

FACULTY OF SCIENCE

Bachelor of Science (Biology)

Program Code: 04UGR002

PROGRAM EDUCATIONAL OBJECTIVE (PEO'S)

The program of B.Sc. Biology is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. The program focuses on the all-round development of the students to face the competitive world. The objectives of the program are as follows:

- To understand the scope and significance of the discipline.
- To imbibe love and curiosity towards nature through the living plants.
- To make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
- To make the students exposed to the diverse life forms.
- To make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
- To encourage the students to do research in related disciplines.
- To develop the ability of the students to transform the society through their education.

PROGRAM OUTCOMES (PO'S)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings towards Flora.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues related to plants (Flora) and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development.
- **Self-directed and life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in Botanical practices and education program.

- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Botany, Instrumentation & Technology.
- **Technical Skills:** Develop an ability to use various instruments and equipment with an in depth knowledge on standard operating procedures for the same.
- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Botany, Botanical Sciences and Zoological Sciences.
- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of Botany, Chemistry and Zoology.
- **The Society:** Apply regional Botanical reasoning for Plants informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOME

- **PSO1:** Identification and taxonomy of plants and animals through different taxonomic description of plants.
- **PSO2:** To get a better understanding of different families of plants in the angiosperms and gymnosperms and also identification of animals.
- **PSO3:** To get the techniques involved in plant tissue culture and plant breeding.
- **PSO4:** To perform a detailed study about the different types of microbes viz. bacteria, Cyanobacteria, algae and fungi.

Course Code: 3CBCA201

Course Name: BASIC COMPUTER & INFORMATION TECHNOLOGY-I

Course Objective

- To educate students to analyze, design, integrate & manage information systems using information technology.

Course Outcome

- Student will be able to use computer system easily and they will get knowledge about how to use different type of operating system.

Course Code: 3HBHL-101

Course Name: हिन्दी भाषा और संरचना

पाठ्यक्रम के उद्देश्य

- विद्यार्थियों में राष्ट्र प्रेम की भावना का विकास करना।
- हिन्दी के समृद्ध साहित्य को नयी पीढ़ी तक पहुँचाना।
- पत्र-लेखन, सारलेखन, भाव पल्लवन एवं साक्षात्कार के कौशल का विकास करना।
- डायरी, संस्मरण, लेखन, पारिभाषिक, शब्दावली, तत्सम, तद्भव, देशज, विदेशी शब्दों इत्यादि के ज्ञान का परिमार्जन करना।

अपेक्षित परिणाम

- विद्यार्थी भारत भूमि से प्रेम व स्नेह के भावों को बढ़ा सकेंगे।
- विद्यार्थियों की हिन्दी की शब्द संपदा में वृद्धि होगी।
- पत्र-लेखन, सार लेखन, भाव पल्लवन साक्षात्कार के कौशल का विकास होगा।
- डायरी एवं संस्मरण लेखन विद्या का परिमार्जन होगा।
- हिन्दी के समृद्ध साहित्य कोश से लाभान्वित होंगे।

Course Code: 3SBBO103

Course Name: Botany-1 (Diversity of microbes and cryptogams)

Course Objective:

- To make the student know the outline of origin and evolution of life.
- Understand the structure of Bacteria & viruses and plant diseases caused by Bacteria & viruses and their control
- To make students learn the general characters and economic importance of Algae & Fungi.
- To make the students understand the vegetative and reproductive features of different algae and fungi through the study of representative types of various classes.
- To help the students identify and understand plant diseases caused by fungi and their Control measures.
- To make the students know the formation of lichens and their economic and ecological importance.
- To help the students know the systematic position of the two Cryptogamic groups (Bryophyta & Pteridophyta) and their classification
- To make the students understand the life histories of Bryophyta & Pteridophyta through the study of representative types
- To enable the students to assess the phylogenetic aspects of the above two groups.

- To help the students to get an insight into the geological past, extinct plants and their preservation.

Course Outcomes

- On completion of this course, the students will be able to:
- Study of Pteridophytes and Gymnosperms will help the students understand the connecting link between the lower and higher organisms in the plant kingdom.
- The anatomy imparts a thorough knowledge about the internal structure and relationship between tissues and evolution.
- Most of the techniques in biotechnology uses bacteria, viruses and fungi. This course will make the students adept in the structure and functions of these microbes which in turn will give them confidence to work using these organisms.

Course Code: 3SBCH 104

Course Name: Chemistry-I (Physical, Inorganic & Organic chemistry)

Course Objective

- To develop an understanding on the basics of mathematical concept, gaseous, liquid and colloidal states.
- To understand chemical kinetics, structure bonding and stereochemistry.

Course Outcome

- The knowledge gained on mathematical concepts, liquid state, chemical kinetics, structure & bonding and stereochemistry will provide a strong platform to understand the concepts on these Courses for further learning

Course Code: 3SBZO105

Course Name: Zoology-I (Invertebrates & Cell Biology)

Course Objective

- This paper is aimed to introducing the students for the salient features of all Invertebrates, cell organization and cell division.

Course Outcomes

- The student have a knowledge of Classification and life cycle of invertebrates and cell division.

Course Code: 3HBEL201

Course Name: Foundation Course (Paper I: English Language and Indian Culture)

Course Objective

- To Study the basic concept and Language Skills of English Language.
- Comprehensive study of different kinds of vocabulary in English Language.
- To Study the different era in every story and moods in poems.

Course Outcome

- Students will be able to understand the basic concept and Language Skills of English Language.
- Students will be able to understand the different use of vocabulary in their sentences.
- Students will be able to understand the varieties of stories on different issues and on different format.

Course Code: 3MBFE101

Course Name: FUNDAMENTALS OF ENTREPRENEURSHIP

Course Objective

- Understanding basic concepts of entrepreneurship and key steps in the elaboration of business ideas, Developing personal creativity and entrepreneurial initiative.

Course Outcome

- Students have understood the basic idea of entrepreneurship and business ideas and startups.

Course Code: 3SBBO203

Course Name: BOTANY-II (CELL BIOLOGY AND GENETICS)

Course Objective

- Outline the structure of the biomolecules found in all living organisms.
- Describe the function and structure of cells including the metabolic reactions that occur in cells.
- Explain the process of inheritance.
- Describe how RNA, DNA and proteins are synthesized.
- Explain the process of cell division in both somatic and germ cells.
- Explain the processes by which animals acquire nutrients, water and oxygen, eliminate wastes, protect against foreign substances, acquire information about their environment and reproduce.
- Generate a hypothesis from a set of observations and then design experiments to test the

hypothesis.

Course Outcome

- The course aims to develop students understanding of three areas of widely used and advanced scientific methods – spectroscopic tools, molecular imaging and bioinformatics. This is achieved via lectures, classes, seminars and a bioinformatics problem-based learning exercise.
- To help students develop successful strategies for learning how to learn and communicate complex information in cell biology, we developed a quarter-long cell biology class based on team projects.
- Each team researches a particular human disease and presents information about the cellular structure or process affected by the disease, the cellular and molecular biology of the disease, and recent research focused on understanding the cellular mechanisms of the disease process.

Course Code: 3SBCH 204

Course Name: Chemistry –II (PHYSICAL, INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- Study of Chemical bonding, Noble gases, S-block and P-block element. Brief discussion of Arenes and Aromaticity, cycloalkens, dienes and alkynes.

Course Outcome

- Upon successful completion of this course, students will understand theories of chemical bonding and determine the molecular geometry of molecules using VSEPR theory. Understand the general and physical properties of matter.

Course Code: 3SBZO205

Course Name: Zoology-II (Vertebrates & Developmental Biology)

Course Objective

- This paper is aimed to introducing the students for the salient features of all Vertebrates, and developmental biology

Course Outcome

- The student have a knowledge of Classification and life cycle of Vertebrates, gametogenesis is and formation of three germinal layers

Course Code: 3HBHL-302

Course Name: हिन्दी भाषा संवेदना एवं संचार साधन

पाठ्यक्रम के उद्देश्य

- विद्यार्थियों को भारतीय संवेदना, संस्कृति, वैश्विक चेतना से परिचित कराना।
- धर्म, दर्शन, न्याय, नीति, साहित्य की प्राचीन व नवीन मान्यताओं से परिचित करवाना।
- संचार साधनों से परिचित करवाना।
- सिनेमा, रंगमंच, संगीत, चित्रकला इत्यादि से परिचित करवाना।

अपेक्षित परिणाम

- विद्यार्थी आधुनिक संचार साधनों के प्रयोग में कुशल हो सकेंगे।
- भारत की धर्म, दर्शन, नीति, संस्कृति, सभ्यता, संस्कारों इत्यादि के प्रति ज्ञान प्राप्त कर कुशल एवं संवेदनशील नागरिक बन सकेंगे।

Course Code: 3CBCA502

Course Name: BASIC COMPUTER & INFORMATION TECHNOLOGY-II

Course Objective

- To educate students to analyze, design, integrate & manage information systems using information technology.

Course Outcome

- Student will be able to use computer system easily and they will get knowledge about how to use different type of operating system.

Course Code: 3SBBO303

Course Name: Botany-III (Biodiversity & Systematic of seed plant)

Course Objective

- Discuss the type of seeds produced by gymnosperms, as well as other characteristics of gymnosperms
- State which period saw the first appearance of gymnosperms and explain when they were the dominant plant life
- List the four groups of modern-day gymnosperms and provide examples of each
- To appreciate the fantastic commonness existing among organisms.
- The student will be able to appreciate the uniqueness of different groups and the way they are classified

- To develop curiosity in observing and identifying different types of gymnosperms.
- To observe and differentiate the variations existing in the internal structure of plants.
- To create interest in plant anatomy and to appreciate the function of a particular tissue or organ correlated with its structure.
- To enable the student understand the anatomical features within the system instead of merely memorizing the technical terms and the text book figures.

Course Outcomes

- An understanding of major patterns in the evolution of seed plants
- Study of Gymnosperms will help the students understand the connecting link between the lower and higher organisms in the plant kingdom. The anatomy imparts a thorough knowledge about the internal structure and relationship between tissues and evolution.
- An appreciation of seed plant diversity.
- A basic understanding of the principles of phylogenetic systematic.
- An overview of the diagnostic characters of the main lineages of seed plants.
- An understanding of the methods and principles of classification and nomenclature

Course Code: 3SBCH404

Course Name: Chemistry –III (physical, inorganic & organic chemistry)

Course Objective

- Study of efficiency and terms as well as thermodynamic process, spectrum, transition elements and coordination compounds

Course Outcome

- Upon successful completion of this course, students will understand kinetics, equilibrium, LeChatelier's principle, acid and base reactions, pH, buffers, colligative properties, and electrochemical applications in an undergraduate laboratory.
- Understand the first law of thermodynamics and the role of energy and enthalpy in chemical reactions and perform thermochemical calculations.

Course Code: 3SBZO305

Course Name: Zoology-III (Genetics)

Course Objective

- This paper is aimed to introducing the students for Genetics and applied Genetics.

Course Outcomes

- The student have a knowledge of Gene, genetic code ,diseases and treatment.

Course Code: 3HBEL402

Course Name: English Language and Scientific Temper

Course Objective

- To Study the basic language skills (speaking, listening, reading, and writing) and grammar
- Comprehensive study of different kinds of letters and applications.
- To study the different kinds of prose and poetry

Course Outcome:

- Student will be able to understand correct use of grammar and language skills.
- Student will be familiar with different prose and poetry.
- Student should be able to write analytically in a variety of formats, including essays, report writing and application.

Course Code: 3HBHP401

Course Name: HUMAN VALUES AND ETHICS

Course Objectives

- To help students understand the basic guidelines, content and process of Human value and value crisis in contemporary Indian Society
- To help students understand the meaning of happiness and prosperity for a human being.
- To help students reflect critically on gender violence.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly

Course Outcomes

- On completion of this course, the students will be able to:
- Understand the significance of value inputs in a classroom and start applying them in their life and profession.
- Understand the value of harmonious relationship based on trust and respect in their life and profession.
- Students will develop a sense of appreciation of women in all walks of life.
- Understand the role of a human being in ensuring harmony in society

Course Code: 3SBBO403

Course Name: Botany-IV (Structure, Development &Reproduction in flowering plant)

Course Objective

- The anatomy of a flower
- The life cycle of flowering seed plants

- The anatomy of a seed
- The role of pollination and seed dispersal in the angiosperm life cycle
- Identify the characteristics of flowering plants
- Describe the structure of a flower and the difference between perfect and imperfect flowers
- Summarize the life cycle of a flowering plant, identifying the sporophyte, the gametophytes, and when mitosis/meiosis/fertilization occur
- Diagram the process of double fertilization
- Explain the importance of pollen and the different types of pollination seen in this group
- Describe the role of the seed, its relationship to fruit, the different types of seeds, and seed dispersal mechanisms

Course Outcomes

- Sexual Reproduction in Flowering Plants
- Recognize that flowering plants exhibit an alternation of generations even though they produce two types of spores and two types of gametophytes.
- Identify the reproductive parts of a flower and describe the function of each part.
- Diagram and describe the development of male and female gametophytes and the development of the sporophyte of flowering plants.
- Growth and Development
- Recognize the developmental steps of a eudicot embryo and compare the function of its cotyledons to that of a cotyledon in monocots.
- Identify different types of fruits.
- Label seed structure and describe germination and dispersal.
- Asexual Reproduction and Genetic Engineering in Plants
- Recognize how asexual reproduction in plants differs from sexual reproduction.
- Describe how plants are propagated in tissue culture.
- Explain how genetic engineering can be used to alter plant traits.
- Control of Growth and Responses
- Explain the importance of plant hormones.
- Identify the various types of plant hormones and their function.
- Recognize how plants respond to stimuli.

Course Code: 3SBCH404

Course Name: Chemistry-IV (PHYSICAL, INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- To make students understand the basic principal of transition elements and coordination compounds

Course Outcome

- Upon successful completion of this course students will describe the bonding and properties of transition and inter transition element coordination compounds

Course Code: 3SBZO405

Course Name: Zoology-IV (Animal Physiology)

Course Objective

- This paper is aimed to introducing the students for animal physiology viz digestion, respiration, excretion, nervous and endocrine function

Course Outcomes

- The student have a knowledge of physiological diseases and treatment

Course Code: 3HBEL501

Course Name: INTRODUCTION TO SOFT SKILL & TEAM BUILDING

Course Objective

By the end of the soft skills training program, the students should be able to:

- Develop effective communication skills (spoken and written).
- Develop effective presentation skills.
- Conduct effective business correspondence and prepare business reports which produce results.
- Become self-confident individuals by mastering inter-personal skills, team management skills, and leadership skills.
- Develop all-round personalities with a mature outlook to function effectively in different circumstances.
- Develop broad career plans, evaluate the employment market, identify the organizations to get good placement, match the job requirements and skill sets.
- Take part effectively in various selection procedures adopted by the recruiters.

Course Outcome

- The teaching methods in the soft skills training include lectures, projects, role plays, quizzes, and various other participatory sessions. The emphasis will be on learning by doing.
- Since the method of training is experiential and highly interactive, the students imbibe the skills and attributes in a gradual and subtle way over the duration of the program. The students will not only learn the skills and attributes but also internalize them over a period of time.
- Internalization ensures that the skills and attributes become part of the students' nature.

Subtle changes are bound to occur in their behavior and outlook, and these will make them more self-assured and confident. Moreover, the behavior changes will be gradual and natural and will not appear artificial or put on. Thus, the changes in them will be genuine and positive.

- The Soft Skills training program is a credit course and the evaluation of the students takes place on a continuous basis. Active participation in activities, interest displayed by the students in acquiring the necessary attributes and skills and the commitment shown by them to improve in terms of attitudes are the main criteria for evaluation.

Course Code: 3SBES501

Course Name: ENVIRONMENTAL STUDIES

Course Objective

- Student will be able to become proficient in the natural and physical sciences, as well as to be aware of social and cultural influences upon environmental problems facing society today.

Course Outcome

- The Environmental Studies minor supplements other majors to facilitate students' understanding of complex environmental issues from a problem-oriented, interdisciplinary perspective.
- Enable the student to acquire basic ideas about environment and emerging issues about environment problems.
- Aware about the need and importance of Natural Resources.
- Develop knowledge and understanding of the environment and enable the students to contribute towards maintaining and improving the quality of the environment.

Course Code: 3SBBO503

Course Name: Discipline Specific Elective-I BOTANY-V (PLANT PHYSIOLOGY AND BIOCHEMISTRY)

Course Objective

- Understand the basic principles related to various physiological functions in plant life.
- Familiarize with the basic skills and techniques related to plant physiology.
- Understand the role, structure and importance of the bio molecules associated with plant life.
- Familiarize with the recent trends in the field of plant physiology.
- Familiarize with applied aspects of plant physiology in other fields like agriculture.
- To get an idea of environmental issues and its conservation
- To have an understanding of Environmental legislation and laws

Course Outcomes

- The study of functions of plant cell incorporates knowledge at molecular level.
- This gives an idea of the cell functions and by alteration of the functioning of enzymes and biomolecules,
- The student can find out more ideas of improving productivity.
- The physiological knowledge help to develop newer ideas in developing newer techniques in agriculture.
- Environmental awareness makes the students respect mother earth by protecting and conserving the plants and animals and keep up the balance on the earth.

Course Code: 3SBBO504

Course Name: Discipline Specific Elective-II BOTANY-V (PLANT PATHOLOGY)

Course Objective

- To introduce concepts and principles of plant pathology. Study of interaction between plant and pathogen in relation to the overall environment and mechanism of disease development by pathogens.

Course Outcomes

- Students will know about concept of diseases, knowledge and awareness of diseases, causal agents of plant diseases, identification methods and management of crop diseases.

Course Code: 3SBBO505

Course Name: Discipline Specific Elective-III BOTANY-V (PLANT REPRODUCTION)

Course Objective

To enable the students:

- To understand the various aspects of plant floral parts, development and reproduction
- To understand the various aspects of embryology and apomixes

Course Outcomes

On completion of this course, the students will be able to:

- Discuss the structural elements of plants floral parts and reproduction.
- Discuss the Pollination, embryology and apomixes.

Course Code: 3SBCH503

Course Name: Chemistry-V (PHYSICAL INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- To Study the concepts of UV and IR spectroscopy and Bio-Organic & Bioinorganic

Chemistry

Course Outcomes

- After completion of the course student will able to Understand the Spectroscopy ,acid/base reactions, their products, and how buffer systems work

Course Code: 3SBCH504

Course Name: CHEMISTRY-V (ELECTIVE –I) INDUSTRIAL CHEMISTRY

Course Objective

- Study of basic concept of distillation, evaporation, absorption, filtration and drying catalysis Microwave and Ultrasound assisted green synthesis, Green catalysis and its application.

Course Outcomes

- Knowledge of industrial chemistry and its application.

