiquarks, General properties of quarks. |
| 3. | SOP/FOS/PHY/C018 | Lab Course | 3 | In this lab course, students do C programming based on numerical computational methods. |
| 4. | SOP/FOS/PHY/E007 | Condensed Matter Physics B | 3 | **In this course, students will learn:**<br>**Dielectrics and ferroelectrics: P**olarization, Macroscopic electric field, depolarization fiels, local electric field at an atom, fields of dipoles inside cavity, dielectric constant and polarizability.<br>**Carbon nanobud:** carbon nanotubes as quantum wires, Areas of Nanotechnology, nanomaterials, nanoelectronics, nanobiotechnology, nanofabrication, microelectromechanical systems (MEMS) |
| 5 | SOP/FOS/PHY/E008 | Electronics B | 3 | **In this course, students will learn:**<br>**Communication:** Modulation, Demodulation,Transmitters & Receivers, Transmission Lines, Antennas, Propagation of Radio |

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| | | | | Waves, Radar Systems |
| 6. | SOP/FOS/PHY/E009 | Laser Physics B | 3 | **In this course, students will learn:**<br>Electro optic effect, longitudinal and transverse phase modulation,Optical sources and detectors, Fibre optics, Holography. |
| 7. | SOP/FOS/PHY/E010 | High Energy Physics B | 3 | **In this course, students will learn:**<br>Symmetries and conservation laws, Noether's Theorem, U (1) Gauge Invariance, Baryon and Lepton number conservation,Weinberg- Salam theory of electroweak unification,The classic predictions of SU (5) Grand Unified, Theory, quark and Lepton masses. |
| 8. | SOP/FOS/PHY/E011 | Astrophysics B | 3 | **In this course, students will learn:**<br>Detectors, Photometry and Spectroscopy, Galactic System, Gravitation & Cosmology. |
| 9. | SOP/FOS/PHY/E012 | Project/Dissertation | 3 | The dissertation is in-depth study on a particular subject released to Physics where the student carries out a *mini* research-type activity under one supervisor. The subjects of dissertation are in the field of Bio-Physics, Nano-Physics, Statistical Physics, VLSI Design and System, Mathematical Physics. In many instances, this may lay the foundation of a research career for a student. Which is why it is very important for student to choose the right topic |

## M.Sc. Zoology

**Programme Code: 348**

**Programme Summary**

Duration: 2 years

**Eligibility**

B Sc with CBZ with minimum 45% marks in aggregate.

## Programme Outcome:

- To be trained in taxonomy and study of Animal Diversity (Nonchordata and Chordata) and museum specimens and slides.
- To acquire knowledge of intracellular compartmentalization of cell, plasma membrane, cell signalling, cell cycle, cell division and cell death pathways. Understand the concepts of Molecular biology, Elementary biotechnology and microbiology.
- To understand the concepts of genetics and evolution.
- To learn in detail about Principles and applications of instruments (Microscopy, Centrifugation, Ultracentrifugation, Colorimeter, Spectrophotometer, Chromatography and Electrophoresis)
- To learn in detail about the developmental process, organogenesis and pathogenic parasites of human beings.
- To gain knowledge of animal physiology, metabolism and toxicology.
- To understand fundamentals of biochemistry including carbohydrates, lipids, proteins nucleotides, enzymes, acid-base chemistry and bioenergetics.
- To learn detail related to immune response
- Introduction to principle and theories of Ecology, conservation biology and wildlife study
- To be trained in collection, preservation and identification of local fish fauna and insects.
- To gain knowledge and practical application of fish physiology and techniquies used in Fishery science.
- To understand the hormones, physiological actions and dysfunction of endocrine gland in vertebrates.
- To understands the fundamentals of animal behaviour.
- To gain knowledge and practical application of inesct physiology, Veternary, Medical, Forensic, Economic insects and techniquies used in Entomology.
- To develop aptitude for formulating research problem and experimental planning, data collection, statistical planning and project report complilation.

## Course Outcome:

| S. No. | Course code | Course name | Credits | Course outcome |
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| **1st Semester** | | | | |
| 1 | SOLS/Zool/C 001 | Animal Diversity I – (Lower Non-Chordata) | 3 | Understand the various aspects of Major and Minor Phyla in relation to general Characters, organization and classification.<br>To introduce the basic concept of morphology, nutrition, locomotion and reproduction of Protozoa.<br>To learn about the morphology, canal system and reproduction of phylum Porifera.<br>Gain knowledge of general feature, Polymorphism and reproduction of phylum Coelenterata.<br>To learn about the morphology and anatomy of Helminthes. |
| 2 | SOLS/Zool/C 002 | Cell Biology & Molecular Biology | 3 | To acquire knowledge of Intracellular Compartmentalization of Cell. Their structure, organization, functions and types<br>To learn about the architecture of Plasma Membrane and Solute Transport (Fluid mosaic model) Solute transport across membranes diffusion (Simple and facilitated), Active transport (Primary and secondary), Pumps and transporters, Ion channels (Ligand gated and voltage gated channels), Trans-epithelial transport, Mechanism of regulation of intracellular transport.<br>To provide knowledge of Cell Signalling Cell Cycle and Cell Division, Cell Death, Pathways.<br>To provide knowledge of Intracellular compartments/organelles (ER, Golgi, membrane) protein sorting, secretory and endocytic pathways<br>To learn about Cytoskeleton, its components & functions & derived organelles (cilium, flagellum).<br>To provide knowledge of mitochondria, its structure function & genetic organisation<br>To study about ribosome biosynthesis & formation in nucleolus<br>To understand about cell cycle and its genetic regulation taking yeast as model system<br>To learn about Cellular transformation and malignancy. Retroviruses, Apoptosis and causes of cancer. Nuclear cytoplasmic interaction<br>To provide knowledge of cell and tissue culture in plants and animals, primary culture, cell line, cell clones, callus culture, soma clonal variation.<br>To understand the central dogma of molecular biology |

