

# Bachelor of Science

## Programme Outcome

The under-graduate programme is aimed at making student capable of comprehending the post-graduate syllabus and be able to analyse simple as well as complex situations involving application of scientific concepts in real life situations. B.Sc. graduates would apply their expansive knowledge of science over a scope of fields, with inside and out learning in at least one field of discipline of their studies, while exhibiting a comprehension of the nearby and worldwide settings in which science is rehearsed.

A science graduate is expected to articulate the methods of science and explain why current scientific knowledge is both contestable and testable by further inquiry. Develop the skill and ability to apply and understand the principles of various disciplines objectively, creatively and through independent thinking. Apply appropriate methods of research, investigation and design, to solve problems in science.

A science graduate would be competent and independent enough for further studies within the field, can work in an autonomous and sorted out way, set objectives for specified work, devise a work routine and tail it.

## Physics

### Program Specific Outcome (PSO)

1. Develop scientific attitude and temperament and give emphasis on the development of experimental skills, data analysis, calculation, measurements and also on the limitations and precautions about the experimental method data and results obtained.
2. To apply graduate-level knowledge and solve problems in the areas of electrodynamics, quantum mechanics, classical mechanics, statistical mechanics, mathematical physics and Nanoscience and nanotechnology, Electricity and magnetism, Atomic physics, Nuclear – Physics
3. Understand theories of physics and its relevance in present day Technology.
4. Study the strength of equation, format graphs, and mathematical tools to solve the problems.
5. Make models and circuits through the study of digital electronics.

### Course outcomes (CO)

On the completion of the course the students are able to:

1. Explain the concept of Gravitation, Astrophysics, planetary motion, rotational motion of rigid body and moment of inertia and concept of linear, angular momentum and Newton's laws of Motion (Mechanics)
2. Understand the concept of properties of matter viz. Elasticity, viscosity, surface tension, thermodynamics and Kinetic theory.
3. Interpret and illustrate concepts of sound waves, acoustics and ultrasonic and oscillations (Free, damped and forced oscillation).
4. Honed the skilled to understand Electrostatic properties, Magnetostatics, magnetism, Electromagnetic nature.
5. Develop the understanding of the optical phenomenon such as interference, diffraction, polarization, reflection, refraction, transmission etc.
6. Acclimatize with the concept of solid state Physics, relativity, Nuclear Physics, Bio-Physics, X-ray, Laser, Raman spectroscopy, Electron spin resonance, Nuclear magnetic Resonance, Atomic and molecular physics.
7. Learn the basics of solid state electronics eg. BJT, FET, JFET, MOSFET, also communication and digital electronics, fibre optical communication.
8. Gain the knowledge of quantum mechanical concepts applicable in understanding behaviour of nanomaterials and applications in nanotechnology.

## **Chemistry**

### **Programme Specific Outcomes (PSOs):**

- ❖ Students will demonstrate an understanding of major concepts in all disciplines of chemistry.
- ❖ Students will employ critical thinking and the scientific method to design, carry out, record and analyze the results of chemical experiments and get an awareness of the impact of chemistry on the environment, society, and other cultures outside the scientific community.
- ❖ To enable students to develop an understanding of the principals of chemical safety and to enable them to apply these concepts when working in a laboratory.
- ❖ The principle, design, observations, procedures and calculations of the experiment results should demonstrate an understanding of practical's and its applications in different chemical industries and R&D laboratories.

## **Course Outcomes (PSOs) :**

### **(I) Inorganic Chemistry (CH: 101, 301, 401, 601)**

- ❖ To enable students to learn the atomic structure, concept of covalent bond, periodic table and its properties, S-block and P-block elements and chemistry of hydrides, oxides and oxyacides.
- ❖ To enable students to know about VSEPR and MO theories, Chemistry of elements of first, second, third transition series, Errors in Chemical Analysis, non-aqueous solutions, Chemistry of lanthanides and actinides.
- ❖ The students will understand some fundamental aspects of coordination compounds and isomerism, concept of oxidation and reduction, Colorimetry and Spectrophotometry, separation techniques, introductions of some inorganic polymers.
- ❖ To have the idea about Metal ligand bonding in Transition Metal Complexes, Electronic spectra of Transition Metal Complexes, Magnetic Properties of Transition Metal Complexes, Thermodynamic and Kinetic aspect of metal complexes, Organometallic Chemistry, Metal carbonyls, Bioinorganic Chemistry, concept of Hard and Soft Acids and Bases.