Course Code: 3SBCH505

Course Name: CHEMISTRY-V (ELECTIVE –I) GREEN CHEMISTRY

Course Objective

- To Study the basic concepts of Green Chemistry, Green Reactions, Microwave and Ultrasound assisted Green synthesis, Green Catalysis and its application.

Course Outcome

- After completion of the course the learners will be able to know about the reaction of Green catalysis, Microwave and Ultrasound assisted green synthesis and its modern application in Green Chemistry.

Course Code:3SBZO503

Course Name: Discipline Specific Elective-I Zoology –V (Applied Zoology)

Course Objective

- This paper is aimed to introducing the students for Aquaculture, Economic Entomology, toxicology and lab techniques.

Course Outcomes

- The student have a knowledge of different culture Skill to develop own Business, lab Techniques and self employment.

Course Code:3SBZO504

Course Name: Discipline Specific Elective-II Zoology-V (Wild Life Conservation)

Course Objective

- This paper is aimed to introduce wildlife conservation, endangered species, sanctuaries biosphere reserve Project Tiger and. Gir Lion.

Course Outcome

- The student have a knowledge of different biosphere reserve, sanctuaries, wildlife conservation Skill to develop employment in Zoo.

Course Code: 3SBZO505

Course Name: Discipline Specific Elective-III Zoology-V (Industrial Biology)

Course Objective

- This paper is aimed to introduce micro-organism used in Fermentation. Vitamin, Enzyme Antibiotics, Alcohol, dairy products and other pathogenic treatment.

Course Outcomes

- The student have a knowledge of different micro-organism used for drug, alcohol vitamin, antibiotics, enzyme, dairy production Skill to develop own Business, marketing and self employment.

Course Code: 3SBBO603

Course Name: Discipline Specific Elective-I Botany-VI (Plant Ecology, Biodiversity and Phytogeography)

Course Objective

- To examine the role that biotic and abiotic factors play in ecological biogeography
- To gain an appreciation of Earth's geological history and understand the role of historical biogeography in interpreting plant distributions
- To investigate the relationship between systematics and biogeography
- To investigate the relationship between systematics and biogeography (phylogeography)
- To review major features of contemporary plant distributions with emphasis on hot-spots, endemics, and islands
- To understand the role that glaciation has played in plant distributions
- To examine pattern and process in bent hic marine algal distributions with a focus on kelp

Course Outcomes

Students will be able to:

- Distinguish between ecological versus historical biogeography
- Recognize patterns and hypothesize underlying process
- Summarize the five areas that have resulted in a Renaissance in Biogeography
- Describe the 3 major biogeographic patterns and illustrate them with significant plant genera
- Compare long-distance dispersal vicariance as mechanisms for disjunct distributions
- Define endemic and illustrate with significant plant genera (from BC and elsewhere)

Course Code: 3SBBO604

Course Name: Discipline Specific Elective-II Botany-VI (Ethno Botany)

Course Objective

To enable the students:

- To proper documentation and presentation of traditional knowledge about plants.
- To use important plants by the tribal communities for various purposes.
- Conservation natural growing plants and socioeconomic impacts.
- Ethnobotany solve human problem of nutrition health care and life support system.

Course Outcomes

On completion of this course, the students will be able to:

- To express the historical development of ethnobotany. Recognize and identify important plant species.
- Explain ethnobotanically uses of plants. Detail their native habitats and cultivated lands.

Course Code: 3SBBO605

Course Name: Discipline Specific Elective-III Botany-VI (Evolutionary and Economic Botany)

Course Objective

- Describe the theory of natural selection.
- Explain how new species arise.
- Construct a phylogenetic tree.
- Explain the mechanisms which underlie evolution at the molecular level.
- To identify the following crops: Sorghum, Maize, Rice, and Wheat
- To know the origin, distribution, spread and taxonomy of the above listed crops
- To be able to describe morphological feature
- To know the economic importance of the listed crops.

Course Outcomes

- Acknowledge the economic uses of plants in modern society.
- Acquire an increased awareness and appreciation of plants & plant products encountered in everyday life.
- Develop scientific insights into the development of many plant products that have shaped our society.
- Appreciate the diversity of plants and the plant products in human use;
- Understand the biological reasons why certain plant resources are important;
- Explain the geographical, historical, and cultural contributions of economically important plants on the development of human culture.
- Understand the conditions & consequences of natural selection; & describe different modes of speciation
- Search the library for literature review; & choosing a valuable research topic.

Course Code: 3SBCH 603

Course Name: Chemistry-VI (PHYSICAL INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- To Study the basic concepts of photochemistry, solution, Inorganic polymer, preparation and properties of organometallic compounds.

Course Outcome

- After completion of the course student will able to understand the physical photochemistry, application of inorganic polymers and organometallic compounds.

Course Code: 3SBCH 604

Course Name: DISCIPLINE SPECIFIC ELECTIVE-II (BIO-CHEMISTRY)

Course Objective

- To Study & know about the basic concepts of biochemistry, Cellular mechanisms, cell biology, chemical entities supporting life, Vitamins, Carbohydrates, lipids, proteins, enzymes, DNA, RNA, and their Structure and classification as well as their physical, chemical and optical properties.

Course Outcome

- The Students will able to understand the biochemistry of organisms, the building blocks of life & all the relevant biochemical processes including the properties and synthesis.

Course Code: 3SBCH 605

Course Name: DISCIPLINE SPECIFIC ELECTIVE-II (NANOCHEMISTRY)

Course Outcome

- To understand preparation of nanoparticle, organic nanoparticle and about the role of nanoparticle in environmental protection.

Course Outcome

After the completion of course learner is able to understand about:

- Nanochemistry of Nanomaterials and its types
- Nanoscience affecting environment
- Organic nanoparticles & their characterization techniques.
- Nanomaterials for Environmental Protection

Course Code: 3SBZO603

Course Name: Discipline Specific Elective-I Zoology – VI (Environmental Biology & Evolution)

Course Objective

- This paper is aimed to introduce Ecology, Origin of life and evolution, Palaeontology and distribution

Course Code: 3SBZO604

Course Name E: Discipline Specific Elective-II Zoology – VI (AQUACULTURE)

Course Objective

- This paper is aimed to introduce fresh water Prawn, Fish and Pearl Culture.

Course Outcome

- The student have a knowledge of different culture Skill to develop own Business, marketing and self employment.

Course Code: 3SBZO605

Course Name: Discipline Specific Elective-III Zoology-VI (Economic Zoology)

Course Objective

- This paper is aimed to introduce Pearl Culture, Lac –Culture, Sericulture and Poultry keeping. Protozoa, rats, mites, insect diseases and control.

Course Outcome

- The student have a knowledge of different culture Skill and diseases and their control to develop own Business, marketing and self employment.

Bachelor of Science (Microbiology)

Programme Code: 04UGR004

PROGRAM EDUCATIONAL OBJECTIVE (PEO'S)

The program of B.Sc. Microbiology is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. The program focuses on the all-round development of the students to face the competitive world. The objectives of the program are as follows:

- To understand the scope and significance of the discipline.
- To imbibe love and curiosity towards nature through the living plants and Microorganisms.
- To make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
- To make the students exposed to the diverse life forms.
- To make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
- To encourage the students to do research in related disciplines.
- To develop the ability of the students to transform the society through their education.

PROGRAM OUTCOMES (PO'S)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings towards Flora.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues related to plants (Flora), Microorganisms and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development.
- **Self-directed and life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in Botanical practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Botany, Instrumentation & Technology.

- **Technical Skills:** Develop an ability to use various instruments and equipment with an in depth knowledge on standard operating procedures for the same.
- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Botany, Botanical Sciences and Microbiological Sciences.
- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of Botany, Chemistry and Microbiology.
- **The Society:** Apply regional Botanical reasoning for Plants informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOME

- **PSO1:** Identification and taxonomy of plants, microorganisms through different taxonomic description of plants and microorganisms.
- **PSO2:** To get a better understanding of different families of plants in the angiosperms and gymnosperms and also identification of microorganisms.
- **PSO3:** To get the techniques involved in plant tissue culture and plant breeding.
- **PSO4:** To perform a detailed study about the different types of microbes viz. bacteria, Cyanobacteria, algae and fungi.

Course Code: 3CBCA201

Course Name: BASIC COMPUTER & INFORMATION TECHNOLOGY-I

Course Objective

- To educate students to analyze, design, integrate & manage information systems using information technology.

Course Outcome

- Student will be able to use computer system easily and they will get knowledge about how to use different type of operating system.

Course Code: 3HBHL-101

Course Name: हिन्दी भाषा और संरचना

पाठ्यक्रम के उद्देश्य

- विद्यार्थियों में राष्ट्र प्रेम की भावना का विकास करना।
- हिन्दी के समृद्ध साहित्य को नयी पीढ़ी तक पहुँचाना।
- पत्र-लेखन, सारलेखन, भाव पल्लवन एवं साक्षात्कार के कौशल का विकास करना।
- डायरी, संस्मरण, लेखन, पारिभाषिक, शब्दावली, तत्सम, तद्भव, देशज, विदेशी शब्दों इत्यादि के ज्ञान का परिमार्जन करना।

अपेक्षित परिणाम

- विद्यार्थी भारत भूमि से प्रेम व स्नेह के भावों को बढ़ा सकेंगे।
- विद्यार्थियों की हिन्दी की शब्द संपदा में वृद्धि होगी।
- पत्र-लेखन, सार लेखन, भाव पल्लवन साक्षात्कार के कौशल का विकास होगा।
- डायरी एवं संस्मरण लेखन विद्या का परिमार्जन होगा।
- हिन्दी के समृद्ध साहित्य कोश से लाभान्वित होंगे।

Course Code: 3SBBO103

Course Name: Botany-1(Diversity of microbes and cryptogams)

Course Objective

- To make the student know the outline of origin and evolution of life.
- Understand the structure of Bacteria & viruses and plant diseases caused by Bacteria & viruses and their control
- To make students learn the general characters and economic importance of Algae & Fungi.
- To make the students understand the vegetative and reproductive features of different algae and fungi through the study of representative types of various classes.
- To help the students identify and understand plant diseases caused by fungi and their Control measures.
- To make the students know the formation of lichens and their economic and ecological importance.
- To help the students know the systematic position of the two Cryptogamic groups (Bryophyta & Pteridophyta) and their classification.
- To make the students understand the life histories of Bryophyta & Pteridophyta through the study of representative types.
- To enable the students to assess the phylogenetic aspects of the above two groups.

- To help the students to get an insight into the geological past, extinct plants and their preservation.

Course Outcomes

On completion of this course, the students will be able to:

- Study of Pteridophytes and Gymnosperms will help the students understand the connecting link between the lower and higher organisms in the plant kingdom.
- The anatomy imparts a thorough knowledge about the internal structure and relationship between tissues and evolution.
- Most of the techniques in biotechnology uses bacteria, viruses and fungi. This course will make the students adept in the structure and functions of these microbes which in turn will give them confidence to work using these organisms.

Course Code: 3SBCH 104

Course Name: Chemistry-I (Physical, Inorganic & Organic Chemistry)

Course Objective

- To develop an understanding on the basics of mathematical concept, gaseous, liquid and colloidal states.
- To understand chemical kinetics, structure bonding and stereochemistry.

Course Outcome

- The knowledge gained on mathematical concepts, liquid state, chemical kinetics, structure & bonding and stereochemistry will provide a strong platform to understand the concepts on these Courses for further learning

Course Code: 3SMB105

Course Name: Microbiology- I (General Microbiology and Biotechnology)

Course Objective

- This course focuses on the general principles of microbiology and bacterial and virus cell structure and function.

Course Outcomes

- Describe diversity of microorganisms, bacterial cell structure and function, microbial growth and metabolism, and the ways to control their growth by physical and chemical means.

Course Code: 3HBEL201

Course Name: Foundation Course Paper I: English Language and Indian Culture

Course Objective

- To Study the basic concept and Language Skills of English Language.
- Comprehensive study of different kinds of vocabulary in English Language.
- To Study the different era in every story and moods in poems.

Course Outcome

- Students will be able to understand the basic concept and Language Skills of English Language.
- Students will be able to understand the different use of vocabulary in their sentences.
- Students will be able to understand the varieties of stories on different issues and on different format.

Course Code: 3MBFE101

Course Name: FUNDAMENTALS OF ENTREPRENEURSHIP

Course Objective

- Understanding basic concepts of entrepreneurship and key steps in the elaboration of business ideas, Developing personal creativity and entrepreneurial initiative.

Course Outcome

- Students have understood the basic idea of entrepreneurship and business ideas and startups.

Course Code: 3SBBO203

Course Name: BOTANY-II (CELL BIOLOGY AND GENETICS)

Course Objective

- Outline the structure of the biomolecules found in all living organisms.
- Describe the function and structure of cells including the metabolic reactions that occur in cells.
- Explain the process of inheritance.
- Describe how RNA, DNA and proteins are synthesized.
- Explain the process of cell division in both somatic and germ cells.
- Explain the processes by which animals acquire nutrients, water and oxygen, eliminate wastes, protect against foreign substances, acquire information about their environment and reproduce.
- Generate a hypothesis from a set of observations and then design experiments to test the

hypothesis.

Course Outcome

- The course aims to develop students understanding of three areas of widely used and advanced scientific methods – spectroscopic tools, molecular imaging and bioinformatics. This is achieved via lectures, classes, seminars and a bioinformatics problem based learning exercise.
- To help students develop successful strategies for learning how to learn and communicate complex information in cell biology, we developed a quarter-long cell biology class based on team projects.
- Each team researches a particular human disease and presents information about the cellular structure or process affected by the disease, the cellular and molecular biology of the disease, and recent research focused on understanding the cellular mechanisms of the disease process.

Course Code: 3SBCH 204

Course Name: Chemistry –II (Physical, Inorganic & Organic Chemistry)

Course Objective

- Study of Chemical bonding, Noble gases, S-block and P-block element. Brief discussion of Arenes and Aromaticity, cycloalkenes, dienes and alkynes.

Course Outcome

- Upon successful completion of this course, students will understand theories of chemical bonding and determine the molecular geometry of molecules using VSEPR theory. Understand the general and physical properties of matter.

Course Code: 3SMB205

Course Name: Microbiology- II (Biochemistry and Immunology)

Course Objective

- Biochemistry is the study to understand the molecular basis of life and its role in the disease process. Immunology is the study of body defends itself against disease and helps us understand how the immune system is tricked into attacking its own tissue

Course Outcomes

- Biochemistry is a specialised application of chemistry to biological samples. Immunology is the study of a patient's immune system. Immunology testing is less automated than Biochemistry and results usually take about a week before they are available.

Course Code: 3HBHL-302

Course Name: हिन्दी भाषा संवेदना एवं संचार साधन

पाठ्यक्रम के उद्देश्य

- विद्यार्थियों को भारतीय संवेदना, संस्कृति, वैश्विक चेतना से परिचित कराना।
- धर्म, दर्शन, न्याय, नीति, साहित्य की प्राचीन व नवीन मान्यताओं से परिचित करवाना।
- संचार साधनों से परिचित करवाना।
- सिनेमा, रंगमंच, संगीत, चित्रकला इत्यादि से परिचित करवाना।

अपेक्षित परिणाम

- विद्यार्थी आधुनिक संचार साधनों के प्रयोग में कुशल हो सकेंगे।
- भारत की धर्म, दर्शन, नीति, संस्कृति, सभ्यता, संस्कारों इत्यादि के प्रति ज्ञान प्राप्त कर कुशल एवं संवेदनशील नागरिक बन सकेंगे।

Course Code: 3BCA502

Course Name: BASIC COMPUTER & INFORMATION TECHNOLOGY-II

Course Objective

- To educate students to analyze, design , integrate & manage information systems using information technology.

Course Outcome

- Student will be able to use computer system easily and they will get knowledge about how to use different type of operating system.

Course Code: 3SBBO303

Course Name: Botany-III (Biodiversity & Systematic of seed plant)

Course Objective

- Discuss the type of seeds produced by gymnosperms, as well as other characteristics of gymnosperms
- State which period saw the first appearance of gymnosperms and explain when they were the dominant plant life
- List the four groups of modern-day gymnosperms and provide examples of each
- To appreciate the fantastic commonness existing among organisms.
- The student will be able to appreciate the uniqueness of different groups and the way they are classified
- To develop curiosity in observing and identifying different types of gymnosperms.

- To observe and differentiate the variations existing in the internal structure of plants.
- To create interest in plant anatomy and to appreciate the function of a particular tissue or organ correlated with its structure.
- To enable the student understand the anatomical features within the system instead of merely memorizing the technical terms and the text book figures.

Course Outcomes

- An understanding of major patterns in the evolution of seed plants
- Study of Gymnosperms will help the students understand the connecting link between the lower and higher organisms in the plant kingdom. The anatomy imparts a thorough knowledge about the internal structure and relationship between tissues and evolution.
- An appreciation of seed plant diversity.
- A basic understanding of the principles of phylogenetic systematic.
- An overview of the diagnostic characters of the main lineages of seed plants.
- An understanding of the methods and principles of classification and nomenclature

Course Code: 3SBCH404

Course Name: Chemistry –III (physical, inorganic & organic chemistry)

Course Objective

- Study of efficiency and terms as well as thermodynamic process, spectrum, transition elements and coordination compounds

Course Outcome

- Upon successful completion of this course, students will understand kinetics, equilibrium, LeChatelier's principle, acid and base reactions, pH, buffers, colligative properties, and electrochemical applications in an undergraduate laboratory.
- Understand the first law of thermodynamics and the role of energy and enthalpy in chemical reactions and perform thermochemical calculations.

Course Code: 3SMB305

Course Name: Microbiology –III (Principle of Bioinstrumentation and Techniques)

Course Objective

- Learn the qualitative functions of the four primary system components and technical vocabulary associated with instrumentation, design and basic signal analysis and static analysis

Course Outcomes

- provide the reader with a tool to help select the most appropriate instrument for use in an observational study.

Course Code: 3HBEL402

Course Name: English Language and Scientific Temper

Course Objective

- To Study the basic language skills (speaking, listening, reading, and writing) and grammar
- Comprehensive study of different kinds of letters and applications.
- To study the different kinds of prose and poetry

Course Outcome

- Student will be able to understand correct use of grammar and language skills.
- Student will be familiar with different prose and poetry.
- Student should be able to write analytically in a variety of formats, including essays, report writing and application.