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| | | | | To acquire knowledge of structure and conformation, supercoiling, packing of DNA into chromosomes, polymorphism of DNA & RNA. three dimensional structure of t-RNA<br>To provide knowledge of DNA replication. Genetic code, transcription and translation in prokaryotes and eukaryotes. RNA processing. Mutations & DNA repair systems. |
| 3 | SOLS/Zool/C 003 | Genetics, Evolution & Taxonomy | 3 | To understand the concepts of genetics and evolution.<br>To understand about the gene as carrier of genetic informations and how genes moves from one generation to another generation through the mendals law.<br>To study the fine structure of gene, chromatin and chromosome. Study the pedigree analysis to know probability of disease occurance in family.<br>To get knowledge about genetic disorders, mutations, linkage and operon model and learn how to prepare the genetic map.<br>Basic knowledge of organic evolution and evolutionary theories.<br>To impart knowledge of origin of life and role of natural selection and mutation in evolution.<br>To understand the species formation by allopatric, sympatric and parapatric speciation. Basic information of zoogeographical divisions of world and geological distribution of animals.<br>To understand the evolution of man and horse by use of fossils. |
| 4 | SOLS/Zool/C 004 | Developmental Biology & Parasitology | | To provide the knowledge about predevelopment, development and post development stages of animals.<br>To acquire knowledge about fertilization events, polyspermy and post fertilization development.<br>To understand the concept of cellular differentiation and induction in development of an organism.<br>To learn about the development of Drosophila and role of genes as molecular basis of development<br>To understand the organogenesis, regeneration and metamorphosis in amphibian and insects.<br>To provide knowledge on lymphocyte differentiation, trandifferentiation and metaplasia.<br>To introduce the basic concept of tetratogenesis and genome alteration.<br>To understand the concept of evolution of parasitism.<br>To study the protozoan parasites and their pathogenicity.<br>To study the helminths parasites and their pathogenicity.<br>To study the arthropod vectors and their role in spreading diseases. |

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| | | | | To understand about the parasitism in crustaceans. |
| 5 | SOLS/Zool/C 005 | Laboratory course 1 | 3 | To impart practical knowledge based on theory papers SOLS/Zool/C 001 and SOLS/Zool/C 002 |
| 6 | SOLS/Zool/C 006 | Laboratory course 2 | 3 | To impart practical knowledge based on theory papers SOLS/Zool/C 003 and SOLS/Zool/C 004 |
| **2nd Semester** | | | | |
| 7 | SOLS/Zool/C 007 | Animal Diversity-II (Higher Non-Chordata) | 3 | Understand the various aspects of Minor Phyla -Phoronida and Rotifera.<br>Understand the organization of Onychophora and Arachnida.<br>Understand the mouthparts and appendages of of insects.<br>To learn about the comparative morphology of all classes of Mollusca. External morphology and anatomy of Grasshopper.<br>To gain knowledge and general features of the reproductive and respiratory system, Larval forms, Torsion and pearl formation in Mollusca.<br>To learn about the larval form, Affinities and Water vascular system in Echinodermata. |
| 8. | SOLS/Zool/C 008 | Animal Physiology and Toxicology | | To learn about the physiology of respiration and the regulation of it.<br>To acquire the knowledge about the digestive system of mammals, physiology of digestion ,absorption and control of gastrointestinal motility<br>To uderstand the anatomy of kidney, physiology of excretion , regulation by hormones, RAAS and process of osmoregulation<br>To learn about the physiology of cardiovascular system and regulation<br>To gain knowledge about the ECG, myocardial infarction and Blood pressure<br>To study the blood groups, blood coagulation and types of circulatory system in animals.<br>To acquire knowledge about the lymphatic system.<br>To understand the high altitude adaptation for survival<br>To learn about the functional differentiation of brain, types of neurons, physiology of nerve impulse conduction, synaptic transmission, neurotransmitters and reflexes.<br>To understand the neuromuscular physiology and molecular basis of signal transduction.<br>To learn about the eye, the visual process and visual adaptation among animals<br>To study about the ear and auditory processes<br>To gain knowledge about the mechanism of thermoregulation, aestivation and hibernation<br>To learn about the toxicity, exposure to toxicants, duration & frequency of exposure, dose-response relationship, mechanism of action of toxicants and bioaccumulation of |

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| | | | | xenobiotics and process of elimination of xenobiotics |
| 9 | SOLS/Zool/C 009 | Instrumentation, Computer Application and Biostatistics | 3 | To learn in detail about Principles and applications of Microscopy (light microscope, electron microscope), Centrifugation and its types, Ultracentrifugation, colorimeter and use of spectrophotometer, to learn how separate different sugars and amino acids by chromatography, Electrophoresis.<br>To learn importance of Statistics in Biological Research<br>To learn, understand and apply tools of mean, median, mode, range, variance, standard deviation and structured problem solving.<br>To learn and apply concepts of co-efficient of variation, skewness & kurtosis. Simple correlation and linear regression (scatter diagram, regression coefficients, regression lines for problem solving and forecasting.<br>To learn sampling techniques.<br>To learn probabilistic distributions like Binominal, Poisson and Normal.<br>To learn and apply student t test, chi square test and f test.<br>Hands on training on statistical softwares<br>To under stand the types of mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units). Data storage device, Memory concepts.<br>To gain knowledge about the software and types of software.<br>Understanding the computer applications in biology and information communications |
| 10 | SOLS/Zool/C 010 | Elementary Biotechnology & Microbiology | 3 | Development of an ability to design and conduct genetic engineering experiments, as well as to analyze and interpret data and construction of DNA and cDNA libraries.<br>Development of research aptitude and technical skills to work in the field of Genetic Engineering.<br>Define biotechnology, provide examples of biotechnology products.<br>Outline the strategies and fundamental steps in a genetic engineering procedure.<br>Describe the mechanism of action and the use of restriction enzymes and Vectors in biotechnology research<br>To gain knowledge of sequence detection, amplification and modification techniques of DNA.<br>Southern, Northern and Western blotting; Probe labelling and hybridization;<br>DNA sequencing (Chemical, enzymatic and automated methods); Sequence assembly for whole genome analysis.<br>Discuss techniques used to probe DNA for specific genes of interest<br>Explain the steps of a bacterial transformation and various selection processes for identifying transformants.<br>Understanding the classification, staining techniques, pathological significance of |

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| | | | | Bacteria<br>To gain knowledge about Physiology, genetics & reproduction of viruses of plants and animals, Bactriophage, lysogenic & lytic cycle.<br>To learn about the Microbial culture techniques & media enrichment techniques.<br>To acquire knowledge about microbes in decomposition and recycling processes.<br>Understanding the role of microbes as pathological agents in plants, animals and man. |
| 11 | SOLS/Zool/C 011 | Lab Course I Based C007 & C008 | 3 | To impart practical knowledge and hands on training based on courses SOLS/Zool/C 007 and SOLS/Zool/C 008 |
| 12 | SOLS/Zool/C 012 | Lab Course II Based C009 & C010 | 3 | To impart practical knowledge and hands on training based on courses SOLS/Zool/C 009 and SOLS/Zool/C 010 |
| **3rd Semester** | | | | |
| 13 | SOLS/Zool/C 013 | Animal Diversity (Chordata) | 3 | To learn about the General Characters development of Urochordata and Cephalochordata and affinities of Hemichordata, Urochordata & Cephalochordata.<br>To learn about origin evolution of cyclostaomata, fishes amphibians, reptiles, birds and mammals.<br>To understand about the parental care in amphibians.<br>To understand about the origin and mechanism of flight in birds. Palate in birds. Migration in birds.<br>To gain knowledge about the dentition in mammals, aquatic and flying adaptations in mammals and adaptive radiation in mammals. |