### **(II) Organic Chemistry (CH: 201, 302, 501, 602)**

- ❖ To predict the outcome, chemical reactions, preparations & mechanism of organic reactions, stereochemistry of organic compounds, geometrical and conformational isomerism, and basic concept of alkanes, alkenes, dienes, alkynes and aromaticity.
- ❖ To impart the students concepts of the fundamentals of orientations in organic molecules, properties and mechanism involved in alkyl halides, polyhalogen compounds, aryl halides, alcohols, phenols, aldehydes, ketones, carboxylic acids and its derivatives.

- ❖ To understand the basic concepts and mechanisms organic compounds of nitrogen, heterocyclic compounds, elemental analysis, organometallic compounds, UV-visible and infrared spectroscopy and its application.
- ❖ To learn the concept of NMR Spectroscopy and its applications, Organic synthesis via enolates, carbohydrates, amino acids, peptides, proteins, nucleic acids, synthetic drugs, dyes and detergents.

### **(III) Physical Chemistry (CH : 102, 202, 402, 502)**

- ❖ To acquaint knowledge on basics of thermodynamics, gaseous states, liquid state, properties of liquids, surface chemistry and catalysis.
- ❖ Students to learn and understand about second law of thermodynamics, free energy functions, chemical equilibrium, phase rule, chemistry of liquid-liquid mixtures, nuclear chemistry, molecular structure, chemical kinetics and theories of chemical kinetics.
- ❖ To provide an insight into the properties of solid state, electrochemistry, rotational and vibrational spectroscopy, basics of quantum chemistry.
- ❖ To get an overview about the concept of electrochemistry, quantum mechanics and MOT, photochemistry, Raman spectroscopy, Colligative properties and Macromolecules.

### **(IV) Laboratory Courses (CH : 103, 203, 303, 403, 503, 603)**

- ❖ To analyse and determine the acid and basic radicals from inorganic mixture using basic knowledge of qualitative analysis, basics experiments based volumetric analysis, preparation of inorganic complexes, chromatographic separation of binary mixtures, gravimetric and colorimetric analysis
- ❖ Students will gain an understanding of method of analysis related to element detection, functional group detection, synthesis of organic compounds, determination of organic compounds by chemical analysis, estimations of acids, glucose, amide, nitro group, saponification of oils, separation of binary mixture and analysis of organic compound.

- ❖ To perform and understand the experimental procedures during physical chemistry experiments, Students will enable the standard procedures and principles of physical chemistry experiments, handling of instruments, instrumental analysis techniques,

## Mathematics

### Programme Specific Outcome

Mathematics UG student at Dr. Ambedkar College, Deekshabhoomi, Nagpur will be able to apply critical thinking skills to solve problems that can be modeled mathematically, to critically interpret numerical and graphical data, to read and construct mathematical arguments and proofs, to use computer technology appropriately to solve problems and to promote understanding, to apply mathematical knowledge to a career related to mathematical sciences or in post - UG studies.

### Course Outcomes

Course/Semester/Paper	Name of Paper	Course outcome
<b>B.Sc. Sem I Paper I</b>	<b>Algebra and Trigonometry</b>	To inculcate knowledge on Algebra, Trigonometry and their properties & proofs.
<b>B.Sc. Sem I Paper II</b>	<b>Calculus</b>	To inculcate knowledge on the ability to find the effects of changing conditions on a system.
<b>B.Sc. Sem II Paper I</b>	<b>Geometry, Differential and Difference Equations</b>	To inculcate knowledge on solve problems in analytic geometry and able to find appropriate solutions for given problems. To inculcate knowledge on solving of first and second order Ordinary Differential equations.
<b>B.Sc. Sem II Paper II</b>	<b>Vector Calculus and Improper Integrals</b>	To inculcate knowledge on Vector Calculus and Improper Integrals and their properties & proofs.