Course Code: 3HBHP401

Course Name: HUMAN VALUES AND ETHICS

Course Objectives

- To help students understand the basic guidelines, content and process of Human value and value crisis in contemporary Indian Society
- To help students understand the meaning of happiness and prosperity for a human being.
- To help students reflect critically on gender violence.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly

Course Outcomes

On completion of this course, the students will be able to:

- Understand the significance of value inputs in a classroom and start applying them in their life and profession.
- Understand the value of harmonious relationship based on trust and respect in their life and profession.
- Students will develop a sense of appreciation of women in all walks of life.
- Understand the role of a human being in ensuring harmony in society

Course Code: 3SBBO403

Course Name: Botany-IV (Structure, Development &Reproduction in flowering plant)

Course Objective

- The anatomy of a flower
- The life cycle of flowering seed plants

- The anatomy of a seed
- The role of pollination and seed dispersal in the angiosperm life cycle
- Identify the characteristics of flowering plants
- Describe the structure of a flower and the difference between perfect and imperfect flowers
- Summarize the life cycle of a flowering plant, identifying the sporophyte, the gametophytes, and when mitosis/meiosis/fertilization occur
- Diagram the process of double fertilization
- Explain the importance of pollen and the different types of pollination seen in this group
- Describe the role of the seed, its relationship to fruit, the different types of seeds, and seed dispersal mechanisms.

Course Outcomes

- Sexual Reproduction in Flowering Plants
 - Recognize that flowering plants exhibit an alternation of generations even though they produce two types of spores and two types of gametophytes.
 - Identify the reproductive parts of a flower and describe the function of each part.
 - Diagram and describe the development of male and female gametophytes and the development of the sporophyte of flowering plants.
- Growth and Development
 - Recognize the developmental steps of a eudicot embryo and compare the function of its cotyledons to that of a cotyledon in monocots.
 - Identify different types of fruits.
 - Label seed structure and describe germination and dispersal.
- Asexual Reproduction and Genetic Engineering in Plants
 - Recognize how asexual reproduction in plants differs from sexual reproduction.
 - Describe how plants are propagated in tissue culture.
 - Explain how genetic engineering can be used to alter plant traits.
- Control of Growth and Responses
 - Explain the importance of plant hormones.
 - Recognize how plants respond to stimuli.

Course Code: 3SBCH404

Course Name: Chemistry-IV (Physical, Inorganic & Organic chemistry)

Course Objective

- To make students understand the basic principal of transition elements and coordination compounds

Course Outcome

- Upon successful completion of this course students will describe the bonding and

properties of transition and inter transition element coordination compounds

Course Code: 3SMB405

Course Name: Microbiology –IV (Environmental and Medical Microbiology)

Course Objective

- The study of the composition and physiology of microbial communities in the environment. It also includes the study of microorganisms that exist in artificial environments such as bioreactors. The taxonomic, ecological, and genetic relationships among microorganisms, and the biotechnological application of microorganisms to solve environmental problems.

Course Outcome

- An awareness of the need for a good understanding of how microorganisms react in the environment, and this has been heightened from time to time as detrimental microbial activities become evident under certain conditions. study of the relationships of microorganisms with each other and with their environments.

Course Code: 3HBEL501

Course Name: INTRODUCTION TO SOFT SKILL & TEAM BUILDING

Course Objective

By the end of the soft skills training program, the students should be able to:

- Develop effective communication skills (spoken and written).
- Develop effective presentation skills.
- Conduct effective business correspondence and prepare business reports which produce results.
- Become self-confident individuals by mastering inter-personal skills, team management skills, and leadership skills.
- Develop all-round personalities with a mature outlook to function effectively in different circumstances.
- Develop broad career plans, evaluate the employment market, identify the organizations to get good placement, match the job requirements and skill sets.
- Take part effectively in various selection procedures adopted by the recruiters.

Course Outcome

- The teaching methods in the soft skills training include lectures, projects, role plays, quizzes, and various other participatory sessions. The emphasis will be on learning by doing.
- Since the method of training is experiential and highly interactive, the students imbibe the skills and attributes in a gradual and subtle way over the duration of the program. The

students will not only learn the skills and attributes but also internalize them over a period of time.

- Internalization ensures that the skills and attributes become part of the students' nature. Subtle changes are bound to occur in their behavior and outlook, and these will make them more self-assured and confident. Moreover, the behavior changes will be gradual and natural and will not appear artificial or put on. Thus, the changes in them will be genuine and positive.
- The Soft Skills training program is a credit course and the evaluation of the students takes place on a continuous basis. Active participation in activities, interest displayed by the students in acquiring the necessary attributes and skills and the commitment shown by them to improve in terms of attitudes are the main criteria for evaluation.

Course Code: 3SBES501

Course Name: ENVIRONMENTAL STUDIES

Course Objective

- Student will be able to become proficient in the natural and physical sciences, as well as to be aware of social and cultural influences upon environmental problems facing society today.

Course Outcome

- The Environmental Studies minor supplements other majors to facilitate students' understanding of complex environmental issues from a problem-oriented, interdisciplinary perspective.
- Enable the student to acquire basic ideas about environment and emerging issues about environment problems.
- Aware about the need and importance of Natural Resources.
- Develop knowledge and understanding of the environment and enable the students to contribute towards maintaining and improving the quality of the environment.

Course Code: 3SBBO503

Course Name: Discipline Specific Elective-I BOTANY-V (PLANT PHYSIOLOGY AND BIOCHEMISTRY)

Course Objective

- Understand the basic principles related to various physiological functions in plant life.
- Familiarize with the basic skills and techniques related to plant physiology.
- Understand the role, structure and importance of the bio molecules associated with plant life.
- Familiarize with the recent trends in the field of plant physiology.

- Familiarize with applied aspects of plant physiology in other fields like agriculture.
- To get an idea of environmental issues and its conservation
- To have an understanding of Environmental legislation and laws

Course Outcomes

- The study of functions of plant cell incorporates knowledge at molecular level.
- This gives an idea of the cell functions and by alteration of the functioning of enzymes and biomolecules,
- The student can find out more ideas of improving productivity.
- The physiological knowledge help to develop newer ideas in developing newer techniques in agriculture.
- Environmental awareness makes the students respect mother earth by protecting and conserving the plants and animals and keep up the balance on the earth.

Course Code: 3SBBO504

Course Name: Discipline Specific Elective-II BOTANY-V (PLANT PATHOLOGY)

Course Objective

- To introduce concepts and principles of plant pathology. Study of interaction between plant and pathogen in relation to the overall environment and mechanism of disease development by pathogens.

Course Outcomes

- Students will know about concept of diseases, knowledge and awareness of diseases, causal agents of plant diseases, identification methods and management of crop diseases.

Course Code: 3SBBO505

COURSE: Discipline Specific Elective-III BOTANY-V (PLANT REPRODUCTION)

Course Objective

To enable the students:

- To understand the various aspects of plant floral parts, development and reproduction
- To understand the various aspects of embryology and apomixes

Course Outcomes

On completion of this course, the students will be able to:

- Discuss the structural elements of plants floral parts and reproduction.
- Discuss the Pollination, embryology and apomixes.

Course Code: 3SBCH503

COURSE: Chemistry-V (Physical Inorganic & Organic Chemistry)

Course Objective

- To Study the concepts of UV and IR spectroscopy and Bio-Organic & Bioinorganic Chemistry

Course Outcome

- After completion of the course student will able to Understand the Spectroscopy, acid/base reactions, their products, and how buffer systems work

Course Code: 3SBCH504

Course Name: Chemistry-V (Elective –I) Industrial Chemistry

Course Objective

- Study of basic concept of distillation, evaporation, absorption, filtration and drying catalysis Microwave and Ultrasound assisted green synthesis, Green catalysis and its application.

Course Outcome

- Knowledge of industrial chemistry and its application.

Course Code: 3SBCH505

Course Name: Chemistry-V (Elective –I) Green Chemistry

Course Objective

- To Study the basic concepts of Green Chemistry, Green Reactions, Microwave and Ultrasound assisted Green synthesis, Green Catalysis and its application.

Course Outcome

- After completion of the course the learners will be able to know about the reaction of Green catalysis, Microwave and Ultrasound assisted green synthesis and its modern application in Green Chemistry.

Course Code: 3SBMB503

Course Name: Discipline Specific Elective-I Microbiology-V (Industrial and Agriculture Microbiology)

Course Objective

- Industrial microorganisms are used to produce many things, including food, cosmetics,

pharmaceuticals and construction materials. Microorganisms can be genetically modified or engineered to aid in large-scale production.

Course Outcomes

- Industrial microbiology includes the use of microorganisms to manufacture food or industrial products in large quantities. Numerous microorganisms are used within industrial and agriculture microbiology.

Course Code: 3SBMB504

Course Name: Discipline Specific Elective-II Microbiology-V (Microbial Genetics)

Course Objective

- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels.
- Students will understand causal relationships between molecule/cell level phenomena (“modern” genetics) and organism-level patterns of heredity (“classical” genetics)
- Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.
- Recombinant DNA methods and their basis in bacterial genetics.
- Applications of DNA technology: pharmaceuticals, agriculture.

Course Outcome

The student will demonstrate knowledge of gene manipulation and analysis by:

- Describing the processes and applications of Recombinant DNA Technology.
- Explaining the role of restriction end nucleases in gene manipulation.
- Determining the applicability of different kinds of cloning vectors.
- Illustrating the use of genomic libraries in gene detection and characterization.
- Examining the process of restriction mapping.
- Describing the process of Southern Blot analysis.
- Summarizing methods used for DNA sequencing.
- Describing the principles of the Polymerase Chain Reaction (PCR) and their applications.

Course Code: 3SBMB505

Course Name: Discipline Specific Elective-III Microbiology-V (Microbial Physiology)

Course Objective

Microbial physiology is a broad Course area and this course will attempt to provide a balance between the breadth of Course s addressed and the depth at which the Course s are discussed. The course has three overarching topics:

- Central metabolism and energy conservation,

- Macromolecular biogenesis and function
- Integration of metabolic events.
- The introductory lectures will address metabolic functions that are common to most organisms. The lectures will then progress to address metabolic functions that are the “exception to rule” to highlight the diversity of the microbial world.
- Students will learn about current events in the Course of microbial physiology and modern techniques used to examine metabolism. They will also learn about how the metabolic potential of micro-organisms has been harnessed to address problems facing society.

Course Outcome

- Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures
- 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
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization
- Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae
- Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively
- Comprehend the various methods for identification of unknown microorganisms
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy
- Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

Course Code: 3SBBO603

Course Name: Discipline Specific Elective-I Botany-VI (Plant Ecology, Biodiversity and Phytogeography)

Course Objective

- To examine the role that biotic and abiotic factors play in ecological biogeography
- To gain an appreciation of Earth’s geological history and understand the role of historical biogeography in interpreting plant distributions
- To investigate the relationship between systematics and biogeography
- To investigate the relationship between systematics and biogeography (phylogeography)
- To review major features of contemporary plant distributions with emphasis on hot-spots, endemics, and islands

- To understand the role that glaciation has played in plant distributions
- To examine pattern and process in benthic marine algal distributions with a focus on kelp

Course Outcome

Students will be able to:

- Distinguish between ecological versus historical biogeography
- Recognize patterns and hypothesize underlying process
- Summarize the five areas that have resulted in a Renaissance in Biogeography
- Describe the 3 major biogeographic patterns and illustrate them with significant plant genera
- Compare long-distance dispersal vs vicariance as mechanisms for disjunct distributions
- Define endemic and illustrate with significant plant genera (from BC and elsewhere)

Course Code: 3SBBO604

Course Name: Discipline Specific Elective-II Botany-VI (Ethno Botany)

Course Objective

To enable the students:

- To proper documentation and presentation of traditional knowledge about plants.
- To use important plants by the tribal communities for various purposes.
- Conservation natural growing plants and socioeconomic impacts.
- Ethnobotany solve human problem of nutrition health care and life support system.

Course Outcomes

On completion of this course, the students will be able to:

- To express the historical development of ethnobotany. Recognize and identify important plant species.
- Explain ethnobotanically uses of plants. Detail their native habitats and cultivated lands.

Course Code: 3SBBO605

Course Name: Discipline Specific Elective-III Botany-VI (Evolutionary and Economic Botany)

Course Objective

- Describe the theory of natural selection.
- Explain how new species arise.
- Construct a phylogenetic tree.
- Explain the mechanisms which underlie evolution at the molecular level.
- To identify the following crops: Sorghum, Maize, Rice, and Wheat

- To know the origin, distribution, spread and taxonomy of the above listed crops
- To be able to describe morphological feature
- To know the economic importance of the listed crops.

Course Outcomes

- Acknowledge the economic uses of plants in modern society.
- Acquire an increased awareness and appreciation of plants & plant products encountered in everyday life.
- Develop scientific insights into the development of many plant products that have shaped our society.
- Appreciate the diversity of plants and the plant products in human use;
- Understand the biological reasons why certain plant resources are important;
- Explain the geographical, historical, and cultural contributions of economically important plants on the development of human culture.
- Understand the conditions & consequences of natural selection; & describe different modes of speciation
- Search the library for literature review; & choosing a valuable research topic.

Course Code: 3SBCH 603

Course Name: CHEMISTRY-VI (PHYSICAL INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- To Study the basic concepts of photochemistry, solution, Inorganic polymer, preparation and properties of organometallic compounds.

Course Outcome

- After completion of the course student will able to understand the physical photochemistry, application of inorganic polymers and organometallic compounds.

Course Code: 3SBCH 604

Course Name: DISCIPLINE SPECIFIC ELECTIVE-II (BIO-CHEMISTRY)

Course Objective

- To Study & know about the basic concepts of biochemistry, Cellular mechanisms, cell biology, chemical entities supporting life, Vitamins, Carbohydrates, lipids, proteins, enzymes, DNA, RNA, and their Structure and classification as well as their physical, chemical and optical properties.

Course Outcome

- The Students will able to understand the biochemistry of organisms, the building blocks of

life & all the relevant biochemical processes including the properties and synthesis.

Course Code: 3SBCH 605

Course Name: DISCIPLINE SPECIFIC ELECTIVE-II (NANOCHEMISTRY)

Course Objective

- To understand preparation of nanoparticle, organic nanoparticle and about the role of nanoparticle in environmental protection.

Course Outcome

After the completion of course learner is able to understand about:

- Nanochemistry of Nanomaterials and its types
- Preparation methods of Nanomaterials/Nanoparticles & nanosynthesis
- Nanoscience affecting environment
- Organic nanoparticles& their characterization techniques.
- Nanomaterials for Environmental Protection

Course Code: 3SBMB603

Course Name: Discipline Specific Elective- VI Microbiology – VI (Molecular Biology and Genetic Engineering)

Course Objective

- Knowledge about national or international research laboratories, biomedical or biotechnology institutions, pharmaceutical companies, biotechnology and genetic engineering application and research centers, genetic diagnosis centers, or fertility centers.

Course Outcome

- Advancements in Genetic Engineering, in the field of biotechnology, agriculture and medicine.

Course Code: 3SBMB604

Course Name: Discipline Specific Elective-VI Microbiology -VI (ANALYTICAL MICROBIOLOGY)

Course Objective

- Analytical Microbiology focuses on the processes, methodologies, developments, and approaches involved in analytical microbiology, including microbiological, antibiotic, and amino acid assays and dilution methods.
- The selection first offers information on the theory of antibiotic inhibition zones, microbiological assay using large plate methods, and dilution methods of antibiotic assays.

- Discussions focus on serial dilution assay, requirements for accurate assay, microbiological assay of riboflavin, laws of adsorption and partition, mechanisms of antibiotic action, and biological considerations affecting the use of statistical methods.

Course Outcome

- define/explain within multiple microbiology disciplines the core theories and practices;
- describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations;
- explain the theoretical basis of the tools, technologies and methods common to microbiology; and
- demonstrate practical skills in the use of tools, technologies and methods common to microbiology, and apply the scientific method and hypothesis testing in the design and execution of experiments.
- In addition, in upper level courses, students will be able to: evaluate and respond to a complex question or challenge, using perspectives and scholarship drawn from microbiology and from cognate and non-cognate fields;

Course Code: 3SBMB605

Course Name: Discipline Specific Elective-VI Microbiology – VI (IMMUNOLOGY AND CLINICAL MICROBIOLOGY)

Course Objective

- The student will be able to identify common infectious agents and the diseases that they cause.
- The student will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
- The student will be able to recall microbial physiology including metabolism, regulation and replication.
- The student will be able to explain general and specific mechanisms by which an infectious agent causes disease.
- The student will be able to recognize and diagnose common infectious diseases from the clinical presentation and associated microbiology.
- The student will be able to describe the epidemiology of infectious agents including how infectious diseases are transmitted.
- The student will be able to assess treatment strategies including the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance.

Course Outcome

- Students will be able to communicate scientific information effectively, especially relating to microbiological organisms, and the roles of microbial organisms in ecosystem function

and health-related issues

- Students will be able to collect, analyze and interpret scientific data, including developing a familiarity with microbiology laboratory techniques and safety procedures
- Students will develop proficiency in the quantitative skills necessary to analyze biological problems (e.g., arithmetic, algebra, dimensional analysis, and statistical analysis as applied to biology), with a knowledge of specialized techniques used in microbiology.
- Students will be able to apply the scientific method as a demonstration that they understand its application furthering our knowledge of the microbial world
- Students will be able to describe fundamental principles of biology e.g., central dogma, diversity of life, inheritance and how these principles relate to microorganisms
- Students will be able to describe unique microbial genetic systems (i.e., prokaryotic and viral genomes, lateral gene transfer, plasmid structure and function, etc.)
- Students will appreciate the biological diversity of microbial forms, and appreciate that this diversity results from evolutionary processes
- Students will be able to access and interrogate the primary scientific literature and be aware of leading journals in the field of microbiology
- Students will be able to synthesize material from lower division courses across a biological sub-discipline and apply this to advanced course material (i.e., a Capstone experience); specifically, students will draw from their learning experiences in the fields of microbial ecology & evolution, microbial physiology, bioremediation, immunology, etc., as related to the topic of their capstone course
- Students will gain familiarity with the unique role of microbes play in genetic modification technologies (i.e., creation of GMOs, industrial applications, gene therapy, etc.)
- Students will gain familiarity with the role of microbes in human disease, the role of microbes in issues of international health, and the human immune response to microbial infection
- Students will gain familiarity with the role of microbes in the context of ecosystem function (e.g., microbial ecology, micro biome, etc.)

Bachelor of Science (Biotechnology)

Programme Code: 04UGR005

PROGRAM EDUCATIONAL OBJECTIVE (PEO'S)

The program of B.Sc. Biotechnology is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. The program focuses on the all-round development of the students to face the competitive world. The objectives of the program are as follows:

- To understand the scope and significance of the discipline.
- To imbibe love and curiosity towards nature through the animals and Microorganisms.
- To make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
- To make the students exposed to the diverse life forms.
- To make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
- To encourage the students to do research in related disciplines.
- To develop the ability of the students to transform the society through their education.