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| | SOLS/Zool/C 014 | Ecology & Wildlife | 3 | To understand the scope, importance and application of ecology.<br>To undersatnd the limiting factors. Combined concept of limiting factor, factor interaction and homeostasis.<br>To learn about the biogeochemical cycle (nitrogen, phosphorus, carbon & water cycle).<br>Understanding the concept of ecosystem. Concept of habitats & ecological niche.<br>Understanding the concept of population, population growth forms; Carrying capacity; population regulation (Density dependent and independent). Cycles and fluctuations.<br>Understanding the Concept & characteristics of community, succession of communities and key stone species.<br>To gain knowledge about the concepts & importance of Biodiversity.<br>To acquire knowledge about Environmental Impact Assessment., Cumulative Impact Assessment of hydropower development; Environmental flows, DRIFT and BBM.<br>Understanding the identification techiques used in wildlife ( Passive and Dynamic marking).<br>Understanding the population estimation techniques of wldlife.<br>To gain knowledge about Biogeography of India.<br>To learn about Wildlife Conservation and Management.<br>Understanding the Endangered species and Endangered fauna of Himalaya. |
| 15 | SOLS/Zool/C 015 | Lab Course Based on C013 & C014 | 3 | To impart practical knowledge based on courses SOLS/Zool/C 013 and SOLS/Zool/C 014 |
| 16 | SOLS/Zool/E 01a | Fish Biology I | 3 | To study the zoogeographical distribution, origin, evolution, and phylogeny of fishes.<br>To study the classification of fossil and living fish proposed by earlier scientists.<br>Methods of collection, preservation and identification of fish by morphometry and meristic characteristics.<br>To learn about the different groups of fish by understading the morphology and biology.<br>To learn about the comparative morphology of elasmobranch and teleost fish.<br>To study the skeleton system, scales, fins of fish.<br>To learn about the physiology of fish.<br>To provide knowledge about the histology, histochemistry and biochemistry of fish.<br>Composition of blood, haemopoietic tissues, synthesis of hemoglobin in fish.<br>Physiology of Thermo-regulation in fishes.<br>To learn about the spawning patterns and stimulating factors and mechanism of follicular atresia. |

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| | | | | To learn about the mechanism of water- salt balance in freshwater, marine and estuarine fishes. |
| 17 | SOLS/Zool/E 01b | Entomology I | 3 | To introduce the Morphology with their appendages of insects.<br>To provide the knowledge of classification of insect with special reference to that of general characters, habits, habitats, importance of the all 29 insect Orders (Taxonomical aspects). |
| 18 | SOLS/Zool/E 02a | Fish Biology II | 3 | To learn about the special organs in fishes as accessory respiratory organs, swim bladder, weberian ossicles, electric organs, bioluminescent organs and sound producing organs.<br>To study the fish behaviour, parental care and migration in fishes and the factors affecting it.<br>To learn about the effect of pheromones on sexual behaviour of fishes.<br>Basic knowledge of embryology in fishes as pattern of cleavage and formation of blastula, gastrula and post embryonic development.<br>To get knowledge about the endocrine glands, their hormones and their physiological effects in fishes as pituitary gland, thyroid gland, pancreas, corpuscles of stannius and urophysis. |
| 19 | SOLS/Zool/E 02b | Entomology II | 3 | Know and use names and terms specific to insect physiology.<br>Obtain and integrate information pertaining to specific physiological systems.<br>Explain cellular and molecular basis of specific physiological processes.<br>An understanding of principles of insect physiology obtained from lectures, notes and extracurricular reading of a textbook and review literature.<br>Learning examples of how basic research in insect physiology contributes to biomedical advances and pest control applications. |
| 20 | SOLS/Zool/E 03 | Lab Course Based on E001a/b/c/d & E002 a/b/c/d | 3 | To impart practical knowledge based on theory papers SOLS/Zool/E 01a/b and SOLS/Zool/E 02a/b |
| **4th Semester** | | | | |
| 21 | SOLS/Zool/C 016 | Endocrinology & Animal Behaviour | 3 | To obtain knowledge about hormones, neurohormones, hormone like substances (neuronal peptides, autocoids, pheromones, neurosecretion).<br>To learn about the structure, hormones and physiological actions of the Thyroid, Parathyroid, Pancreas, Gastro-intestinal tract, Adrenal cortex and Medulla, Thymus & Pineal in vertebrates.<br>To acquire knowledge about hormonal dysfunction.<br>To provide knowledge about mechanism of action of protein hormones and |

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| | | | | catecholamines, membrane bound receptors, G-protein and control of adynelate cyclase, Cyclic nucleotide cascade.<br>Mechanism of action of Steroid and Thyroid hormones, Cytosolic receptors, effect on transcriptional and translational processes.<br>To learn about hormone biosynthesis: Protein peptide hormones, gonadotrophins, thyrotrophin, corticotrophin, Steroids and catecholamines.<br>To provide knowledge about the organisation & physiological actions of the testis and ovary. Androgen binding protein (ABP), Inhibin. Neurendocrine control of testicular functions (Gn RH regulation, FSH- effects on germinal epitheluim, LH-effects on Leydig cells, negative feed back regulation) Folliculogensis, Ovulaton, Luteinization, Ovarian cycles; Seasonal reproductive cycles; sexual dysfunctions in man.<br>To learn about the science of behaviour, Proximate and ultimate causes of behaviour, sign stimuli and Fixed Action Pattern, Spatial learning. Associative learning, classical conditioning, operant conditioning, language learning. Imprinting. Kin recognition. Instinct versus learning behaviour.<br>To obtain knowledge about the timing of behaviour, The Biological Clock. Circadian rhythms and their synchronisation and seasonal rhythms. Photoperiodism.<br>To learn about the communication in animals, echolocation in bats, electrolocation in fish, Chemicals (pheromones) as signals in insects, fish and mammals.<br>To provide knowledge about the neural and hormonal control of behaviour.<br>To understand about the evolutionary and ecological aspects of animal behaviour, Ecology of foraging behaviour and Cooperation and conflict in animals. |
| 22 | SOLS/Zool/C 017 | Biochemistry & Immunology | 3 | To get information about classification of enzymes, enzyme substrate complex formation and michaelis- menten equation.<br>To understand metabolic pathways and their regulation as in carbohydrate metabolism pathway and regulation of glycolysis, gluconeogenesis, glycogen metabolism, citric acid cycle, electron transport chain and pentose phosphate pathway.<br>To learn about protein metabolism by understanding amino acid synthesis and breakdown and urea cycle. To understand fat and nucleic acid metabolism and their regultion, synthesis and degradation of fatty acids and nucleic acids.<br>To introduce the basic concepts of immune system and immunity structure and function of antigen and antibodies.<br>To provide knowledge about Humoral and Cell Mediated Immune Response and Regulation: B- cell and T – cell receptor complex, Positive and negative regulation; Immune Response: T -Cell independent and T- Cell dependent defence mechanisms. Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells,Antibody |

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| | | | | dependent cell cytotoxicity (ADCC), Macrophage-mediated cytotoxicity.<br>To learn about Complement system, Cytokines and Major Histo-compatibility Complex.<br>To update knowledge in aspect of Immunopathology and Transplantations including : Rh- blood groupings, Hypersensitivity reactions (Antibody mediated type I, anaphylaxis, type II- antibody dependent cell cytotoxicity, type III-immune complex mediated reactions and type IV-delayed hypersensitivity reactions), Autoimmune diseases, Immunodeficiency; Transplantation: Graft vs. host reaction and rejection; Immunization and Vaccines.<br>To provide knowledge of antigen antibody responses and Immunodiagnostic techniques: Immunoelectrophoresis, RIA, ELISA, Chemiluminescence immunoassay, Western blotting, Immunofluorescence. |
| 23 | SOLS/Zool/C 018 | Lab Course Based on C016 & C017 | 3 | To impart practical knowledge and hands on training based on theory papers SOLS/Zool/C 016 and SOLS/Zool/C 017. |
| 24 | SOLS/Zool/E 04a | Fisheries Science | 3 | To learn about the different component of culture and capture fishery.<br>To understand about the concept of different culture systems: Extensive and intensive fish culture, Fish culture in ponds and reservoirs. Culture in rice fields, bheries, Cage culture, Pen culture, Monoculture and polyculture.<br>To learn about the preparation and maintenance of fish farm, development of natural food and supplementary feeding, Procurement of stocking material from natural sources and Transport of fish seed.<br>To learn about the Induced breeding and use of new generation drugs.<br>To learn about the culture practices Common carp, Exotic Trouts, Prawn, Mahaseer and *Schizothorax.*<br>To learn about Sewage – fed Fisheries and Integrated fish farming, common fish diseases and their control and culture of larvicidal fishes.<br>To learn about the harvesting and post harvesting techniques, fish preservation and processing techniques.<br>To gain knowledge about the Fish spoilage, causes of rigor mortis, precautions to control rancidity, microbial spoilage.<br>To learn about the problems and perspectives in capture fisheries, marine fishery, Exclusive Economic Zone.<br>Major, Marine and freshwater ornamental fishes, their food & breeding needs. Health management of ornamental fishes. Specific diseases and their cure. Setting and maintenance of aquaria. |
| 25 | SOLS/Zool/E | Applied Entomology | 3 | To have a good understanding of the holistic approach of Integrated Pest management |

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| | 04b | | | and its various components and their implementation in pest management.<br>Knowledge of some beneficial insects like silkworm, honey bees and lac insects and learning methods by which these can be best exploited for the human welfare.<br>Be able to identify the potential impact of different insect species on agriculture, human health, and society in general; to be knowledgeable about preventive measures and potential control strategies.<br>Obtain and integrate information about insecticides and the possible hazards of using insecticides to the mankind and environment in general. |
| 26 | SOLS/Zool/E 05a | Methodology in Fishery Science | 3 | To understand the physico chemical parameters of water as temperature, pH, turbidity. Transparancy, DO, BOD, free $CO_2$, hardness, alkalinity, sulphate, phosphate and nitrate.<br>To learn how to collect the sample of water for their physico chemical estimation and what are the sampling techniques for fish, plankton collection.<br>To learn the quantitative and qualitative estimation of planktons, benthos and periphytons.<br>To get information about the fish preservation, fish identification by using keys and monographs and by molecular taxonomy.<br>To get some knowledge about length-weight relationship, condition factors, dietary components and food preference of fishes.<br>To study gonadosomatic index, fecundity of fish, age of fish and their biology.<br>Understanding the use of statistics and softwares in fishery science.<br>Understanding the Calculation and importance of Coefficient of Similarity (S), Shannon wiener Diversity Index (H ), Species richness and Margalef diversity index. Relative Species Number index (RSN x), Descriptive statistics, Regression analysis and Coefficient of correlation, Chi square test (X ) test, Analysis of variance (F. test), "t" test. Multivariate analysis, cluster analysis, Factor analysis and Discriminate analysis and FISAT for population dynamics.<br>Understanding the pathological analysis of fish.<br>To learn the techniques of toxicity analysis of pollutants. |
| 27 | SOLS/Zool/E 05b | Methodology in Entomology | 3 | To introduce the basic concepts of Research methodology in entomology.<br>To provide the knowledge of role of entomology in agriculture, Medical entomology, Veterinary entomology, Forensic.Entomology and its importance.<br>To be trained the students in Entomological techniques-Type of sampling survey, Different collection methods, collection of wild flies and domestic insects, Collecting Insect in the wild area, Transporting live adults or larvae. Preservation of insects, classification of insects up to the level of families with hands-on experience in |

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| | | | | identifying the families of insects and Catalogues.<br>To learn about National Biodiversity Authority (NBA),<br>To learn about Trophic relationships, ecological data, and insect diversity: Indices, richness, rarity.<br>To learn the principles of Population estimates. Coexistence and Competition.<br>Distribution patterns, insect biodiversity, physic-chemical parameters of water (turbidity/transparency, velocity, pH, temperature, estimation of $CO_2$, $O_2$ hardness)<br>Understanding the Chi-Square test, Student t-test, Transofrmation of data: square root transformation, logarithmic transformation and angular, transformation, Analysis of variation, Mean separation: LSD and Duncan's Multiple Range test, Probit analysis and Non-parametric analysis.<br>To gain knowledge about the project report preparation. |
| 28 | SOLS/Zool/E 06 | Lab Course Based E004 a/b/c/d & E005 a/b/c/d | 3 | To impart practical knowledge and hands on training based on theory papers SOLS/Zool/E04a/b and SOLS/Zool/C 05a/b |
| 29 | SOLS/Zool/E 07 | Dissertation | 6 | To develop skills for carrying out a small research project and statistically interpret the outcomes and write the thesis. |

# Master in Commerce

**Programme Code: 322**

**Programme Summary**

Duration: 2 years

**Eligibility**

B.Com with 40% marks in aggregate or B.A., B. Sc. with Mathematics OR Economics with minimum 50% marks in aggregate.