PROGRAM OUTCOMES (PO'S)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings towards Flora.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues related to animals (Fauna), Microorganisms and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development.
- **Self-directed and life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in Biotechnological and Zoological practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Botany, Instrumentation & Technology.

- **Technical Skills:** Develop an ability to use various instruments and equipment with an in depth knowledge on standard operating procedures for the same.
- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Biotechnology, Zoological Sciences and Microbiological Sciences.
- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modeling to complex issues of Zoology, Chemistry and Biotechnology.
- **The Society:** Apply regional Zoological reasoning for Animals informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOME

- **PSO1:** Identification and taxonomy of animals, microorganisms through different taxonomic description of animals and microorganisms.
- **PSO2:** To get a better understanding of different Phylum of animals in the Invertebrates and Vertebrates and also identification of animals and microorganisms.
- **PSO3:** To get the techniques involved in animal tissue culture and Genetic engineering.
- **PSO4:** To perform a detailed study about the different types of microbes viz. bacteria, Cyanobacteria, algae and fungi.

Course Code: 3CBCA201

Course Name: BASIC COMPUTER & INFORMATION TECHNOLOGY-I

Course Objective

- To educate students to analyze, design, integrate & manage information systems using information technology.

Course Outcome

- Student will be able to use computer system easily and they will get knowledge about how to use different type of operating system.

Course Code: 3HBHL-101

Course Name: हिन्दी भाषा और संरचना

पाठ्यक्रम के उद्देश्य

- विद्यार्थियों में राष्ट्र प्रेम की भावना का विकास करना।
- हिन्दी के समृद्ध साहित्य को नयी पीढ़ी तक पहुँचाना।
- पत्र-लेखन, सारलेखन, भाव पल्लवन एवं साक्षात्कार के कौशल का विकास करना।
- डायरी, संस्मरण, लेखन, पारिभाषिक, शब्दावली, तत्सम, तद्भव, देशज, विदेशी शब्दों इत्यादि के ज्ञान का परिमार्जन करना।

अपेक्षित परिणाम

- विद्यार्थी भारत भूमि से प्रेम व स्नेह के भावों को बढ़ा सकेंगे।
- विद्यार्थियों की हिन्दी की शब्द संपदा में वृद्धि होगी।
- पत्र-लेखन, सार लेखन, भाव पल्लवन साक्षात्कार के कौशल का विकास होगा।
- डायरी एवं संस्मरण लेखन विद्या का परिमार्जन होगा।
- हिन्दी के समृद्ध साहित्य कोश से लाभान्वित होंगे।

Course Code: 3SBBT103

Biotechnology- I (General Microbiology & Biotechnology)

Course Objective

- This course focuses on the general principles of microbiology and bacterial and virus cell structure and function.

Course Outcome

- Describe diversity of microorganisms, bacterial cell structure and function, microbial growth and metabolism, and the ways to control their growth by physical and chemical means.

Course Code: 3SBCH 104

Course Name: Chemistry-I (Physical, Inorganic & Organic Chemistry)

Course Objective

- To develop an understanding on the basics of mathematical concept, gaseous, liquid and colloidal states.
- To understand chemical kinetics, structure bonding and stereochemistry.

Course Outcome

- The knowledge gained on mathematical concepts, liquid state, chemical kinetics, structure & bonding and stereochemistry will provide a strong platform to understand the concepts on these Courses for further learning

Course Code: 3SBZO105**Course Name: Zoology-I (Invertebrates & Cell Biology)****Course Objective**

- This paper is aimed to introducing the students for the salient features of all Invertebrates, cell organization and cell division.

Course Outcomes

- The student have a knowledge of Classification and life cycle of invertebrates and cell division.

Course Code: 3HBEL201**Course Name: Foundation Course - English Language and Indian Culture****Course Objective**

- To Study the basic concept and Language Skills of English Language.
- Comprehensive study of different kinds of vocabulary in English Language.
- To Study the different era in every story and moods in poems.

Course Outcome

- Students will be able to understand the basic concept and Language Skills of English Language.
- Students will be able to understand the different use of vocabulary in their sentences.
- Students will be able to understand the varieties of stories on different issues and on different format.

Course Code: 3MBFE101**Course Name: FUNDAMENTALS OF ENTREPRENEURSHIP****Course Objective**

- Understanding basic concepts of entrepreneurship and key steps in the elaboration of business ideas, Developing personal creativity and entrepreneurial initiative.

Course Outcome

- Students have understood the basic idea of entrepreneurship and business ideas and

startups.

Course Code: 3SBBT203

Course Name: BIOTECHNOLOGY– II (BIOTECHNOLOGY AND IMMUNOLOGY)

Course Objective

- Biochemistry is the study to understand the molecular basis of life and its role in the disease process. Immunology is the study of body defends itself against disease and helps us understand how the immune system is tricked into attacking its own tissue.

Course Outcome

- Biochemistry is a specialised application of chemistry to biological samples. Immunology is the study of a patient's immune system.. Immunology testing is less automated than Biochemistry and results usually take about a week before they are available.

Course Code: 3SBCH 204

Course Name: Chemistry –II (PHYSICAL, INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- Study of Chemical bonding, Noble gases, S-block and P-block element. Brief discussion of Arenes and Aromaticity, cycloalkens, dienes and alkynes.

Course Outcome

- Upon successful completion of this course, students will understand theories of chemical bonding and determine the molecular geometry of molecules using VSEPR theory. Understand the general and physical properties of matter.

Course Code: 3SBZO205

Course Name: Zoology-II (Vertebrates & Developmental Biology)

Course Objective

- This paper is aimed to introducing the students for the salient features of all Vertebrates, and developmental biology

Course Outcome

- The student have a knowledge of Classification and life cycle of Vertebrates, gametogenesis and formation of three germinal layers

Course Code: 3HBHL-302

Course Name: हिन्दी भाषा संवेदना एवं संचार साधन

पाठ्यक्रम के उद्देश्य

- विद्यार्थियों को भारतीय संवेदना, संस्कृति, वैश्विक चेतना से परिचित कराना।
- धर्म, दर्शन, न्याय, नीति, साहित्य की प्राचीन व नवीन मान्यताओं से परिचित करवाना।
- संचार संसाधनों से परिचित करवाना।
- सिनेमा, रंगमंच, संगीत, चित्रकला इत्यादि से परिचित करवाना।

अपेक्षित परिणाम

- विद्यार्थी आधुनिक संचार संसाधनों के प्रयोग में कुशल हो सकेंगे।
- भारत की धर्म, दर्शन, नीति, संस्कृति, सभ्यता, संस्कारों इत्यादि के प्रति ज्ञान प्राप्त कर कुशल एवं संवेदनशील नागरिक बन सकेंगे।

Course Code: 3CBCA502

Course Name: BASIC COMPUTER & INFORMATION TECHNOLOGY-II

Course Objective

- To educate students to analyze, design, integrate & manage information systems using information technology.

Course Outcome

- Student will be able to use computer system easily and they will get knowledge about how to use different type of operating system.

Course Code: 3SBBT303

Course Name: Biotechnology-III – (Molecular Biology)

Course Objective

- The field overlaps with other areas of biology and chemistry, particularly genetics and biochemistry.
- Molecular biology chiefly concerns itself with understanding the interactions between the various systems of a cell, including the interrelationship of DNA, RNA and protein synthesis and learning how these interactions are regulated.

Course Outcome

- Molecular Biology gives depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.

Course Code: 3SBCH404

Course Name: Chemistry –III (physical, inorganic & organic chemistry)

Course Objective

- Study of efficiency and terms as well as thermodynamic process, spectrum , transition elements and coordination compounds

Course Outcome

- Upon successful completion of this course, students will understand kinetics, equilibrium, LeChatelier's principle, acid and base reactions, pH, buffers, colligative properties, and electrochemical applications in an undergraduate laboratory.
- Understand the first law of thermodynamics and the role of energy and enthalpy in chemical reactions and perform thermochemical calculations.

Course Code: 3SBZO305

Course Name: Zoology-III (Genetics)

Course Objective

- This paper is aimed to introducing the students for Genetics and applied Genetics.

Course Outcomes

- The student have a knowledge of Gene, genetic code, diseases and treatment.

Course Code: 3HBEL402

Course Name: ENGLISH LANGUAGE AND SCIENTIFIC TEMPER

Course Objective

- To Study the basic language skills (speaking, listening, reading, and writing) and grammar
- Comprehensive study of different kinds of letters and applications.
- To study the different kinds of prose and poetry

Course Outcome

- Student will be able to understand correct use of grammar and language skills.
- Student will be familiar with different prose and poetry.
- Student should be able to write analytically in a variety of formats, including essays, report writing and application.

Course Code: 3HBHP401

Course Name: HUMAN VALUES AND ETHICS

Course Objectives

- To help students understand the basic guidelines, content and process of Human value and value crisis in contemporary Indian Society
- To help students understand the meaning of happiness and prosperity for a human being.
- To help students reflect critically on gender violence.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly

Course Outcomes

On completion of this course, the students will be able to:

- Understand the significance of value inputs in a classroom and start applying them in their life and profession.
- Understand the value of harmonious relationship based on trust and respect in their life and profession.
- Students will develop a sense of appreciation of women in all walks of life.
- Understand the role of a human being in ensuring harmony in society

Course Code: 3SBBT403

Course Name: Biotechnology– IV (Industrial Biotechnology)

Course Objective

- The objective is to develop biotechnology approaches that will yield 'green' industrial processes that are cost effective and sustainable.

Course Outcomes

- Industrial biotechnology is one of the most promising new approaches to pollution prevention, resource conservation, and cost reduction. It is often referred to as the third wave in biotechnology. If developed to its full potential, industrial biotechnology may have a larger impact on the world than health care and agricultural biotechnology.

Course Code: 3SBCH404

Course Name: Chemistry-IV (PHYSICAL, INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- To make students understand the basic principal of transition elements and coordination compounds

Course Outcome

- Upon successful completion of this course students will describe the bonding and properties of transition and inter transition element coordination compounds

Course Code: 3SBZO405**Course Name: Zoology-IV (Animal Physiology)****Course Objective**

- This paper is aimed to introducing the students for animal physiology viz digestion, respiration, excretion, nervous and endocrine function

Course Outcomes

- The student have a knowledge of physiological diseases and treatment

Course Code: 3HBEL501**Course Name: INTRODUCTION TO SOFT SKILL & TEAM BUILDING****Course Objective**

By the end of the soft skills training program, the students should be able to:

- Develop effective communication skills (spoken and written).
- Develop effective presentation skills.
- Conduct effective business correspondence and prepare business reports which produce results.
- Become self-confident individuals by mastering inter-personal skills, team management skills, and leadership skills.
- Develop all-round personalities with a mature outlook to function effectively in different circumstances.
- Develop broad career plans, evaluate the employment market, identify the organizations to get good placement, match the job requirements and skill sets.
- Take part effectively in various selection procedures adopted by the recruiters.

Course Outcome

- The teaching methods in the soft skills training include lectures, projects, role plays, quizzes, and various other participatory sessions. The emphasis will be on learning by doing.
- Since the method of training is experiential and highly interactive, the students imbibe the skills and attributes in a gradual and subtle way over the duration of the program. The students will not only learn the skills and attributes but also internalize them over a period of time.
- Internalization ensures that the skills and attributes become part of the students' nature.

Subtle changes are bound to occur in their behavior and outlook, and these will make them more self-assured and confident. Moreover, the behavior changes will be gradual and natural and will not appear artificial or put on. Thus, the changes in them will be genuine and positive.

- The Soft Skills training program is a credit course and the evaluation of the students takes place on a continuous basis. Active participation in activities, interest displayed by the students in acquiring the necessary attributes and skills and the commitment shown by them to improve in terms of attitudes are the main criteria for evaluation.

Course Code: 3SBES501

Course Name: ENVIRONMENTAL STUDIES

Course Objective

- Student will be able to become proficient in the natural and physical sciences, as well as to be aware of social and cultural influences upon environmental problems facing society today.

Course Outcome

- The Environmental Studies minor supplements other majors to facilitate students' understanding of complex environmental issues from a problem-oriented, interdisciplinary perspective.
- Enable the student to acquire basic ideas about environment and emerging issues about environment problems.
- Aware about the need and importance of Natural Resources.
- Develop knowledge and understanding of the environment and enable the students to contribute towards maintaining and improving the quality of the environment.

Course Code: 3SBBT503

**Course Name: Discipline Specific Elective-I BIOTECHNOLOGY-V
(INSTRUMENTATION BIOTECHNOLOGY AND COMPLEX)**

Course Objective

- To ensure quality control in bioinformatics research through a scientific user committee, documentation, data traceability and reliability, CECILL licences, indicator measurement.

Course Outcome

- Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.

Course Code: 3SBBT504

Course Name: Discipline Specific Elective-II BIOTECHNOLOGY-V (ENVIRONMENTAL BIOTECHNOLOGY)

Course Objective

- One of the main objectives of environmental biotechnology is the conservation of resources via the recycling of waste materials.

Course Code: 3SBBT505

Course Name: Discipline Specific Elective-III BIOTECHNOLOGY-V (GENETICS & GENETIC ENGINEERING)

Course Objective

- To impart basic knowledge and genetics techniques of various aspects of biotechnology. Biotechnology is the research oriented Course.

Course Outcomes

- Origin of life: Classical experiments and current concepts.
- Microbial genetics: Gene Cloning and expression of foreign gene in bacteria.
- Production of transgenic microbes, Animals & plants and their application in Biotechnology. Gene Cloning in medicine, Production of protein from cloned genes.

Course Code: 3SBCH503

Course Name: CHEMISTRY-V (PHYSICAL INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- To Study the concepts of UV and IR spectroscopy and Bio-Organic & Bioinorganic Chemistry

Course Outcome

- After completion of the course student will be able to Understand the Spectroscopy, acid/base reactions, their products, and how buffer systems work

Course Code: 3SBCH504

Course Name: CHEMISTRY-V (ELECTIVE –I) INDUSTRIAL CHEMISTRY

Course Objective

- Study of basic concept of distillation, evaporation, absorption, filtration and drying catalysis Microwave and Ultrasound assisted green synthesis, Green catalysis and its application.

Course Outcome

- Knowledge of industrial chemistry and its application.

Course Code: 3SBCH505**Course Name: CHEMISTRY-V (ELECTIVE –I) GREEN CHEMISTRY****Course Objective**

- To Study the basic concepts of Green Chemistry, Green Reactions, Microwave and Ultrasound assisted Green synthesis, Green Catalysis and its application.

Course Outcome

- After completion of the course the learners will be able to know about the reaction of Green catalysis, Microwave and Ultrasound assisted green synthesis and its modern application in Green Chemistry.

Course Code:3SBZO503**Course Name: Discipline Specific Elective-I Zoology –V (Applied Zoology)****Course Objective**

- This paper is aimed to introducing the students for Aquaculture, Economic Entomology, toxicology and lab techniques.

Course Outcomes

- The student have a knowledge of different culture Skill to develop own Business, lab Techniques and self employment.

Course Code:3SBZO504**Course Name: Discipline Specific Elective-II Zoology-V (Wild Life Conservation)****Course Objective**

- This paper is aimed to introduce wildlife conservation, endangered species, sanctuaries biosphere reserve Project Tiger and. Gir Lion.

Course Outcome

- The student have a knowledge of different biosphere reserve, sanctuaries, wildlife conservation Skill to develop employment in Zoo.

Course Code: 3SBZO505

Course Name: Discipline Specific Elective-III Zoology-V (Industrial Biology)

Course Objective

- This paper is aimed to introduce micro-organism used in Fermentation. Vitamin, Enzyme Antibiotics, Alcohol, dairy products and other pathogenic treatment.

Course Outcomes

- The student have a knowledge of different micro-organism used for drug, alcohol vitamin, antibiotics, enzyme, dairy production Skill to develop own Business, marketing and self employment.

Course Code: 3SBBT603

Course Name: Discipline Specific Elective-I Biotechnology (Applied Biotechnology)

Course Objective

- To trained the students for industrial need and pursue further education.
- To include entrepreneurship among the student so as to start their own ventures in the field of biotechnology.

Course Outcomes

Students will be able to:

- To introduced the plant tissue culture, Nutritional requirements, In vitro culture, Single cell culture, Somaclonal variations, Anther culture, Ovule culture somatic embryogenesis, Organogenesis.
- To the study of DNA probes and their application in diagnosis of genetic and other disorders. Plant DNA finger printing

Course Code: 3SBBT604

Course Name: Discipline Specific Elective-II BIOTECHNOLOGY (RECOMBINANT DNA TECHNOLOGY)

Course Objective

- To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology as well as to create understanding and expertise in wet lab techniques in genetic engineering.

Course Outcome

- At the end of the course, the students will have sufficient scientific understanding of the Course and have good knowledge of application of Recombinant DNA techniques in Life

Sciences Research.

Course Code: 3SBBT605

Course Name: Discipline Specific Elective-III Biotechnology (Plant and Animal Tissue culture Techniques and its Application Biotechnology)

Course Objective

- This course focuses on the Laboratory organization & Plant and Animal Tissue Culture Techniques and its application.

Course Outcome

- Student able to, Plant and Animal tissue culture Laboratory organization & Cloning.

Course Code: 3SBCH 603

Course Name: CHEMISTRY-VI (PHYSICAL INORGANIC & ORGANIC CHEMISTRY)

Course Objective

- To Study the basic concepts of photochemistry, solution, Inorganic polymer, preparation and properties of organometallic compounds.

Course Outcome

- After completion of the course student will able to understand the physical photochemistry, application of inorganic polymers and organometallic compounds.

Course Code: 3SBCH 604

Course Name: DISCIPLINE SPECIFIC ELECTIVE-II (BIO-CHEMISTRY)

Course Objective

- To Study & know about the basic concepts of biochemistry, Cellular mechanisms, cell biology, chemical entities supporting life, Vitamins, Carbohydrates, lipids, proteins, enzymes, DNA, RNA, and their Structure and classification as well as their physical, chemical and optical properties.

Course Outcome

- The Students will able to understand the biochemistry of organisms, the building blocks of life & all the relevant biochemical processes including the properties and synthesis.

Course Code:3SBCH 605

Course Name: DISCIPLINE SPECIFIC ELECTIVE-II (NANOCHEMISTRY)

Course Outcome

- To understand preparation of nanoparticle, organic nanoparticle and about the role of nanoparticle in environmental protection.

Course Outcome

After the completion of course learner is able to understand about:

- Nanochemistry of Nanomaterials and its types
- Preparation methods of Nanomaterials/Nanoparticles & nano synthesis
- Nanoscience affecting environment
- Organic nanoparticles& their characterization techniques.
- Nanomaterials for Environmental Protection

Course Code: 3SBZO603

Course Name: Discipline Specific Elective-I Zoology – VI (Environmental Biology & Evolution)

Course Objective

- This paper is aimed to introduce Ecology, Origin of life and evolution, Palaeontology and distribution

Course Code: 3SBZO604

Course Name: Discipline Specific Elective-II Zoology – VI (AQUACULTURE)

Course Objective

- This paper is aimed to introduce fresh water Prawn, Fish and Pearl Culture.