## Program outcomes:

- To demonstrate an advanced, specialized and well-rounded knowledge of the chosen academic discipline.
- To develop aptitude for formulating research problem and data collection and statistical planning.
- To critically apply theories, methodologies, and knowledge in order to address fundamental questions in their primary area of study.
- To knowledge about Corporate accounting and Management accounting
- To demonstrate skills of critical evaluation and research within the field so as to be eligible for doctoral training as academic professionals in the discipline.
- To demonstrate the ability to apply theoretical knowledge to practical and professional contexts so as to evince eligibility to occupy positions of responsibility and leadership in the society at large.
- To develop analytic thinking skills and sound oral and written communication skills so as to be able to communicate ideas effectively
- Ability to compute taxable income of Partnership Firm ,HUF , Companies.
- Ability to analyze financial data for managerial decision-making
- Knowledge of legal aspects of business like company act, consumer act, Information Technology Act 2000 etc.
- Knowledge of emerging field E-commerce and its working pattern
- To be trained in recombinant in on-line filing return
- Knowledge about financial management and cost accounting procedure and technique
- To gain knowledge of financial market and international financial management
- Understand the concepts of Managerial Economics

- To evince an interest in and knowledge of interdisciplinary frameworks of study, experiment, and research.

# Course outcomes:

| S.no. | Course code | Course name | Credits | Course outcomes |
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| | | | **1st Semester** | |
| **1** | M.Com101 | Corporate Financial Accounting | 3 | Develop an understanding about Issue and Redemption of Debenture and its types.<br>To give an exposure to the company final accounts.<br>To provide knowledge on valuation of Goodwill & Shares.<br>Enable the students to understand about amalgamation, absorption and external reconstruction.<br>Students can get an idea about internal reconstruction.<br>To introduce and develop knowledge of holding companies accounts. |
| **2** | M.Com102 | Management Principles and Practice | 3 | To understand concept and thought of management.<br>To know about nature and importance of planning.<br>To develop organizations skills.<br>To understand concept and importance of direction.<br>To know the technique of control. |
| **3** | M.Com103 | Business Environment | 3 | Make the students understand about business and corporate law.<br>Develop knowledge on contract and various types of contracts.<br>To help the students to understand the concept of sale of goods.<br>Make the students understand about companies and its types.<br>To equip the students with proper knowledge about Foreign exchange. |
| **4** | M.Com104 | Managerial Economics | 3 | To learn the basic theories in economics in connection with business and the various economics models and tools required to run a business.<br>To make the students to have importance and need of business economics.<br>To understand the basic elements of managerial economics aspects , nature and decision making.<br>To understand the law of demand, supply forecasting, consumer durable.<br>To understand theories of profit, profit maximization and analysis of breakeven |

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| | | | | point.<br>To know law of diminishing proportion , product function , economies of scale.<br>To understand Pricing policy under Perfect Competition Monopoly, Monopolistic Competition , Oligopoly and Pricing Objectives and Methods for production to minimize the cost and maximum the profit. |
| **5** | M.Com105 | Computer Application in Business | 3 | Demonstrate a basic understanding of computer hardware and software, how to assess hardware, solve problems using computer<br>Software's, doing business online, and the inner workings of the Internet. Basic idea of networking, email and cyber security.<br>Describe the features and functions of the major categories of applications software (word processing, database, spreadsheet, presentation).<br>To create PPT presentation, application of excel in business and accounts. how to work with<br>Databases.<br>Demonstrate the concepts of Tally ERP.9 Software, to create company, journal entries, and financial statement. |
| **6** | M.Com106 | Business Communication | 3 | To develop communication skills and overall personality development of the students.<br>To acquire skills in reading, writing, comprehension and communication, as also to use electronic media for business communication.<br>The effective use of various types of communication.<br>Develop communications kills for the workplace<br>Techniques to improving your presentation skills.<br>Student should know how to write resume. |
| **2nd Semester** | | | | |
| **7** | M.Com 201 | Financial management | 3 | To introduce the subject of financial management.<br>To acquaint the student with various methods and techniques of financial management.<br>To acquaint students with the advanced concept of financial management and to develop financial strategies for the organization. |
| **8** | M.Com202 | Marketing management | 3 | To familiarize the students with the fundamentals of marketing including marketers' perspectives and their market orientations while sensitizing them about the dynamic and volatile marketing environment to enable them to take |

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| | | | | better marketing decisions.<br>Understand the market characteristics and the nature of competition in such markets.<br>Develop skills in organizing for effective marketing and in implementing the market planning process.<br>Develop an insight and knowledge base of the various underlying concepts driving marketing strategies. |
| **9** | M.Com203 | Human resource management | 3 | Imparted the concept of human resource management.<br>Knowledge on different methods of training.<br>Acquired knowledge on components of remuneration and welfare & social security<br>measures.<br>Comprehend the knowledge about Trade union – industrial disputes & settlements.<br>Describe about Human resource audit. |
| **10** | M.Com204 | Research methods & Statistics | 3 | Describe the different types of educational research and the needs of research.<br>Discuss the concept of variables and hypotheses, their nature, importance and types.<br>Identify the important conditions conducive to the formulation of hypotheses.<br>Define the term population, sample and describe the steps involved in the process of sampling<br>Evaluate the different tools of data collection.<br>Apply writing of report for project. |
| **11** | M.Com205 | Management Accounting | 3 | Understand about the concept of management tools.<br>Understands about different methods of analysis tools.<br>Acquired knowledge about preparation of fund flow and cash flow statements and ratio.<br>Described about different concept in preparation of difference types of budgets -<br>Cash, variable etc.<br>Imparted knowledge on capital budgeting and decision making techniques.<br>To develop the know -how and concept of marginal costing with practical |

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| | | | | problem<br>To provide knowledge about Standard Costing. |
| **12** | M.Com206 | Legal Aspect of business | 3 | Understand the provisions relating to Company Act 2013<br>Analyse the laws relating to Competition Commission Act, 2002<br>Analyse the laws relating to Consumer Protection Act, 1986<br>Describe the provision relating to Right to Information Act, 2005<br>Describe the provisions relating to IT Act |
| **13** | M.Com207 | Organization Design, Development and change | 3 | Understanding of organizational culture, misbehaviour at work and OD<br>Introduction: Basic knowledge of organization development.<br>Organisational diagnosis:<br>Techniques of collection and analyses of organizational.<br>Diagnosis information.<br>Organisational Change, Renewal, and Development:<br>Planned and unplanned changed models and institution building.<br>OD Interventions:<br>Design and evaluation of different types and levels of change interventions.<br>Trends in Organization Development: Recent trends and future of OD field. |
| **3rd Semester** | | | | |
| **14** | M.Com301 | International Business | 3 | To understand different aspects of international business.<br>To understand the global trade barriers and liberalization of business.<br>The students acquire the knowledge about the Foreign trade, Foreign exchange, etc.<br>Conduct an environmental scan to evaluate the impact of world issues on an organization's international business opportunities.<br>Conduct, evaluate and present market research to support an organization's international business decision-making.<br>Manage the preparation of documents and the application of procedures to support the movement of products and services in the organization's global supply chain. |
| **15** | M.Com302 | Management of Financial services | 3 | To give an idea about fundamentals of financial services and players in financial sectors.<br>To create awareness about merchant banking, issue management, capital markets and role of SEBI. |

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| | | | | To provide knowledge about leasing , factoring and hire purchase concepts.<br>To make them understand about different types of Credit Rating Services. |
| **16** | M.Com303 | Income Tax Laws and Practice | 3 | To introduce the basic concept of Income Tax.<br>In order to familiarize the different know-how and heads of income with its components.<br>It helps to build an idea about income from house property as a concept.<br>It gives more idea about the income from business or profession. |
| **17** | M.Com304 | Financial Markets and Institutions | 3 | It provides sound information and knowledge of broad framework of Financial Systems and its constituents.<br>Make an informed judgment about whether or to what extent a financial market satisfies the conditions of an efficient market.<br>It provides knowledge of institution in India.<br>It provides understanding of instruments which are helpful in making investments.<br>It facilitates information of rates, interest, guidelines, schemes of banks and financial institutions. |
| **18** | M.Com305 | Security Analysis and Portfolio Management | 3 | To help them to understand security analysis.<br>To create an awareness about risk and return of different investments.<br>To enlighten the evolution of securities and derivatives.<br>To make them understand the investment decisions and portfolio management. |
| **19** | M.Com306 | Consumer Behavior | 3 | To provide in-depth understanding of the consumer and Industrial buying process and their determinants as relevant for marketing decision making.<br>Students understand the importance and nature of consumer behavior.<br>Understand buying motives.<br>Understand the needs and motivation.<br>Levels of consumer decision making.<br>Understand the models of consumer behavior and business buying behavior. |
| **20** | M.Com307 | Marketing Communication | 3 | To provide an in-depth understanding of integrated marketing communications concepts<br>To research and evaluate an organizations marketing and promotional situation in order<br>to develop effective communication strategies and programmes<br>To understand the industry and the players promotional plan adapted to a |

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| | | | | specific organization.<br>To develop communication skills and overall personality. |
| **4th Semester** | | | | |
| **21** | M.Com401 | Project Planning and Evaluation | 3 | It help them to design project which includes the actual planning and design of a project<br>The evaluation of project results occurs at the end of a project and involves determining whether the project's goal and objectives were achieved. The evaluation stage then leads to the identification of additional or persisting problems, allowing the cycle to begin again<br>Project monitoring 4 occurs throughout all stages allowing for small adjustments in the project's planning, design, and implementation in order to ensure the project's success<br>It helps in implement an effective and efficient process for the collection of monetary penalties while upholding the principles and values of social justice.<br>Defines problems in the community that stand between the community and its long-range goals. |
| **22** | M.Com402 | E-Commerce | 3 | Demonstrate an understanding of the foundations and importance of E-commerce<br>Demonstrate an understanding of retailing in E-commerce.<br>Analyze the impact of E-commerce on business models and strategy<br>Recognize and discuss global E-commerce issues<br>Demonstrate the application of appropriate e-commerce Technologies.<br>Communicate effectively and ethically using electronic media<br>To know about online transactions and payment gateways.<br>To know how to create online business.<br>To understand about cyber security.<br>To know about the emerging business models. |
| | | or | 3 | |
| | | Project Report (only for students scoring 75% and above aggregate marks in 1st & 2nd semester) | | To develop skills for carrying out a small research project and statistically interpret the outcomes and write the thesis.<br><br>The students take up the project on organization and management of industries |

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| | | | | by visiting industries. By the project work the students get good practical knowledge. |
| **23** | M.Com403 | Seminar and Viva Voce | 3 | To gain the experience of a interview before they go out seeking jobs in industry.<br>To develop confidence in a face to face interaction in a formal setting. |
| **24** | M.Com404 | Risk management And Insurance | 3 | Compare and contrast the role of insurance differs between gambling and bonding.<br>Evaluate different types of risk and distinguish differences that exist between them.<br>Evaluate the various methods used to identify risk.<br>Apply the insurance method to design a risk management program for a business.<br>Analyze the fundamentals of insurance contracts.<br>Understand concept of IRDA Act |
| **25** | M.Com405 | International Financial Management | 3 | To give a detailed idea about macro environment on which financial transactions are carried out.<br>To give a comprehensive knowledge about ways and means of rising of finance by MNC.<br>Understand international capital and foreign exchange market<br>Identify and appraise investment opportunities in the international environment<br>Identify risk relating to exchange rate fluctuations and develop strategies to deal with them<br>Identify and evaluate foreign direct investment and international acquisition opportunities |
| **26** | M.Com406 | Marketing of Services | 3 | To know the services vision and mission<br>To study services positioning and differentiation.<br>To familiarize service marketing mix.<br>To analyze the customer focused services.<br>To study the specific service marketing<br>Students know about the 7Ps of Marketing. |
| **27** | M.Com407 | International Marketing | 3 | To know the Globalization concept.<br>To identify legal and ecological factors affecting International Marketing. |

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| | | | | To develop an understanding of the dynamics of International trade and to appreciate the role of World Trade Organization in governing international trade .<br>To analysis different aspects of International Marketing Environment including political, legal, economic and cultural environment and the risks associated with each of them.<br>To introduce the students to the meaning and scope of International Marketing along with drivers of globalization.<br>To identify the various modes of entry in International Marketing. |
| **28** | M.Com408 | Entrepreneurship Development | 3 | Acquired knowledge about entrepreneur and their functions.<br>Described about functions of development banks, commercial banks and service institutes.<br>Gained facts on feasibility study, project report and tools of appraisal.<br>Acquired knowledge on role of government in organizing EDP and phases of EDP.<br>Imparted knowledge about economic growth and entrepreneurial development.<br>Also gained about problems faced by women entrepreneurs. |

# M.Sc. Medical Lab Technology

## Programme Summary

Duration: 2 years

## Eligibility

B. Sc MLT or Medical Microbiology or M Sc in Medical Sciences with minimum 50% marks in aggregate.

**Program outcomes:**

The mission of the Medical Laboratory Technology Program is to promote and maintain standards of quality for the services and the environment necessary for students to achieve their educational goals and to enhance the social, cognitive, and professional skills required for entry level employment as medical laboratory technicians (MLTs) in the healthcare community.