Course Outcome

- The student have a knowledge of different culture Skill to develop own Business, marketing and self employment.

Course Code: 3SBZO605

Course Name: Discipline Specific Elective-III Zoology-VI (Economic Zoology)

Course Objective

- This paper is aimed to introduce Pearl Culture, Lac–Culture, Sericulture and Poultry keeping. Protozoa, rats, mites, insect diseases and control.

Course Outcome

- The student have a knowledge of different culture Skill and diseases and their control to develop own Business, marketing and self employment.

Master of Science (Microbiology)

Programme Code: 04PGR004

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- The objective of the Master's programme in Microbiology is to equip the students to apply the knowledge of Microbes and their uses in different field.
- The laboratory training and Pathogenicity analysis of microbes in Microbiology. prepare the students for their careers in the Medical and industrial area.
- The student have a knowledge of different culture Skill viz Blood culture, Urin –Culture , Pus culture . Identification of microbes and their causing diseases and control to develop own Business, marketing and self employment.
- The goal is to impart student the knowledge and skills which are contemporary and useful to them as well as for society. The student will write the standard operating protocols (SOPs) and identify requirement for experimental Microbes, ethics and welfare.
- Large scale production of microbes through fermentation process and uses of their secondary metabolites (Byproducts) in different field.

PROGRAM OUTCOMES (PO's)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development in terms of biotechnology.
- **Self-directed and long-life learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in biotechnological practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of biotechnology, Instrumentation & Technology.
- **Technical Skills:** Develop an ability to use various instruments and equipment with an indepth knowledge on standard operating procedures for the same.

- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Biotechnology & biotechnological Sciences.
- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of Biotechnology.
- **The Society:** Apply regional biotechnological reasoning informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOMES (PSO'S)

- **PSO1-**Industry applications of better understanding of the key principles of biochemical functioning at an advanced level
- **PSO2-**To get better awareness of the major issues at the forefront of the discipline of Biotechnology.
- **PSO3-**Possess an in-depth understanding of the area of Biotechnology & biochemistry chosen for research emphasis
- **PSO4-**ability to design and carry out experiments (safely) and to interpret experimental data
- **PSO5-**production of substantial original research of significance and quality sufficient for publication of ability to present their work through written, oral, and visual presentations, including an original research proposal awareness of ethical issues in biochemical & Biotechnological research and careers options.

Course Code: 6SMMB101

Course Name: GENERAL MICROBIOLOGY

Course Objective

- Microbiology is the study of organisms that are too small to be observed with the naked eye.

Course Outcome

- This course focuses on the general principles of microbiology.

Course Code: 6SMMB102

Course Name: VIROLOGY

Course Objective

- How virus and host factors interact and how these interactions lead to disease and/or recovery.

Course Outcome

- The student will be able to evaluate problems in modern virology including areas of virus biology.

Course Code: 6SMMB103

Course Name: Research Methodology & Techniques

Course Objective

- Research method is characterized by the techniques employed in collecting and analyzing data.

Course Outcome

- In this course, student should be able to assess critically the following methods:- literature, case study, structured surveys, interviews, focus groups.

Course Code: 6SMMB104

Course Name: Biochemistry

Course Objective

- Objective of biochemistry is the complete understanding at the molecular level of all of the chemical processes associated with living cells.

Course Outcome

- Student will be able to demonstrate an understanding of fundamental biochemical principles such as the structure/function of biomolecules, metabolic pathways and the regulation of biological/biochemical processes.

Course Code: 6SMMB201

Course Name: MICROBIAL PHYSIOLOGY AND METABOLISM

Course Objective

- In this course, we will explore the vast range of physiologies and metabolisms found throughout the microbial world

Course Outcome

- The student have a knowledge of how microbial cell structures growth and metabolism function in living organisms.

Course Code: 6SMMB202**Course Name: FOOD MICROBIOLOGY AND TOXICOLOGY****Course Objective**

- In this course, the study of microorganisms involving both beneficial and deleterious effects of microbes on the quality and safety of processed and raw food materials.

Course Outcome

- The student has knowledge of how food poisoning, food spoilage, preservation of food is dealt under food microbiology.

Course Code: 6SMMB203**Course Name: IMMUNOLOGY****Course Objective**

- In this course, understand the overall organization of the immune system.

Course Outcome

- This course is to help students develop the skills necessary for the critical analysis of contemporary literature on topics related to health and disease.

Course Code: 6SMMB204**Course Name: PHARMACEUTICAL MICROBIOLOGY****Course Objective**

- In this course, generally pharmaceutical microbiology provides knowledge of the presence of bacteria, yeasts, moulds, viruses and toxins in pharmaceutical raw material.

Course Outcome

- This course is to help student will be able to develop expertise in identification, cultivation and counting of microorganisms, preparation and sterilization of bacterial culture, various staining techniques, aseptic processing etc.

Course Code: 6SMMB301

Course Name: Molecular Biology and Microbial Genetics

Course Objective

- The molecular mechanisms of DNA-replication, repair, protein synthesis.

Course Outcome

- This course should excite about basic science and its applications.

Course Code: 6SMMB302

Course Name: Industrial Microbiology

Course Objective

- The course is designed to develop student's ability to apply the techniques used in the different phases of industrial microbiology.

Course Outcome

- Encouraging students to appreciate the exploitation of microorganisms in industries as a viable alternative to the use of chemicals to the production of useful products.

Course Code: 6SMMB303

Course Name: Environmental and Agricultural Microbiology

Course Objective

- The study of the composition and physiology of microbial communities in the environment.

Course Outcome

- Students will understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.

Course Code: 6SMMB402

Course Name: Soil Microbiology

Course Objective

- Soil microbiology is the study of microorganisms in soil, their functions, and how they affect soil properties.

Course Outcome

- The student will own knowledge on the role of beneficial microorganisms in the transformation of organic matter, biogeochemical cycles, and in biological soil fertility.

Course Code: 6SMMB305

Course Name: Bioenergetics and Molecular Enzymology

Course Objective

- Bioenergetics is a field in biochemistry and cell biology that concerns energy flow through living systems.

Course Outcomes

- Bioenergetics is a branch of biochemistry that studies the transformation of energy within living organisms, and between living organisms and their environment.

Course Code: 6SMMB305

Course Name: Bioinstrumentation

Course Objective

- The objective of this course is to introduce the students to the application of biomedical instrumentation.

Course Outcomes

- The Instrumentation Technology certificate will develop entry-level skills in industrial instrumentation, maintenance and calibration.

Course Code: 6SMMB306

Course Name: Microbial Physiology

Course Objective

- In this course, students will be given the opportunity to learn about the following: Bacterial taxonomy and diversity.

Course Outcomes

- Learning outcomes and competences: After the course the participants should be able to: Describe the metabolic and physiological diversity among prokaryotes.

Course Code: 6SMMB308

Course Name: Medical Microbiology

Course Objective

- Develops basic skills necessary to work in the microbiology laboratory.

Course Outcome

- The student will be able to identify common infectious agents and the diseases that they cause.

Course Code: 6SMMB309**Course Name: Applied Microbiology****Course Objective**

- The main objective of the course is to provide students with the basis to face the study of the major fundamentals of microbiology. The main knowledge provided will be microbiological techniques to be applied in the laboratory

Course Outcome

- Understand the beneficial role of microorganisms in fermented foods and in food processing and the microbiology of different types of fermented food products – dairy, pickles, Legume and cereal based food products
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in manufacture of industrial products

Course Code: 6SMMB310**Course Name: Bioinformatics, Microbial Genomics and Proteomics****Course Objective**

- Bioinformatics objective to enrich biological data and to apply computer based algorithm.

Course Outcomes

- At the completion of the course, you should be able to Apply basic knowledge of the procedures used to assemble genomes, identify genes and predict their function.

Course Code:6SMMB311**Course Name: Bacteriology****Course Objective**

- To recognize, identify and differentiate the internal and external structures of procaryotic and eukaryotic microbial cells.

Course Outcomes

- Students who graduate with a Master of Science in Immunology and Microbiology will

Obtain a significant knowledge on fundamental and advanced aspects of Microbiology.

Course Code: 6SMMB312

Course Name: Advances in Microbiology

Course Objectives

- Advances in Microbiology aims to publish high quality papers in all areas of Microbiology

Course Outcomes

- In spite of many advances in microbiology and bacteriology, there still remain many unanswered questions

Course Code: 6PRSC401

Course Name: Project Work

Course Objective

- To prepare the students with basic knowledge in clinical immunology, biochemical techniques in order to continue their career in higher degree.

Course Outcome

- Students have wide range of options for the occupation in the field of microbiology including: microbial physiology, microbial genetics, microbial ecology, pathogenesis, immunology, virology, evolution, diversity etc.

Course Code: 6SMMB401

Course Name: Mycology, Phycology & Protozoanology

Course Objective

- Mycology is the branch of biology concerned with the study of fungi, including their genetic and biochemical properties. Phycology is the scientific study of algae.

Course Outcome

- After completion of course the students will understand the general characters of fungi, algae and protozoan's economic importance and life cycle of various groups of algae fungi and protozoa. The students will understand the symbiotic and saprotrophic roles of fungi in agriculture and role of fungi as biocontrol agents and Mycorrhizal fungi as biofertilizer.

Course Code: 6SMMB304

Course Name: Parasitology

Course Objective

- The purpose of this first laboratory is to introduce you to some of the techniques that a veterinarian uses to detect the eggs, cysts, and larvae of parasites in the feces of animals.

Course Outcome

- Students will be able to apply working knowledge of fundamental facts, concepts and theories about marine parasitology and disease

Course Code: 6SMMB403

Course Name: Microbial diversity and Extremophiles

Course Objective

- The aim of this work is to offer a short, but comprehensive report on the biology and biodiversity.

Course Outcomes

- At the end of the course, students will be able to Recognize the extent of microbial diversity

Course Code: 6SMMB404

Course Name: Microbial Genetics

Course Objective

- To begin developing a strategy for placing significance on a genetic analysis of microbial forensic evidence and addressing the objectives of microbial forensics

Course Outcomes

- On completion of the course, the student should be able to: explain the processes behind mutations and other genetic.

Course Code: 6SMMB405

Course Name: Recombinant DNA Technology

Course Objective

- After interacting with this Learning Object, the learner will be able to, Recombinant DNA technology which came into existence in the 1970s, allows for genetic manipulation of organisms by incorporating DNA sequences from different sources into a single

recombinant molecule. This revolutionary technology has opened up several applications in plant genomics and clinical research. List out tools used for gene exploration. Utilize the knowledge on creation of a genomic library

Course Outcomes

- Sensitive DNA detection techniques available could detect the transgene

Course Code: 6SMMB406

Course Name: Microbial Ecology

Course Objective

- Microbial ecology focus on life too small to be seen without the aid of a microscope including bacteria, virus and fungi.

Course Outcome

- Studying these tiny organisms and how they interact with their environment has yielded incredible achievements across a variety of scientific disciplines and shed light on how important microbes are to the ecosystem they inhabit.

Course Code: 6SMMB407

Course Name: Cell tissue & Organ culture

Course Objective

- The aim of cell, tissue and organ culture is to isolate at each level of organization the parts from the whole organisms for study in experimentally controlled environments populations of cells from monolayers or suspension cultures are used for nutritional, biochemical and immunological work.

Course Outcome

- Cell, tissue and organ culture system: in vitro methods, their advantages and disadvantages conditions and level of their applications. The most important conditions and factors for in vitro survival, safety measures the analysis and evaluation of the results conclusion to in vivo processes.

Course Code: 6SMMB408

Course Name: Biomathematics

Course Objective

- To gain an insight into modelling techniques and principles in gene regulation, virus growth, cancer and physiology; to consolidate basic mathematical techniques used in these

approaches, such as ODEs, PDEs, probability theory, branching processes and Markov Chains.

Course Outcomes

- This course uses mathematics to solve biological and biomedical problems.

Course Code: 6SMMB409

Course Name: Inheritance Biology

Course Objectives

- Genetics is the study of genes passed from parents to offspring.

Course Outcomes

- On Completion of the course the students will be able to To gain knowledge about the organellar inheritance.

Course Code: 6SMMB410

Course Name: Biosafety and Intellectual Property Rights

Course Objectives

- Regulate research and development activities using recombinant DNA technology should be to minimize risk from such activities and at the same time encourage these activities

Course Outcomes

- One outcome of this workshop was that scientists and government Unfortunately, drafting IPR legislation and biosafety guidelines

Master of Science (Biotechnology)

Programme Code: 04PGR007

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- The objective of the Master's programme in Biotechnology is to equip the students to apply the knowledge of Industrial and Technical awareness. The laboratory training and Research analysis of Macro and Micro molecules, Industrial training and Hands on work included to prepare the students for their careers to become entrepreneur.
- The student have a knowledge of different culture Skill viz Tissue Culture, Blood –Culture, Cell culture. Production of genetically modified new species for research and development.
- The goal is to impart student the knowledge and skills which are contemporary and useful to them as well as for society. The student will write the standard operating protocols (SOPs) and identify requirement for experimental organ, ethics and welfare.

PROGRAMME OUTCOME

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development.
- **Self-directed and long-life learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in microbiological practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Microbiology, Instrumentation & Technology.
- **Technical Skills:** Develop an ability to use various instruments and equipment with an indepth knowledge on standard operating procedures for the same.
- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Microbiology & microbiological Sciences.

- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of microbiology.
- **The Society:** Apply regional microbiological reasoning informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOMES (PSO'S)

- **PSO1-** Significance towards Molecular level: The Physiology, Biochemistry, and Genetics of microorganisms, including such topics as structure, function, diversity, metabolism, and the genetics of metabolic regulation can approach to molecular microbial level.
- **PSO2-** Significance towards Microbial Pathogenesis: the immune response and disease-causing microorganisms, including aspects of the humoral, cell-mediated and non-specific immune responses, as well as the molecular basis for pathogenesis
- **PSO3-** Significance towards Environment: the taxonomic, ecological, and genetic relationships among microorganisms, including such topics as nutrient cycling, microbial diversity, and the biotechnological application of microorganisms can solve environmental problems.
- **PSO4-** Significance towards Industry: This topic helps to learn manipulating organisms in order to yield a specific product such as antibiotics, vitamins, enzymes, amino acids, solvents, alcohol and daily products. They can also be used in an agricultural application and use them as a bio-pesticide instead of using harmful chemicals or as inoculants and help plant proliferation.
- **PSO5-** Relation of Microbiology to other aspects of Science: The curriculum also includes several interdisciplinary topics such as biochemistry, biophysics, bioinformatics, biohydrometallurgy, bioremediation, biodegradation Biostatistics etc. to ensure a wide range of options that allow students to choose modules from various departments that are best suited to their personal interests and career ambitions.
- **PSO6-** Instruments/Techniques usage: The use of various instruments/ techniques and their optimal usage can elucidate students to gain formal knowledge about the practicals as well as creates an opportunity to explore the further extent.
- **PSO7-** Scientific Method: hypothesis generation and testing, including the development of theoretical and practical skills in the design and execution of experiments
- **PSO8-** Scientific Communication: the development and execution of oral and writing skills necessary for effective communication of experimental results, the ability to think critically regarding a discipline topic, and the conveyance of scientific principles to audiences of both scientists and non-scientists.

- **PSO9-** The study of Microbiology will impart in-depth understanding of basic aspects of microbiological science pertaining to industrial applications. The courses of Industrial Microbiology & Fermentation Technology, Genetic Engineering, Microbial Genetics, Bio-analytical Techniques, Molecular Microbial Physiology, Agriculture & Environmental Microbiology, Animal Biotechnology, and Vaccinology will make the students ready to contribute to Molecular, Biochemical, Industrial, medical and other basic and applied applications of better understanding of the key principles of microbial functioning at an advanced level better awareness of the major issues at the forefront of the discipline will possess an in-depth understanding of the area of Biotechnology chosen for research emphasis ability to design and carry out experiments (safely) and to interpret experimental data production of substantial original research of significance and quality sufficient for publication ability to present their work through written, oral, and visual presentations, including an original research proposal awareness of ethical issues in Biotechnology research and careers options

Course Code: 6SMBT101

Course Name: CELL BIOLOGY & BIOMOLECULES

Course Objective

- Students will understand the structures and purposes of cellular components.

Course Outcome

- Students will be able to explain the basic concepts of cell biology and biomolecules.

Course Code: 6SMBT102

Course Name: TOOLS AND TECHNIQUES

Course Objective

- The use of biological processes or organisms for the improvement of the characteristics of plants, animals.

Course Outcome

- Providing powerful and useful tools, in a continuum of technical evolution that contributes or could contribute to the improvement of crop production.

Course Code:6SMBT103

Course Name: MICROBIAL PHYSIOLOGY

Course Objective

- The objective of this course are to learn the fundamentals of molecular microbial

physiology.

Course Outcome

- Study of how microbial cell structures, growth and metabolism function in living organisms.

Course Code: 6SMBT104

Course Name: GENETIC ENGINEERING

Course Objective

- The objective of this process is to introduce the physiological and physical or characteristics.

Course Outcome

- Genetic engineering eliminates and has an array of technical and ethical concerns that make it not feasible.

Course Code: 6SMBT201

Course Name: Biostatistics and Computer Application

Course Objective

- The basic objective of this course is to get familiar with biostatistics and computers.

Course Outcome

- Students will be able to understand biostatistics and apply in research.

Course Code: 6SMBT202

Course Name: Molecular Biology

Course Objective

- Molecular biology deals with nucleic acids and protein and how these molecules interact within the cell to promote proper growth division and development.

Course Outcome

- Molecular biology gives you in-depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.

Course Code: 6SMBT203

Course Name: Environmental Biotechnology

Course Objective

- One of the main objectives of environmental biotechnology is the conservation of resources via the recycling of waste materials.

Course Outcome

- Environmental biotechnology is a system of scientific and engineering knowledge related to the use of microorganisms and their products in the prevention of environmental pollution through biotreatment of solid, liquid, and gaseous wastes, bioremediation of polluted environments and biomonitoring of environment and treatment processes.

Course Code: 6SMBT204

Course Name: Macromolecules and Enzymology

Course Objective

- This course will introduce the general structure and function of the biological macromolecules. Basic knowledge of enzyme kinetics, the parameters of the enzymatic reaction.

Course Outcome

- Students will gain an enhanced overall understanding of macromolecules and enzymology.

Course Code: 6SMBT301

Course Name: Animal Biotechnology

Course Objective

- Is to reduce the environmental impact of livestock farming.

Course Outcome

- Animal biotechnology introduces applications of animal biotechnology and implications for human future prospects.