- Competency to perform a full range of testing in the contemporary medical laboratory encompassing pre-analytical, analytical, and post-analytical components of laboratory services, including hematology, biochemistry, microbiology, immunology, histopathology, cytopathology, serology, urinalysis, body fluids, molecular diagnostics, phlebotomy, and immunohematology.
- Learn proficiency to problem-solve, troubleshoot, and interpret results, and use statistical approaches when evaluating data.
- Effective communication skill to ensure accurate and appropriate information transfer.
- Appropriately and successfully collection of blood specimens through venipuncture, capillary puncture and body fluids.
- Identify basic guidelines for safe use of chemicals including proper labeling, protective measures, location and use of SDS, and disposal of hazardous chemicals.
- To gain knowledge of basic theory for primary aspects of the blood bank including antigen, antibody, compliment, agglutination, antiglobulin, ABO-Rh and other common systems, antibody identification, transfusion therapy, transfusion reactions, and hemolytic disease of the newborn.
- Demonstrate proper care and safe use of basic laboratory equipment including the microscope, centrifuge, pipets and glassware.
- Demonstrate proficient operation of instruments used in coagulation testing and demonstrate understanding of instrument maintenance and QC.
- Discuss the role of the phlebotomist and display professional behavior in dealing with patients, their family, and the public.
- Demonstrate integrity as shown by the admission and documentation of errors, recognition of the potential danger of short cuts, and the maintenance of patient and co-worker confidentiality.
- Adapt to stressful and/or new situations by maintaining composure and flexibility without compromising individual integrity.

## Master in Physiotherapy (M.P.T.)- Orthopaedics/Neurology/Sports

**Course Summary**

Duration: 2 years

**Eligibility**

Bachelor's degree in Physiotherapy (B.P.T) with minimum 50% marks in aggregate.

**Program outcome:**

- The main aim of the course is to prepare the postgraduate student towards his/her professional autonomy with self regulating discipline at par with global standards.
- It works for formation of base of the professional practice by referral as well as first contact mode using evidence based practice.
- Implantation of research basis in order to validate techniques & technology in practice to physiotherapy is the main goal of the course.
- It helps in acquainting a student with concept of quality care at the institutional as well as the community levels.
- It inculcates appropriate professional relationship in multidisciplinary set up, patient management and co partnership basis.
- Prepares the students to address problems related to health education and community physiotherapy.
- The course adds Experience in clinical training and undergraduate teaching partly and provides the honest, competent and accountable physiotherapy services to the community.

**Course outcome:**

| S. no. | Course code | Course name | Max marks | Course outcome |
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| | | | | **1st Year** |
| 1 | MP- 101 | Review of Human Sciences | 70 | Applied anatomy for supportive specialization.<br>Normal functional anatomy for analysis between normal and abnormal.<br>Subject support: Diagnosis & related mechanics.<br>Pharma: Medical Professional supportive purpose / action reaction of medical related to different specialization.<br>Pathology: Basic condition knowledge, their pathological changes & their relevant conditions to support the specialization.<br>Biochemistry: For nutritional and diet chart of different conditions. |
| 2 | MP-102 | Review of Basic Therapeutics | 70 | Review of Exercise Therapy which includes Assessment techniques like MMT & Goniometry, Stretching and mobilization, Re-education and strengthening, Balance and co-ordination exercises.<br>Gait analysis and training (Both normal & Pathological gait).<br>Review of techniques like Relaxation and soft tissue manipulation, Posture, PNF, Traction and Hydrotherapy.<br>Review of Electrotherapy includes Gen. Review of low & medium frequency currents frequencies and their modifications like di-dynamic and Russian currents, Ultrasound, UVR and IRR along with Cryotherapy and other thermal modalities.<br>Review of biomechanics includes Evaluation and assessment of joint motion, Evaluation and assessment of locomotion and Evaluation and assessment of posture. A review of Bio-Engineering. |
| 3 | MP -103 | Advance Therapeutics | 70 | Introduction of new Advance therapy conditions like MET, PRT, MFR and Cyriax. Introduction, History, Basic Classification, Assessment for manipulation, discussion in brief about the concepts of mobilization like Maitland, Mulligan, Butler in Neural tissue mobilization etc.<br>Recent advances on advance therapeutics like Laser, Micro currents, Biofeedback, EMG and Radiological and Pathological Investigations. |
| 4 | MP-104 | Practical in Therapeutics | 70 | Knowledge of basic therapeutics and Advance therapeutics.<br>Practical of all type of strengthening techniques.<br>All type of mobilization techniques.<br>Soft tissues stretching & mobilization.<br>Gait analysis & Training.<br>Postural assessment & re-education.<br>Balance & coordination.<br>Special technique of exercise therapy<br>Traction and Hydrotherapy.<br>I. All types of low & medium frequency currents.<br>•Faradic<br>•Galvanic<br>•High Voltage Current<br>•Di dynamic |

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| | | | | •Russian<br>•Interferential Therapy<br>•TENS<br>•Micro currents<br>II. All type of high frequency currents & modalities.<br>• Short wave diathermy<br>• Microwave diathermy<br>• Ultrasound<br>• Cryotherapy<br>• Biofeedback UVR IRR LASER |
| **2nd Year** | | | | |
| 5 | MPN-201 | Physical therapy in neurological disorders | 70 | Review of neurological disorders, examination of the patients and rehabilitation through Advanced therapeutic techniques like Bobath, Motor re learning, Rood, PNF, Mobilization etc.<br>Testing of cranial nerves, Stupor and Coma. Management of Disorders of the Cerebral circulation, Infectionus disorders, Demyelinating disease of the Nervous system, Movement disorders, Degenerative diseases of the spinal cord and cerebellum, Disorders of the spinal cord & cauda equine, Disorders of Peripheral Nerves, muscular disorders and Autonomic Nervous Disorders. |
| 6 | MPN-202 | Neurosurgical rehabilitation | 70 | Techniques, Types of skull, brain, spine, surgery & its complication. Pre & post physiotherapy assessment, Treatment.<br>Management of Closed skull fractures, Haematomas, epidural, sub dural, intracerebral, Open cranio cerebral injuries, Re construction operation in head injuries.<br>Tumors Patho -physiology, classification effects of Mass lesion, Symptoms and Sign, Examination Management Pre & Post Operative Rehabilitation protocol.<br>Vascular disease of the Brain and its management. |
| 7 | MPN-203 | Physical therapy in pediatric Neurology | 70 | General Developmental sequence of Normal Child.<br>Normal nutritional requirement of a child infant feeding prevention of some nutritional disorders nutritional deficiency diseases.<br>Immunization (Salk and Sabin DPT and against some common viral diseases)<br>Neurological Affection of Childhood: Poliomyelitis, spina bifida hydrocephalus, encephalitis etiology, clinical features & rehabilitation peripheral nerve injuries in early child hood.<br>Management of Seizures epilepsy of child hood and muscular distrophies. |
| 8 | MPN-204 | Skill enhancing studies | 70 | 1. Biostatistics & Computer for collecting data & programme project work & for planning effective treatment.<br>2. Ethics & Medico legal aspects for clinical purposes.<br>3. Educational Technology for Teaching & Learning purposes.<br>4. Research methodology. |
| 9 | MPN-205 | Practical | 70 | 1. Assessment<br>a) Physical<br>b) Clinical<br>c) Pathological |