Course Code: 6SMBT302

Course Name: Biology of Immune System

Course Objective

- Describes surface membrane barriers and their protective functions.

Course Outcome

- Physicians often observe immune system improvements in health on a clinical level.

Course Code: 6SMBT303**Course Name: Bioprocess Engineering & Technology****Course Objective**

- The course provides the basics of microbiology to build a foundation for more advanced studies in biotechnology.

Course Outcome

- Analyze and identify Limiting factors in a bioprocess and propose solutions to address biological and engineering problems.

Course Code: 6SMBT304**Course Name: BACTERIAL GENETICS****Course Objective**

- The purpose of the course is to teach the students about basics and advanced concepts of bacterial Genetics and ensuring that students acquire an extensive and sound knowledge base for future studies.

Course Outcome

- After the completion of the course, the students would acquire the knowledge of plasmid bacteriophage and gene transfer in bacteria. They would learn advanced techniques of restriction modification. They would also be acquainted with methodological concepts and tools needed to acquire top-level skills in the field of bacterial genetics.

Course Code: 6SMBT305**Course Name: Clinical Pathology****Course Objective**

- To understand basic histology and cytology.
- To learn different method involved in the processing of tissue
- To understand the principle of various test at pathology lab

Course Outcome

- Student will learn basic histology and cytology.
- learn different and understand method involved in the processing of tissue
- learn and understand the principle of various test at pathology lab

Course Code: 6SMBT306

Course Name: Traditional cancer therapies

Course Objective

The aim of the study is to know about:

- The basics of cancer its types and the etiology of cancer
- The several diagnostic method for several types of cancer
- The traditional and advanced therapy for the cancer treatment

Course Outcome

At the end of this course students will be able to:

- Know about cancer and their several types
- Have the information regarding various cause for the cancer
- Understand what are the therapies and treatment Module for the cancer patient

Course Code: 6SMBT307

Course Name: Medical Biotechnology

Course Objective

- Develops basic skills necessary to work in the medical biotechnology laboratory.

Course Outcome

- The student will be able to identify common infectious agents and the diseases that they cause.

Course Code: 6SMBT308

Course Name: Food Microbiology

Course Objective

- In this course, the study of microorganisms involving both beneficial and deleterious effects of microbes on the quality and safety of processed and raw food materials.

Course Outcome

- The student has knowledge of how food poisoning, food spoilage, preservation of food is dealt under food microbiology.

Course Code: 6SMBT309

Course Name: Plant Biotechnology

Course Objective

- The objective of the course is to give student new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology.

Course Outcome

- The course will provide an overview of plant biotechnology with focus on industrial applications

Course Code: 6SMBT310

Course Name: FOOD SCIENCE & TECHNOLOGY

Course Objective

- To convey better knowledge among the students about modern day food biotechnology, its associated techniques like packaging etc and Food safety and Quality control.
- To ensure better quality of education by continuous monitoring and review of performance and counseling students.

Course Outcome

- Food biotechnology has a great scope at present and in future. As there is increasing popularity and explosive growth, there are plenty of opportunities available in Food Biotechnology field. Students get training and skill development in the field of food biotechnology such as: Biotech foods and supplements as GM foods, food from fungi, algae and bacteria and their large scale production.

Course Code: 6SMBT401

Course Name: ENZYME TECHNOLOGY

Course Objective

- This Enzyme-Technology oriented course covers the applications of enzymes in various industries; classification of enzymes on the basis of their structures, functions and their salient features; How enzymes work and their regulation; Strategies being adopted for production, isolation, purification and Characterization of enzymes at laboratory and industrial scale from plant, animal and microbial sources; Strategies for immobilization and engineering of enzymes etc.

Course Outcome

- This foundation course on Enzyme Technology will help the students to understand the nature, structure, function, kinetics, specificity, categories and regulation of enzymes. The students will get acquainted with their role in various sectors and how their structure can be modified to make them industrially suitable.

Course Code: 6SMBT402**Course Name: BIOINFORMATICS****Course Objective**

- The aim of this course is to introduce the students to the basics of bioinformatics. This includes teaching the basis of the biological system via information and technology.

Course Outcome

- After completing the course, students will be able to learn various methods of shortlisting, analyzing, interpreting the vast biological data generated in in vitro and in vivo experiments. They will also learn application of various bioinformatics tools that will help in generating more accurate predictions.

Course Code: 6SMBT403**Course Name: Clinical Biochemistry****Course Objective**

- Overview of various disorder due to defect in the metabolism of biomolecules.
- To know about Electrolytes and acid base balance
- To learn in detail about hormonal disbalance.

Course Outcome

- Student will be able to understand various disorder due to defect in the metabolism of biomolecules.
- They will learn about Electrolytes and acid base balance
- Learn and understand in detail about various hormonal disbalance.

Course Code: 6SMBT404**Course Name: Pharmaceutical Biotechnology****Course Objective**

- In this course, generally pharmaceutical microbiology provides knowledge of the presence of bacteria, yeasts, moulds, viruses and toxins in pharmaceutical raw material.

Course Outcome

- This course is to help student will be able to develop expertise in identification, cultivation and counting of microorganisms, preparation and sterilization of bacterial culture, various staining techniques, aseptic processing etc.

Course Code: 6SMBT405**Course Name: Microbial techniques****Course Objective**

- To acquaint students with basic techniques in Staining and Sterilization

Course Outcome

- To impart the knowledge of growth of microorganisms

Course Code: 6SMBT406**Course Name: Biological chemistry****Course Objective**

- The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.

Course Outcome

- At the end of the course students will be able to demonstrate broad knowledge of the biomolecules, machinery and information flow within living cells, and an appreciation of how these underpin all biological processes, in both normal and diseased states

Course Code: 6SMBT407**Course Name: ETHICS PATENTING AND BIOENTERPRENURSHIP****Course Objective**

- The objective of the course is to make students learn about the legal, safety and public policy issues raised due to the rapid progress in biotechnology and development of new products.

Course Outcome

- At the end of the course, it is expected that students have understood the basic issues of biosafety, bioethics and IPR arising from the commercialization of biotech products. They are now supposed to follow the regulatory framework in their future venture to ensure

product safety and benefit the society

Course Code: 6SMBT408

Course Name: GENOMICS, PROTEOMICS & BIOSAFTEY

Course Objective

- During the course students would learn about genomics including genetic features of nuclear genomes of prokaryotes and eukaryotes, eukaryotic organelle genomes, genome evolution and molecular phylogenetics. The course also aims to introduce the students to the fields of proteomics and metabolomics.

Course Outcome

- After the completion of the course, it is expected that students have understood the concept of genome, proteome and biosafety and their correlation with each other. They would understand genetic organization of nuclear genomes of prokaryotes and eukaryotes, features of eukaryotic organelle genomes, genome evolution and molecular phylogenetics.

Course Code: 6PRSC401

Course Name: PROJECT WORK

Course Objective

- To prepare the students with basic knowledge in the research, biochemical techniques in order to continue their career in higher degree.

Course Outcome

- The student will identify a problem on which he/she would be able to work, identify the scope of research on the chosen topic and will frame the objectives to be addressed in the project.

Master of Science (Botany)

Programme Code: 04PGR005

PROGRAM EDUCATIONAL OBJECTIVE (PEO's)

The program of M.Sc. Botany is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. The program focuses on the all-round development of the students to face the competitive world. The objectives of the program are as follows:

- To understand the scope and significance of the discipline.
- To imbibe love and curiosity towards nature through the living plants.
- To make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
- To make the students exposed to the diverse life forms.
- To make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
- To encourage the students to do research in related disciplines.
- To develop the ability of the students to transform the society through their education.

PROGRAM OUTCOMES (PO's)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings towards Flora.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues related to plants(Flora) and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development.
- **Self-directed and life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in Botanical practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Botany, Instrumentation & Technology.

- **Technical Skills:** Develop an ability to use various instruments and equipment with an in depth knowledge on standard operating procedures for the same.
- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Botany & Botanical Sciences.
- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of Botany.
- **The Society:** Apply regional Botanical reasoning for Plants informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOME

- **PSO1:** Identification and taxonomy of plants through different taxonomic description of plants.
- **PSO2:** To get a better understanding of different families of plants in the angiosperms and gymnosperms.
- **PSO3:** To get the techniques involved in plant tissue culture and plant breeding.
- **PSO4:** To perform a detailed study about the different types of microbes viz. bacteria, Cyanobacteria, algae and fungi.

Course Code: 6SMBO101

Course Name: Biology and Diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms

Course Objective

- To acquaint the students about the morphology, biology and importance of algal organisms, Bryophytes, Pteridophytes and gymnosperms

Course Outcomes

- The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

Course Code: 6SMBO102

Course Name: BIOLOGY AND DIVERSITY OF VIRUSES, BACTERIA AND FUNGI

Course Objective

- To acquaint the students about the morphology, characters and importance of different

microorganisms

Course Outcomes

- The course will enable students to know about different types of microorganisms viz. Bacteria, Viruses, Fungi and Cyanobacteria

Course Code: 6SMBO103

Course Name: MORPHOLOGY, ANATOMY AND TAXONOMY OF ANGIOSPERM PLANT

Course Objective

- To understand the various kinds of plants on the surface of earth with their names, affinities, geographical distribution, habit characteristics and their economic importance.
- To understand the diversities of plant kingdom and their relation to evolution of plants. A systematic reconstruction of plant kingdom can be made only after the complete knowledge of the individual plants.
- To understand the various aspects of plant nomenclature and classification.
- To understand the classical and modern trends of Angiosperm taxonomy
- To understand the salient features of angiosperm families

Course Outcomes

On completion of this course, the students will be able to:

- Acquire basic skills on the plant taxonomy with special reference to Angiosperms
- Illustrate the types; merits and demerits of various system of classification
- Identify the angiosperms families with specific key characters; learn various advanced tools to study plant taxonomy

Course Code: 6SMBO104

Course Name: PLANT STRUCTURE AND DEVELOPMENT

Course Objective

To enable the students:

- To understand the development of SAM and RAM
- To understand the Mechanism of Seed Germination and growth
- To understand the principles of microscopy

Course Outcomes

On completion of this course, the students will be able to:

- Understand the various developments of SAM and RAM
- Describe the mechanism of seed germination and seed growth

- Understand the process of microscopy

Course Code: 6SMBO201

Course Name: PLANT PHYSIOLOGY, BIOCHEMISTRY AND METABOLISM

Course Objective

- Demonstrate an understanding of how water moves in plants at both molecular and organismal levels.
- Demonstrate an understanding of the biochemical processes of photosynthesis, glycolysis, citric acid cycle, and electron transport.
- Use simple laboratory skills in scientific measurements. 4. Write a scientific research paper.
- The field of plant physiology includes the study of all the internal activities of plants-those chemical and physical processes associated with life as they occur in plants.
- A program that focuses on the scientific study of the cell and molecular plant biology and physiology, water relations and transpiration and mineral nutrition, especially nitrogen metabolism.
- Fundamental processes such as photosynthesis, respiration and plant hormone functions. During this course you also will learn how plant growth and development and their tropisms, nastic movements, photoperiodism, photomorphogenesis, circadian rhythms under different environmental conditions.
- Identify the organs and tissue systems of plants, and explain their respective functions.
- Describe the principal cell types comprising each tissue system.
- Identify location and function of apical meristems, and describe their general structure.
- Distinguish secondary from primary tissues in woody stem and root growth
- Understand how to apply the basic concepts of Plant Physiology in other disciplines of agriculture.
- To understand, to know and discuss the concept of physiological processes of plants.
- Understand and describe the distribution of metabolic processes in the cell.
- Understand the importance of mineral nutrition, transpiration, photosynthesis and respiration of plant organisms.
- To understand and explain the processes of growth and development of plants.

Course Outcomes

- Understand how to apply the basic concepts of Plant Physiology in other disciplines of agriculture.
- To understand, to know and discuss the concept of physiological processes of plants.
- Understand and describe the distribution of metabolic processes in the cell.
- Understand the importance of mineral nutrition, transpiration, photosynthesis and respiration of plant organisms.

- To understand and explain the processes of growth and development of plants.

Course Code: 6SMBO202

Course Name: BIOLOGY AND DIVERSITY OF GYMNOSPERMS

Course Objective

- Be able to compare and contrast the characteristics of seed, non-seed, and nonvascular plants. To do this completes the table below.
- Be able to list the uses of some common gymnosperm plants, such as pines and ginkgoes.
- Be able to list some of the uses of flowering plants.
- It has been stated that the ancestor of flowering plants most likely was a gnetalean plant (or at least a plant closely related to them). What evidence supports this?
- How might the fact that a species is monoecious or dioecious affect your decision to use it as a crop plant? As a landscape plant?
- Discuss the type of seeds produced by gymnosperms, as well as other characteristics of gymnosperms
- State which period saw the first appearance of gymnosperms and explain when they were the dominant plant life
- List the four groups of modern-day gymnosperms and provide examples of each

Course Outcomes

- List the feature of an organism that is needed to qualify it as a plant.
- List examples of plants.
- Define the term alternation of generations.
- Diagram the life cycle of a moss and compare it to the life cycle of a fern.
- Know the differences among the plant groups.
- Describe the evolutionary relationships among plants.
- Explain how plants adapted to terrestrial habitats.
- Describe the advantage of vascular tissue to plants.
- Differentiate among roots, stems, and leaves.
- Distinguish between vascular and nonvascular tissue.
- Compare gymnosperms and angiosperms.
- Define and contrast homosporous and heterosporous
- Discuss the evolutionary advantage of heterosporous over homosporous
- Identify the parts of a seed and discuss why reproducing by seeds is an advantage compared to reproducing by spores
- Discuss the life cycle of a pine.

Course Code: 6SMBO203

Course Name: PLANT RESOURCE UTILIZATION AND CONSERVATION

Course Objective

To enable the students:

- To understand the threats of air, soil and water pollution
- To understand the economic importance of different plants
- To understand the various threats of biodiversity and the strategies for conservation

Course Outcomes

On completion of this course, the students will be able to:

- Understand the various uses of plants; biodiversity status, loss and management strategies.
- Describe economically important plants with binomial names, family and uses
- Analyse the biogeography, status and loss of biodiversity, initiatives for biodiversity conservation

Course Code: 6SMBO204

Course Name: CELL BIOLOGY AND GENETICS

Course Objective

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- Students will understand how these cellular components are used to generate and utilize energy in cells
- Students will understand the cellular components underlying mitotic cell division.
- Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.
- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels.
- Students will understand causal relationships between molecule/cell level phenomena (“modern” genetics) and organism-level patterns of heredity (“classical” genetics)
- Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situation.

Course Outcomes

After completing this course, the students will be able to:

- Understand how to apply the basic concepts of Plant Physiology in other disciplines of agriculture.
- To understand, to know and discuss the concept of physiological processes of plants.

- Understand and describe the distribution of metabolic processes in the cell.
- Understand the importance of mineral nutrition, transpiration, photosynthesis and respiration.
- To understand and explain the processes of growth and development of plants.

Course Code: 6SMBO301

Course Name: BIOTECHNOLOGY AND TISSUE CULTURE

Course Objective

- To develop understanding of industrial processes for production of antibiotics, enzymes etc.
- To develop understanding of techniques for tissue culture, cell culture and organ transplantation.
- Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what
- governs the choice of components,
- Explain the various steps taken to establish and optimise media for particular purposes in particular species, without the aid of texts
- Explain and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.
- Establish and maintain plants in tissue culture and micropropagation, including morphogenesis
- Investigate and define a protocol to establish an unknown species and test its response
- Explain the various cell lines used in tissue culture and their origins and uses

Course Outcomes

- Discuss the different applications of biotechnology
- Understand the importance of cells to genetic engineering.
- Know the natural function of restriction endonucleases and how a normal bacterial cell protects its DNA from their activity.
- Understand how insulin is produced using bacterial cells and importance to gene technology.
- Describe techniques used to characterize DNA and Axenic culture of cell

Course Code: 6SMBO302

Course Name: MOLECULAR BIOLOGY OF PLANTS

Course Objective

To enable the students:

- An in-depth study on Structure and organization of D.N.A., Replication Process, Transcription process,
- Translation process and Mutagenesis.
- To expose the students on the understanding of various techniques of gene mapping and sequencing for molecular studies.

Course Outcomes

On completion of this course, the students will be able to:

- Understand in-depth knowledge on Molecular Biology
- Understand in detailed mechanisms of DNA Replication
- Understand the overall concepts of Transcription, Translation
- Understand the process of Mapping and sequencing of genome

Course Code: 6SMBO303

Course Name: PLANT PATHOLOGY

Course Objective

- To introduce concepts and principles of plant pathology. Study of interaction between plant and pathogen in relation to the overall environment and mechanism of disease development by pathogens.

Course Outcomes

- Students will know about concept of diseases, knowledge and awareness of diseases, causal agents of plant diseases, identification methods and management of crop diseases.

Course Code: 6SMBO304

Course Name: PLANT REPRODUCTION

Course Objective

To enable the students:

- To understand the various aspects of plant floral parts, development and reproduction
- To understand the various aspects of embryology and apomixis

Course Outcomes

On completion of this course, the students will be able to:

- Discuss the structural elements of plants floral parts and reproduction
- Discuss the Pollination, embryology and apomixes

Course Code: 6SMBO305

Course Name: PLANT ECOLOGY

Course Objective

- To Distinguish between species, populations, communities, ecosystems biomes and Understand the factors that affect population size, density, distribution, and dynamics.

Course Outcomes

- By understanding the concepts of ecological principles and environmental issues, the student will be able to develop attitude, value system and ethics towards environment related issues.

Course Code: 6SMBO306

Course Name: PLANTS & SOCIETY

Course Objective

- Students will gain an appreciation for the plants in their world.
- Students will develop an understanding of how plants grow.
- Students will gain an understanding of how plants are used by people.
- Students will be able to identify and label the basic parts of a plant, including: root, stem, leaves, flower, and petals, by creating their own flower and explaining it to the teacher or their classmates.
- Introduce children to the concept that plants have various parts.
- Help students to understand the basic functions of each of these structures.
- Children will learn about plants and the elements (food, water, and sun) necessary for plant growth.

Course Outcomes

- Plants are like other organisms in regard to: basic metabolism, sexual reproduction, clonal reproduction, hormonally regulated development, ability to respond to the environment, diversity and evolution.
- Plants are unique organisms in: their varied life histories - especially a sporic one with alternation of generations; their role as primary producers in food webs, serving as the interface organisms between the organic and inorganic worlds viamineral assimilation and photosynthesis; and the oxygenation of the atmosphere.
- Plants serve as an important source of products: food, fiber, flavorings, feed, fuel, pharmaceuticals, etc.