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| | | | | d) Other Investigations<br>2. Differential diagnosis & its reason.<br>3. Treatment: Physiotherapy Management & advanced technique application.<br>4. Home programme. Neurorehabilitation and self care with Mat exercise and ambulatory care. |
| 10 | MPN-206 | Dissertation | 200 | The dissertation is aimed to train a postgraduate student in research method and techniques. It includes identification of a problem, formation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a<br>research study, collection of data, statistical analysis of results, discussion and drawing Conclusion. Presentation of own dissertation in prescribed manner. |
| 11 | MPO-201 | Orthopaedic Physical Therapy | 70 | Detailed assessment & management in view of advanced and traditional methods considering both surgical and physical therapy aspects in general orthopaedics and regional orthopaedics.<br>Incidence, etiology, clinical features, complications, assessment investigations and conservative reductions physiotherapy management of the Traumatological conditions.<br>Methodology of different types of surgeries and its rehabilitation. Menisectomy, laminectomy, patellectomy, total knee replacement, total hip replacement, triple arthrodesis, hip arthrodesis and arthroplasty, bone grafting, internal and external fixations, tendon transfers, nerve suturing and grafting etc.<br>Vascular injuries management, amputation and Bioengineering |
| 12 | MPO-202 | Vertebral disorders & rehabilitation | 70 | Classification, Pathophysiology, causes, clinical features, complication examinations, management, physiotherapy treatment of common vertebral disorders. Traumatology and Spical cord Injury management. Advance techniques like Maitland, Cyriax, PNF etc. apply according to the necessary cases. |
| 13 | MPO-203 | Hand Rehabilitation | 70 | Functions of hand as motor and sensory organ with advanced bio and pathomechanics of hand injuries. Classification of hand injuries and principles of hand Rehabilitation (Functional and Vocational Training)<br>Tendon injuries, Nerve injuries and Crush injury management. Incision and their effects on later rehabilitation, fractures, joint injuries and correction of Deformities.<br>Management of Burns in hand, Spastic hand, Rheumatoid hand, Hand in hansen's disease and Reflex sympathetic dystrophy.<br>Rehabilitation in prosthetic hand. |
| 14 | MPO-204 | Skill enhancing studies | 70 | 1. Biostatistics & Computer for collecting data & programme project work & for planning effective treatment.<br>2. Ethics & Medicolegal aspects for clinical purposes.<br>3. Educational Technology for Teaching & Learning purposes.<br>4. Research methodology. |
| 15 | MPO-205 | Practical | 70 | 1. Assessment<br>a) Physical<br>b) Clinical<br>c) Pathological<br>d) Other Investigations<br>2. Differential diagnosis & its reason.<br>3. Treatment: Physiotherapy Management & advanced technique application. |

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| | | | | 4. Home programme.<br>Fracture Cases : Intensive care, Emergency care, Positioning, Reduction, Plaster application care in period of immobilization & post immobilization rehabilitation. |
| 16 | MPO-206 | Dissertation | 200 | The dissertation is aimed to train a postgraduate student in research method and techniques. It includes identification of a problem, formation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, statistical analysis of results, discussion and drawing Conclusion. Presentation of own dissertation in prescribed manner. |
| 17 | MPS-201 | Traumatology | 70 | Analyse and Interpret Various Sports Injuries / Patho Mechanics And Apply Appropriate Therapeutic Techniques On And off The Field.<br>Devise / Modify Various Exercises For Sports Personnel And Prevent Injuries By Appling Proper Dynamics During Play.<br>Analyse The Effect Of Therapeutic Modalities, Indications And Contra Indications And Precaution To Ensure Safety.<br>Demonstrate Skills Of Assessment And Management In Both Acute And Long Standing Injury Conditions.<br>Carry Out Research In a Particular Aspect / Specific Event Based On Bio Mechanical / Physiological And Other Variables. |
| 18 | MPS-202 | Fundamentals in Sports | 70 | **Brief idea about some common sports:** Terminology, methodology, rules, equipments and infrastructure.<br>Cricket, football, hockey, tennis, badminton, table tennis, wrestling, boxing, track and field, gymnastics volleyball, basketball and aquatic sports.<br>Physics in sports, Biomechanics of running. Biomechanics of throwing. Biomechanics of jumping. Introduction to analysis equipment. Psychological aspect in sports. Spirit and moral values, dopping in sports and performance enhancing drugs. Special aids in performance. Body composition, its analysis and effects of sports. Protective equipment used in sports. |
| 19 | MPS-203 | Rehabilitation in Sports | 70 | **Physiological Responses to Exercise.** Risk factors in sports (intrinsic and extrinisic). Strategies of Injury prevention. Sporting emergencies, onfield assessment, clinical assessments principles of management ( acute management, remodeling and conditioning, maintainance of fitness and rehabilitation).<br>**Nutrition in Sports.** Various techniques like Plymortics etc. in sports training.<br>**Some common injuries related to some common & popular sports and their management.** |
| 20 | MPS-204 | Skill enhancing studies | 70 | 2. Biostatistics & Computer for collecting data & programme project work & for planning effective treatment.<br>2. Ethics & Medicolegal aspects for clinical purposes.<br>3. Educational Technology for Teaching & Learning purposes.<br>4. Research methodology. |
| 21 | MPS-205 | Practical | 70 | 1. Assessment<br>a) Physical<br>b) Clinical<br>c) Pathological<br>d) Other Investigations<br>2. Differential diagnosis & its reason.<br>3. Treatment: Physiotherapy Management & advanced technique application. On field and off field management.<br>4. Home programme. |

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| 22 | MPS-206 | Dissertation | 200 | The dissertation is aimed to train a postgraduate student in research method and techniques. It includes identification of a problem, formation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, statistical analysis of results, discussion and drawing Conclusion. Presentation of own dissertation in prescribed manner. |