Course Code: 6SMBO401

Course Name: TOOLS AND TECHNIQUES

Course Objective

- Utilize safety measures and equipment
- Use a bright field microscope to view and interpret slides
- Properly prepare slides for biological examination
- Properly use aseptic techniques for the transfer and handling of microorganisms and instruments
- Use appropriate biological media and test systems
- Use standard biology laboratory equipment correctly

Course Outcomes

- Students will be able to acquire, articulate, retain and apply specialized language and knowledge relevant to biology.
- Students will acquire and demonstrate competency in laboratory safety and in routine and specialized biological laboratory skills applicable to biological research or clinical methods, including accurately reporting observations and analysis.
- Students will communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.
- Students will demonstrate engagement in the biology discipline through involvement in research or internship activities, the biology Student Association club (MSA) and outreach or mentoring activities specific to biology.

Course Code: 6SMBO402

Course Name: EVOLUTIONARY AND ECONOMIC BOTANY

Course Objectives

- Describe the theory of natural selection.
- Explain how new species arise.
- Construct a phylogenetic tree.
- Explain the mechanisms which underlie evolution at the molecular level.
- to identify the following crops: Sorghum, Maize, Rice, and Wheat
- to know the origin, distribution, spread and taxonomy of the above listed crops
- to be able to describe morphological feature
- to know the economic importance of the listed crops.

Course Outcomes

- Acknowledge the economic uses of plants in modern society.

- Acquire an increased awareness and appreciation of plants & plant products encountered in everyday life.
- Develop scientific insights into the development of many plant products that have shaped our society.
- Appreciate the diversity of plants and the plant products in human use;
- Understand the biological reasons why certain plant resources are important;
- Explain the geographical, historical, and cultural contributions of economically important plants on the development of human culture.
- Understand the conditions & consequences of natural selection; & describe different modes

Course Code: 6SMBO403

Course Name: METHODS IN BIOLOGY APPLIED BIOLOGY INSTRUMENT, BIOSTATISTICS AND COMPUTER

Course Objectives

- Describe the roles biostatistics serves in the discipline of public health.
- Describe basic concepts of probability, random variation and commonly used statistical probability distributions.
- Describe preferred methodological alternatives to commonly used statistical methods when assumptions are not met.
- Distinguish among the different measurement scales and the implications for selection of statistical methods to be used based on these distinctions.
- Apply descriptive techniques commonly used to summarize public health data.
- Apply common statistical methods for inference.
- Apply descriptive and inferential methodologies according to the type of study design for answering a particular research question.
- Apply basic informatics techniques with vital statistics and public health records in the description of public health characteristics and in public health research and evaluation.
- Interpret results of statistical analyses found in public health studies.
- Develop written and oral presentations based on statistical analyses for both public health professionals and educated lay audiences.
- Capability to build statistical model over real health data.
- Estimate and compare efficiency of models.
- Use statistical software to analyze health –related data.
- Be able to explain the advantages of a Bayesian data analysis.
- Perform univariate data analysis for continuous and categorical variables.
- Interpret inferential findings within Bayesian thinking (e.g. credible intervals, hypothesis testing). Conduct inference via posterior simulation and simulations tool.

Course Outcomes

- Draw conclusions or make predictions based on data summaries or statistical analyses.
- Design research studies in collaboration with physicians, life scientists, or other professionals.
- Analyze clinical or survey data using statistical approaches such as longitudinal analysis, mixed effect
- logistic regression analyses, and model building techniques.
- Provide Biostatistician consultation to clients or colleague

Course Code: 6SMBO404

Course Name: ETHNO BOTANY

Course Objective

To enable the students:

- To proper documentation and presentation of traditional knowledge about plants.
- To use important plants by the tribal communities for various purposes.
- Conservation natural growing plants and socioeconomic impacts.
- Ethno botany solve human problem of nutrition health care and life support system.

Course Outcomes

On completion of this course, the students will be able to:

- To express the historical development of ethno botany. Recognize and identify important plant species.
- Explain ethno botanically uses of plants. Detail their native habitats and cultivated lands.

Course Code: 6PRSC401

Course Name: Project Work

Course Objective

- To prepare the students with basic knowledge in the research, botanical techniques in order to continue their career in higher degree.

Course Outcome

- The student will identify a problem on which he/she would be able to work, identify the scope of research on the chosen topic and will frame the objectives to be addressed in the project.

Master of Science (Zoology)

Programme Code: 04PGR006

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- The objective of the Master's programme in Zoology is to equip the students to apply the knowledge of Taxonomy and receptor mechanisms of lower to higher Invertebrates and Vertebrates.
- The laboratory training and behavioral analysis of animal in Zoological Garden, Santury Biosphere reserve and natural environment included to prepare the students for their careers in the wildlife area.
- The student have a knowledge of different culture Skill viz Pearl Culture, Lac –Culture, Sericulture and Poultry keeping. Protozoa, rats, mites, insect diseases and control to develop own Business, marketing and self employment.
- The goal is to impart student the knowledge and skills which are contemporary and useful to them as well as for society. The student will write the standard operating protocols (SOPs) and identify requirement for experimental animal, ethics and welfare.

PROGRAM OUTCOMES (PO's)

- **[PO.1.] Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions
- **[PO.2.] Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3.] Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4.] Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5.] Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **[PO.6.] Environment and sustainability:** Understand the issues of environmental contents and sustainable development.
- **[PO.7.] Self-directed and life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in zoological practices and education program.
- **[PO.8.] Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of zoology, Instrumentation & Technology.
- **[PO.9.] Technical Skills:** Develop an ability to use various instruments and equipment with an in depth knowledge on standard operating procedures for the same.

- **[PO.10.] Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of zoology & zoological Sciences.
- **[PO.11.] Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of zoology.
- **[PO.12.] The Society:** Apply regional zoological reasoning informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- **[PO.13.] Problem analysis**
- **[PO.14.] Conduct investigations of complex problems**
- **[PO.15.] Design/Development of Solutions**
- **[PO.16.] Individual and Teamwork**

PROGRAM SPECIFIC OUTCOMES (PSO's)

- **PSO1-** Animal and byproduct Industry applications of better understanding of the key principles of export and packaging at an advanced level.
- **PSO2-**To get better awareness of the culture of animal product at the forefront of the discipline of Zoology.
- **PSO3-**Possess an in-depth understanding of the area of Zoology & Zoogeographical distribution of animal chosen for research emphasis
- **PSO4-**Ability to design and carry out experiments (safely) and to interpret experimental data
- **PSO5-**Production of substantial original research of significance and quality sufficient for publication of ability to present their work through written, oral, and visual presentations, including an original research proposal awareness of ethical issues in Zoology, Animal Behavior & Toxicological research and careers options.

Course Code: 6SMZO101

Course Name: Biosystematics, Taxonomy and Evolution

Course Objective

- This paper is aimed to introducing the students for the salient features of Taxonomy and Evolution.

Course Outcomes

- Classify animals on the basis of their relation to other animals by body structure, external characters, development and DNA.
- Apply the International rules of Nomenclature to give a scientific name to animals which are found during research.
- Understand the gradual development and evolutionary history of different kinds of living

organisms from earlier forms over several generations.

- Understand and demonstrate the internal anatomy of various animals, biodiversity and related indices.

Course Code: 6SMZO102

Course Name: Structure & Function of Invertebrates

Course Objective

- This paper is aimed to introducing the students for structure & function of Invertebrate.

Course Outcomes

- Understand the structure and organization of invertebrate animals.
- Explain modifications in various functions of animals during transition from invertebrates to vertebrates.
- Discuss the evolutionary significance of larval forms of invertebrates.
- Identify invertebrates and homology, analogy and modifications of mouthparts in relation to feeding habits.

Course Code: 6SMZO103

Course Name: Quantitative Biology, Biodiversity and Wildlife

Course Objective

- This paper is aimed to Quantitative Biology, Biodiversity and Wildlife.

Course Outcomes:

- To understand quantitative approaches and technologies involved in research.
- To identify diversity of fauna on earth and implement conservation measures to save diversity
- To understand importance of wildlife and conservation measures, National parks and Sanctuaries.
- Analyse biological data mathematically and statistically

Course Code: 6SMZO104

Course Name: Biomolecular and Structural Biology

Course Objective

- This paper is aimed to introduce molecular biology viz Amino acid, DNA, RNA and Enzyme.

Course Outcomes

- To explain Biomaterial, Nanoparticles and their importance.
- To understand biological reactions, structure of protein, carbohydrates fats, nucleic acids and their metabolism.
- To develop a knowledge of enzymes and mechanism of their action in various biological reactions.
- To understand the process of gene expression & protein synthesis.

Course Code: 6SMZO201

Course Name: General and Comparative Animal Physiology and Endocrinology

Course Objective

This paper is aimed to introducing the students for comparative Animal Physiology & Endocrinology

Course Outcomes

- Understand all physiological processes of vertebrates & analyse them biochemically
- Correlate the comparative physiology of the systems and understand their regulation & control
- Compare the structure, functions and regulation of the receptor organs of vertebrates
- Understand the structure, function and regulation of endocrine & neuroendocrine glands.

Course Code: 6SMZO202

Course Name: Population Ecology and Environmental Physiology

Course Objective

- This paper is aimed to introducing the students for Population Ecology & Environmental Physiology

Course Outcomes

- Understand population and its characters and regulation.
- Correlate physiological adaptations to environment and pollution, control measures for environmental degradation, as well as risk factors to human health.
- Understand limiting factors, predator-prey relationships and physiological responses of the body to environment.
- Demonstrate the methods of relaxation of Stress and body by Yoga, Meditation, Asana & Pranayam

Course Code: 6SMZO203

Course Name: Tools and Techniques In Biology

Course Objective

- This paper is aimed to Tools & techniques in Biology.

Course Outcomes

- Explain Microscopy, Colorimetry, Chromatography principle, process, applications and working of related instruments.
- Demonstrate Microbiological, Cytological, Histological, Molecular biological techniques.
- Apply and demonstrate Immunological Surgical Immunodetection and Cell culture techniques.
- Understand Cryopreservation, Radioisotope and Isotope techniques and applications of all the techniques in biology.

Course Code: 6SMZO204

Course Name: Molecular Cell Biology and Genetics

Course Objective

- This paper is aimed to introduce molecular cell Biology viz Amino acid, DNA, RNA, protein and Enzyme

Course Outcomes

- Explain Biomembranes and the processes of Cell-cell signalling and cell-cell adhesion.
- Understand the process of Sex determination and details of Human chromosomes & Human chromosome project.
- Understand gene libraries, Transgenic and Knockout animals.
- Understand various genetic processes and their applications to biological systems

Course Code: 6SMZO 301

Course Name: Comparative Anatomy of Vertebrates

Course Objective

- This paper is aimed to introducing the students for the salient features of Comparative anatomy of all Vertebrates.

Course Outcomes

- Knowledge of Origin, Evolution and general organisation of Chordates.
- Knowledge of Evolution of heart, lungs and urino-genital organs of vertebrates
- Knowledge of comparative anatomy of all systems of vertebrates.

- Knowledge of flight and aquatic adaptations in birds and mammals.

Course Code: 6SMZO 302

Course Name: Limnology

Course Objective

- This paper is aimed to introducing the students for morphometric analysis and Zonation

Course Outcomes

- Knowledge of morphometry, physico-chemical and biological characteristics of fresh water bodies.
- An understanding of the significance of aquatic flora, fauna, insects, birds and macrophytes in water bodies.
- Knowledge of pollution of rivers, causes and control measures.
- Knowledge of legislation and regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.

Course Code: 6SMZO303

Course Name: Ecotoxicology

Course Objective

- This paper is aimed to awareness of Toxicant, heavy metal toxicity and environmental pollution and ecological impact assessment

Course Outcomes

- To develop an understanding of environmental biology, productivity and pollution.
- To develop knowledge of Toxicity of foods, pesticides and agrochemicals among youngsters.
- To know public health hazards due to natural disasters and occupation.
- To know the process of recycling and reuse technologies of solid and liquid waste.

Course Code: 6SMZO304

Course Name: Animal Behavior and Neurophysiology

Course Objective

From this paper introduced about the animal behavior and its neurophysiology.

Course Outcomes

- Understand neurophysiology of perception memory, domestic animal and human behaviour.

- Analyse processes at different levels and neurophysiology of sensory processing of animal behaviour.
- Classify behavioral patterns, communication, learning and memory.

Course Code: 6SMZO305

Course Name: Animal Experimentation Ethics & Testing

Course Objective

- M.Sc. student are exposed to a variety of advanced methods and principles which they could employ in research.

Course Outcomes

- The goal is to impart Student the knowledge and skills which are contemporary and useful to them. The student will write the standard operating protocols (SOPs) and identify requirement for equipment and reagents.

Course Code: 6SMZO306

Course Name: Aquaculture

Course Objective

- This paper is aimed to introduce Prawn, Fish, Frog, Pearl Culture, Apiculture, Lac –Culture and Sericulture.

Course Outcomes

- Develop a knowledge of farming of aquatic organisms for increasing food production and animals beneficial to human.
- Observe culture techniques, farm management and hatchery operations.
- Analyse harvesting and marketing strategies.
- Understand the technique of fish preservation and Water quality monitoring techniques.

Course Code: 6SMZO307

Course Name: Gamete Biology Development and Differentiation in Vertebrates

Course Objective

- In this paper the student introduced about the morphology of sperm and ovum or its chemic composition etc

Course Outcomes

- Understand reproductive physiology and development in mammals
- Develop a deep knowledge of the role of endocrine secretion in regulation of reproductive

cycle

- Understand the process of differentiation of eggs and sperms before fertilization.
- Develop a knowledge of cryopreservation technique and stem cell disorders

Course Code: 6SMZO308

Course Name: Ipr and Glp

Course Objective

- M.Sc. student are exposed to a variety of advanced methods and principles which they could employ in research.

Course Outcomes

- The goal is to impart student the knowledge and skills which are contemporary and useful to them. The student will write the standard operating protocols (SOPs) and identify requirement

Course Code: 6SMZO401

Course Name: Fish Structure and Function

Course Objective

- This paper are introduced about origin and evolution of fish, Fish structure And Function

Course Outcomes

- Know the functional anatomy of all organ systems of fish
- Understand migration and adaptations in fishes.
- Observe the phenomenon of Parental care in various fishes and importance of electric organs in fishes.
- Understand the significance of Colouration, luminous and poisonous organs of fish.

Course Code: 6SMZO402

Course Name: Wild Life Conservation

Course Objective

- From this paper are study about the values of wild life, its habitat & management also.

Course Outcomes

- Student able to wild life -Values of wild life, positive and negative. Our conservation ethics, Importance of conservation. Causes of depletion.
- Habitat analysis, Evaluation and management of wild life.
- Physical parameters, biological , parameters and standard evaluation procedures.

- National parks & sanctuaries
- Wild life Legislation - its amendments and implementation.
- To the study of management planning of wild life in protected areas.

Course Code: 6SMZO403

Course Name: Entomology

Course Objective

- To introduce the morphology of typical insect
- To study the general anatomy and physiology of insects.

Course Outcomes

- Student will be able to various types of Mouth parts, special Organs & Metamorphosis off insects physiological aspects and modern concept of pest management

Course Code: 6SMZO404

Course Name: Pisci Culture and Economic Importance of Fishes (Ichthyology)

Course Objective

- This is the elective paper this paper introduced about the economic importance of fish.

Course Outcomes

- Differentiate between natural and induced breeding in fish. Manage hatcheries and fish farm in future.
- Develop technical knowledge of fish preservation and Shark liver oil industry.
- Identify fish by morph metric and meristic characters and apply the method in biodiversity oriented research.
- Explain and apply genetic engineering in fishery technology.

Course Code: 6SMZO405

Course Name: Environment & Biodiversity Conservation

Course Objective

- From this paper the students were study about the scope of environmental biology and biodiversity.

Course Outcomes

- To the study of wild life -Values of wild life, positive and negative. Our conservation ethics , Importance of conservation. Causes of depletion.
- Habitat analysis, Evaluation and management of wild life.

- Physical parameters ,biological , parameters and standard evaluation procedures.
- To the study of protected areas National parks & sanctuaries, community reserve, Important features of protected areas in India, Tiger conservation , Tiger reserve in M.P, in India, management challenges in Tiger reserve.
- Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.
- To the study of management planning of wild life in protected areas.

Course Code: 6SMZO406

Course Name: Applied Entomology

Course Objective

- To introduce classification of insects up to order level.
- To enable learners to categorize insects on the basis of morphological characteristics.
- To study the modern methods of apiculture, sericulture, lac culture to familiarize the learners to the economic aspects of apiculture.
- To study the versatile roles of insects in agriculture.

Course Outcomes

- Student will be able to classify insect up to their respective orders. Understand the difference in the life cycles of insects.: & various ecological importance of insects.

Course Code: 6PRSC401

Course Name: Project Work

Course Objective

- To prepare the students with basic knowledge in the research, botanical techniques in order to continue their career in higher degree.

Course Outcomes

- The student will identify a problem on which he/she would be able to work, identify the scope of research on the chosen topic and will frame the objectives to be addressed in the project through research.

Doctor of Philosophy (Microbiology)

Programme Code: Ph.D001

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- The objective of the Ph.D. Programme in Microbiology is to equip the students to apply the knowledge of Microbes and their uses in different field.
- The laboratory training and Pathogenicity analysis of microbes in Microbiology. prepare the students for their careers in the Medical and industrial area.
- The student have a knowledge of different culture Skill viz Blood culture, Urin –Culture , Pus culture . Identification of microbes and their causing diseases and control to develop own Business, marketing and self employment.
- The goal is to impart student the knowledge and skills which are contemporary and useful to them as well as for society. The student will write the standard operating protocols (SOPs) and identify requirement for experimental Microbes, ethics and welfare.
- Large scale production of microbes through fermentation process and uses of their secondary metabolites (Byproducts) in different field.

PROGRAM OUTCOMES (PO's)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development in terms of biotechnology.
- **Self-directed and long-life learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in Microbiological practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Microbiology, Instrumentation & Technology.
- **Technical Skills:** Develop an ability to use various instruments and equipment with an indepth knowledge on standard operating procedures for the same.

- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Biotechnology & biotechnological Sciences.
- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modeling to complex issues of Microbiology.
- **The Society:** Apply regional biotechnological reasoning informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOMES (PSO's)

- **PSO1-**Industry applications of better understanding of the key principles of biochemical functioning at an advanced level
- **PSO2-**To get better awareness of the major issues at the forefront of the discipline of Biotechnology.
- **PSO3-**Possess an in-depth understanding of the area of Biotechnology & biochemistry chosen for research emphasis
- **PSO4-**ability to design and carry out experiments (safely) and to interpret experimental data
- **PSO5-**production of substantial original research of significance and quality sufficient for publication of ability to present their work through written, oral, and visual presentations, including an original research proposal awareness of ethical issues in biochemical & Biotechnological research and careers options.

Course Code: 5010112801

Course Name: Research Methodology

Course Objective

- The objective of imparting quality and creative research with an in-depth understanding and integrated knowledge of advanced applicable theory in the field of Microbiology.

Course Outcome

- To enable for analyzing and identifying problems and provide the appropriate solution to solve the specific problem. It also provides the educated candidates for employment which require in the academic and non academic field.

Course Code: 5010113302

Course Name: Research and Publication Ethics

Course Objective

- The objective of the course is to enable M. Phil/Ph.D scholar to understand about the publication ethics and publication misconduct and to create the awareness.

Course Outcome

- After learning this Course scholar will be able to understand the concepts and process of research and aware about the publication ethics and publication misconduct.

Course Code: 5040153301

Course Name: MICROBIOLOGY

Course Objective

- Scholars are exposed to different basic techniques and methods of Microbiology which are important for advance research.

Course Outcome

- The goal is to impart scholar the knowledge and skills which are contemporary and useful to them. Scholars will understand what are the basic knowledge for their research work and what type of technologies they should apply.

Course Code:5040153302

Course Name: Food Parasitology

Course Objective

- the purpose of this first laboratory is to introduce you to some of the techniques that a veterinarian uses to detect the eggs, cysts, and larvae of parasites in the feces of animals.

Course Outcome

- Students will be able to apply working knowledge of fundamental facts, concepts and theories about marine parasitology and disease

Course Code: 5040153303

Course Name: Role of Microbiology in the Pharmaceutical

Course Objective

- In this course, generally pharmaceutical microbiology provides knowledge of the presence of bacteria, yeasts, moulds, viruses and toxins in pharmaceutical raw material.

Course Outcome

- This course is to help student will be able to develop expertise in identification, cultivation and counting of microorganisms, preparation and sterilization of bacterial culture, various staining techniques, aseptic processing etc.

Course Code: 5040153304

Course Name: Microbial communities and Interactions

Course Objective

- The study of the composition and physiology of microbial communities in the environment.

Course Outcome

- This course is to help student will be able to develop expertise in identification, cultivation and counting of microorganisms, preparation and sterilization of bacterial culture, various staining techniques, aseptic processing etc.

Course Code: 5040153305

Course Name: Clinical Microbiology

Course Objective

- Develops basic skills necessary to work in the microbiology laboratory.

Course Outcome

- The student will be able to identify common infectious agents and the diseases that they cause.

Doctor of Philosophy (Biotechnology)

Programme Code: Ph.D001

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- The objective of the Ph.D. Programme in Biotechnology is to equip the students to apply the knowledge of Industrial and Technical awareness. The laboratory training and Research analysis of Macro and Micromolecules, Industrial training and Hands on work included to prepare the students for their careers to become entrepreneur.
- The student have a knowledge of different culture Skill viz Tissue Culture, Blood –Culture, Cell culture. Production of genetically modified new species for research and development.
- The goal is to impart student the knowledge and skills which are contemporary and useful to them as well as for society. The student will write the standard operating protocols (SOPs) and identify requirement for experimental organ, ethics and welfare.

PROGRAMME OUTCOME (PO's)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- **Environment and sustainability:** Understand the issues of environmental contents and sustainable development.
- **Self-directed and long-life learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in microbiological practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Microbiology, Instrumentation & Technology.
- **Technical Skills:** Develop an ability to use various instruments and equipment with an indepth knowledge on standard operating procedures for the same.
- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Microbiology &

microbiological Sciences.

- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of microbiology.
- **The Society:** Apply regional microbiological reasoning informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOMES (PSO's)

- **PSO1-** Significance towards Molecular level: The Physiology, Biochemistry, and Genetics of microorganisms, including such topics as structure, function, diversity, metabolism, and the genetics of metabolic regulation can approach to molecular microbial level.
- **PSO2-** Significance towards Microbial Pathogenesis: the immune response and disease-causing microorganisms, including aspects of the humoral, cell-mediated and non-specific immune responses, as well as the molecular basis for pathogenesis
- **PSO3-** Significance towards Environment: the taxonomic, ecological, and genetic relationships among microorganisms, including such topics as nutrient cycling, microbial diversity, and the biotechnological application of microorganisms can solve environmental problems.
- **PSO4-** Significance towards Industry: This topic helps to learn manipulating organisms in order to yield a specific product such as antibiotics, vitamins, enzymes, amino acids, solvents, alcohol and daily products. They can also be used in an agricultural application and use them as a bio-pesticide instead of using harmful chemicals or as inoculants and help plant proliferation.
- **PSO5-** Relation of Biotechnology to other aspects of Science: The curriculum also includes several interdisciplinary topics such as biochemistry, biophysics, bioinformatics, biohydrometallurgy, bioremediation, biodegradation Biostatistics etc. to ensure a wide range of options that allow students to choose modules from various departments that are best suited to their personal interests and career ambitions.
- **PSO6-** Instruments/Techniques usage: The use of various instruments/ techniques and their optimal usage can elucidate students to gain formal knowledge about the practicals as well as creates an opportunity to explore the further extent.
- **PSO7-** Scientific Method: hypothesis generation and testing, including the development of theoretical and practical skills in the design and execution of experiments
- **PSO8-** Scientific Communication: the development and execution of oral and writing skills necessary for effective communication of experimental results, the ability to think critically regarding a discipline topic, and the conveyance of scientific principles to audiences of

both scientists and non-scientists.

- **PSO9-** The study of Biotechnology will impart in-depth understanding of basic aspects of microbiological science pertaining to industrial applications. The courses of Industrial Microbiology & Fermentation Technology, Genetic Engineering, Microbial Genetics, Bio-analytical Techniques, Molecular Microbial Physiology, Agriculture & Environmental Microbiology, Animal Biotechnology, and Vaccinology will make the students ready to contribute to Molecular, Biochemical, Industrial, medical and other basic and applied applications of better understanding of the key principles of microbial functioning at an advanced level better awareness of the major issues at the forefront of the discipline will possess an in-depth understanding of the area of Microbiology chosen for research emphasis ability to design and carry out experiments (safely) and to interpret experimental data production of substantial original research of significance and quality sufficient for publication ability to present their work through written, oral, and visual presentations, including an original research proposal awareness of ethical issues in Microbiology research and careers options

Course Code: 5010112801

Course Name: Research Methodology

Course Objective

- Objective of the course to enable Ph.D scholar to understand the methods of research & different computer application in research and apply the knowledge and skills in conducting research work.

Course Outcome

- After learning this scholar will be able to understand the concept and process of research and will able to carry out their research work effectively considering the ethics of research for usefulness of society.

Course Code: 5010113302

Course Name: Research and Publication Ethics

Course Objective

- The objective of the course is to enable M. Phil/Ph.D scholar to understand about the publication ethics and publication misconduct and to create the awareness.

Course Outcome

- After learning this Course scholar will be able to understand the concepts and process of research and aware about the publication ethics and publication misconduct.

Course Code: 5030153301

Course Name: BIOTECHNOLOGY

Course Objective

- Ph.D. Scholar are exposed to a variety of advanced methods and principles which they could employ in research.

Course Outcome

- The goal is to impart scholar the knowledge and skills which are contemporary and useful to them. Scholars will understand what are the basic knowledge for their research work and what type of technologies they should apply.

Course Code: 5030153302

Course Name: INDUSTRIAL BIOTECHNOLOGY

Course Objective

- This course helps the students to provide biologically trained students with appropriate academic studies and industrial experience to enable them to contribute to the field of biotechnology.
- To update students knowledge of new developments in biology of industrial relevance.
- To give students a broad understanding and experience, of technological processes involved in biotechnological industries.

Course Outcome

At the end of the course students will be able to acquire knowledge on

- The facts, concepts, principles and theories relevant to the broad area of Biotechnology.
- The professional and ethical responsibilities of the Biotechnologist.
- Current themes and/or insights, at/or informed by, the forefront of the Biotechnology Industry and its related disciplines.

Course Code: 5030153303

Course Name: PLANT BIOTECHNOLOGY

Course Objective

- The purpose of the course is to provide training in the science behind plant biotechnology, an appreciation of the current scope and limits to its industrial application, and the implications of modern methods of genetic modification for plant industries.

Course Outcome

At the end of the course the students will acquire:

- An understanding of the theoretical background knowledge in molecular, biochemical and plant sciences needed for an understanding of plant biotechnology.
- A working knowledge of laboratory techniques used in plant biotechnology.
- An appreciation of the issues associated with growing and using transgenic plants as food crops.

Course Code: 5030153304

Course Name: ANIMAL BIOTECHNOLOGY

Course Objective

- The course aims to provide the students with the theoretical basis of the main mechanism of cell, tissues, organs and apparatus functionality and the current methods of animal cell culture and its application in research.

Course Outcome

At the end of the course students will be able to

- Apply biotechnological methods for basic research;
- Apply bimolecular methods to veterinary pharmacology, to the design, correct use and traceability of medicines;
- Apply reproduction methods with particular reference to gamete and embryo manipulation techniques, production of transgenic animals and cloning;

Course Code: 5030153305

Course Name: FOOD BIOTECHNOLOGY

Course Objective

- To convey better knowledge among the students about modern day food biotechnology, its associated techniques like packaging etc and Food safety and Quality control.
- To ensure better quality of education by continuous monitoring and review of performance and counseling students.

Course Outcome

- Food biotechnology has a great scope at present and in future. As there is increasing popularity and explosive growth, there are plenty of opportunities available in Food Biotechnology field. Students get training and skill development in the field of food biotechnology such as: Biotech foods and supplements as GM foods, food from fungi, algae and bacteria and their large scale production.

Doctor of Philosophy (Botany)

Programme Code: Ph.D001

PROGRAM EDUCATIONAL OBJECTIVE

The program of Ph.D. Botany is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. The program focuses on the all-round development of the students to face the competitive world. The objectives of the program are as follows:

- To understand the scope and significance of the discipline.
- To imbibe love and curiosity towards nature through the living plants.
- To make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
- To make the students exposed to the diverse life forms.
- To make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
- To encourage the students to do research in related disciplines.
- To develop the ability of the students to transform the society through their education.

PROGRAM OUTCOMES (PO's)

- **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings towards Flora.
- **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues related to plants (Flora) and participate in civic life through volunteering.
- **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.

Environment and sustainability: Understand the issues of environmental contents and sustainable development.

- **Self-directed and life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in Botanical practices and education program.
- **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of Botany, Instrumentation & Technology.

- **Technical Skills:** Develop an ability to use various instruments and equipment with an in depth knowledge on standard operating procedures for the same.
- **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Botany & Botanical Sciences.
- **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modeling to complex issues of Botany.
- **The Society:** Apply regional Botanical reasoning for Plants informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- Problem analysis
- Conduct investigations of complex problems
- Design/Development of Solutions
- Individual and Teamwork

PROGRAM SPECIFIC OUTCOME

- **PSO1:** Identification and taxonomy of plants through different taxonomic description of plants.
- **PSO2:** To get a better understanding of different families of plants in the angiosperms and gymnosperms.
- **PSO3:** To get the techniques involved in plant tissue culture and plant breeding.
- **PSO4:** To perform a detailed study about the different types of microbes viz. bacteria, Cyanobacteria, algae and fungi.

Course Code: 5010112801

Course Name: Research Methodology

Course Objectives

- Objective of the course to enable Ph.D scholar to understand the methods of research and different computer application in research and apply the knowledge and skills in conducting research work.

Course Outcomes

- After learning this scholar will be able to understand the concept and process of research and will able to carry out their research work effectively considering the ethics of research for usefulness of society.

Course Code: 5010113302

Course Name: Research and Publication Ethics

Course Objective

- The objective of the course is to enable M. Phil/Ph.D scholar to understand about the publication ethics and publication misconduct and to create the awareness.

Course Outcome

- After learning this Course scholar will be able to understand the concepts and process of research and aware about the publication ethics and publication misconduct.

Course Code: 5010153301

Course Name: Current and Future Prospect in Plant Science

Course Objectives

To enable the students:

- To understand the various aspects of Mycology
- To understand the conservation methods of Biodiversity
- To understand the salient features of Ecology
- To understand the Basic aspect of Plant Tissue Culture

Course Outcomes

On completion of this course, the students will be able to:

- Acquire basic skills on the various aspects of Mycology
- Understand the various aspects of Biodiversity
- Have a brief idea of Ecology
- Acquire the knowledge about different methods adopted in Plant tissue culture

Course Code: 5010153302

Course: Plant Taxonomy

Course Objectives

To enable the students:

- To understand the various aspects of plant nomenclature and classification
- To understand the classical and modern trends of Angiosperm taxonomy
- To understand the salient features of angiosperm families

Course Outcomes

On completion of this course, the students will be able to:

- Acquire basic skills on the plant taxonomy with special reference to Angiosperms

- Illustrate the types; merits and demerits of various system of classification
- Identify the angiosperms families with specific key characters; learn various advanced tools to study plant taxonomy.

Course Code: 5010153303

Course: Phytoecology

Course Objective

- To Distinguish between species, populations, communities, ecosystems biomes and Understand the factors that affect population size, density, distribution, and dynamics.

Course Outcomes

- By understanding the concepts of ecological principles and environmental issues, the student will be able to develop attitude, value system and ethics towards environment related issues.

Course Code: 5010153304

Course: -Plant Tissue Culture

Course Objectives

To enable the students:

- To understand the basic principles and methodologies of plant tissue culture
- To learn various methods of Tissue Culture and secondary metabolites production.

Course Outcomes

On completion of this course, the students will be able to:

- Understand various media, sterilization, organogenesis
- Able to apply the techniques to develop a standard protocol for Plant Tissue Culture

Course Code: 5010153305

Course: Biodiversity Conservation

Course Objectives

To enable the students:

- To understand the threats of air, soil and water pollution
- To understand the economic importance of different plants
- To understand the various threats of biodiversity and the strategies for conservation

Course Outcomes

On completion of this course, the students will be able to:

- Understand the various uses of plants; biodiversity status, loss and management strategies.
- Describe economically important plants with binomial names, family and uses
- Analyse the biogeography, status and loss of biodiversity, initiatives for biodiversity conservation

Doctor of Philosophy (Zoology)

Programme Code: Ph.D001

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- The objective of the Doctorate programme in Zoology is to equip the students to apply the knowledge of Taxonomy and receptor mechanisms of lower to higher Invertebrates and Vertebrates.
- The laboratory training and behavioral analysis of animal in Zoological Garden, Sanctuary Biosphere reserve and natural environment included to prepare the students for their careers in the wild life area.
- The student have a knowledge of different culture Skill viz. Pearl Culture, Lac –Culture, Sericulture and Poultry keeping. Protozoa, rats, mites, insect diseases and control to develop own Business, marketing and self employment.
- The goal is to impart student the knowledge and skills which are contemporary and useful to them as well as for society. The student will write the standard operating protocols (SOPs) and identify requirement for experimental animal, ethics and welfare.

PROGRAM OUTCOMES (PO's)

- **[PO.1.]** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking & actions
- **[PO.2.]** Effective communication: Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3.]** Social interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4.]** Effective citizenship: Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5.]** Ethics: recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them
- **[PO.6.]** Environment and sustainability: Understand the issues of environmental contents and sustainable development.
- **[PO.7.]** Self-directed and life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in zoological practices and education program.
- **[PO.8.]** Knowledge: Provide basic knowledge for understanding the principles and their applications in the area of zoology, Instrumentation & Technology.
- **[PO.9.]** Technical Skills: Develop an ability to use various instruments and equipment with an in depth knowledge on standard operating procedures for the same.

- **[PO.10.] Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of zoology & zoological Sciences.
- **[PO.11.] Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of Zoology.
- **[PO.12.] The Society:** Apply regional zoological reasoning informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.
- **[PO.13.] Problem analysis**
- **[PO.14.] Conduct investigations of complex problems**
- **[PO.15.] Design/Development of Solutions**
- **[PO.16.] Individual and Teamwork**

PROGRAM SPECIFIC OUTCOMES (PSO's)

- **PSO1-** Animal and byproduct Industry applications of better understanding of the key principles of export and packaging at an advanced level.
- **PSO2-**To get better awareness of the culture of animal product at the forefront of the discipline of Zoology.
- **PSO3-**Possess an in-depth understanding of the area of Zoology & Zoogeographical distribution of animal chosen for research emphasis
- **PSO4-**Ability to design and carry out experiments (safely) and to interpret experimental data
- **PSO5-**Production of substantial original research of significance and quality sufficient for publication of ability to present their work through written, oral, and visual presentations, including an original research proposal awareness of ethical issues in Zoology, Animal Behavior & Toxicological research and careers options.

Course Code: 5010112801

Course Name: Research Methodology

Course Objectives

- Objective of the course to enable Ph.D scholar to understand the methods of research & different computer application in research and apply the knowledge and skills in conducting research work.

Course Outcome

- After learning this scholar will be able to understand the concept and process of research and will be able to carry out their research work effectively considering the ethics of research for usefulness of society.

Course Code: 5010113302

Course Name: Research and Publication Ethics

Course Objectives

- The objective of the course is to enable M. Phil/Ph.D scholar to understand about the publication ethics and publication misconduct and to create the awareness.

Course Outcome

- After learning this Course scholar will be able to understand the concepts and process of research and aware about the publication ethics and publication misconduct.

Course Code: 5020153301

Course Name: ADVANCES IN ZOOLOGY

Course Objectives

- Ph.D. scholar are exposed to a variety of advanced methods and principles which they could employ in research.

Course Outcome

- The goal is to impart scholar the knowledge and skills which are contemporary and useful to them. The scholar will write the standard operating protocols (SOPs) and identify requirement for equipment and reagents.

Course Code: 5020153302

Course Name: Toxicology

Course Objectives

- Ph.D. scholar are exposed to principles, fundamental's of Toxicology and Toxicity Testing methods which they could employ in research.

Course Outcome

- The students will learn handling of synthetic, natural or compound drugs, Chemicals, heavy metal toxicity information the pesticides in crop protection and understand the therapy and antidotes at the time of poisoning.

Course Code: 5020153303

Course Name: Immunology

Course Objectives

- Describes surface membrane barriers and their protective functions.

Course Outcome

- Physicians often observe immune system improvements in health on a clinical level.

Course Code: 5020153304**Course Name: Insect- Biology****Course Objectives**

- This paper aim to emphasizes on understanding the morphological fundamentals of insects and also their biology.

Course Outcome

- The scholar would also learn the latest ideas of comparing these insects in an evolutionary perspective as well as identify and use various insects as biocontrol agents.

Course Code: 5020153305**Course Name: Photobiology****Course Objectives**

- Ph.D. scholar are exposed to principles, fundamentals of light and action on behavior of organism.

Course Outcome

- The students will learn effect of light on organism behavior and hazards, risks and their control methods.