<b>B.Sc. Sem III Paper I</b>	<b>Advanced Calculus ,Sequence and Series</b>	To inculcate knowledge on Advanced Calculus ,Sequence and Series and their properties & proofs.
<b>B.Sc. Sem III Paper II</b>	<b>Differential Equations &amp; Group Homomorphism</b>	To inculcate knowledge on Differential Equations & Group Homomorphism and their properties & proofs.
<b>B.Sc. Sem IV Paper I</b>	<b>PartialDifferential Equations &amp; Calculus of Variation</b>	To inculcate knowledge on Partial Differential Equations & Calculus of Variation and their properties & proofs
<b>B.Sc. Sem IV Paper II</b>	<b>Mechanics</b>	To inculcate knowledge on Classical Mechanics and their properties & proofs.
<b>B.Sc. Sem V Paper I</b>	<b>Analysis</b>	To inculcate knowledge on analysis and their properties & proofs.
<b>B.Sc. Sem V Paper II</b>	<b>Metric Space, Complex integration &amp; Algebra</b>	To inculcate knowledge on Metric space, complex integration, algebra and their properties & proofs.
<b>B.Sc. Sem VI Paper I</b>	<b>Abstract Algebra</b>	To inculcate knowledge on Abstract Algebra and their properties & proofs.
<b>B.Sc. Sem VI Paper II</b>	<b>Special Theory of Relativity(Optional Paper)</b>	To inculcate knowledge on Special theory of relativity and various properties & proofs.

## **Computer Science**

### **Student learning outcome**

- Explain about the basic concepts of program development statements and its syntax.
- Explain the various types of arrays and its structure.

- Explain the top-down and bottom-up programming approach and apply bottom up approach to solve real world problems.
- Discuss the generic data type for the data type independent programming which relate it to reusability.
- Explain about basic Java language syntax and semantics to write Java programs
- Discuss the the fundamentals of object-oriented programming in Java, including defining classes, objects, invoking methods
- Describe the basic components of an operating system and their role in implementations for general purpose, real-time and embedded applications.
- Explain what multi-tasking is and outline standard scheduling algorithms for Multi-tasking.
- Explain the basic Concepts of Program building block control statements and the basic concepts of function and procedure.
- Describe the functionality and properties of GUI based ActiveX Control with example programs
- Describe the fundamentals of File processing and database processing system.
- Explain the various normal forms and its role in DBMS.

## **Electronics**

### **COURSE OUTCOMES**

#### **ELE 1: Analog Electronics – I**

*On completion of the course, students are able to:*

1. Understand Electronic systems with a continuously variable signal
2. Understand proportional relationship between a signal and a voltage or current that represents the signal.
3. To learn function of basic component's use in linear circuits.
4. Understand component symbol, working principle, classification and specification.
5. To learn different theorems for simplification of basic linear Electronics circuits.

## **ELE 2 - Digital Electronics – I**

*On completion of the course, students are able to:*

1. Understand basic digital Electronic systems
2. To learn function of basic digital circuits and use of transistors to create logic gates in order to perform Boolean logic.
3. To learn different theorems for simplification of basic Digital electronics circuits.
4. Student understand symbols, Truth tables, Boolean equations, & working principle.

## **ELE 3: Analog Electronics – II**

*On completion of the course, students are able to:*

1. Understand Basic Circuits using Active Devices
2. Learn function of basic circuit components used in linear circuits.
3. Understand basic construction, equivalent circuits and characteristics of basic electronics devices.
4. Students understand basic linear electronics circuits and their working principle,

## **ELE 4 - Digital Electronics – II**

*On completion of the course, students are able to:*

1. Understand combinational and logical digital circuits and their differences.
2. Students will be introduced to Flip-flop, shifts register, counters and Semiconductor memory for data Processing circuits.
3. To learn symbol, working principle of basic Digital electronics circuits for data processing application.

At the end of this course, students should be able to recognize and analyze instruments

## **ELE 5: Analog Circuits and Applications**

*On completion of the course, students are able to:*



1. To understand Basic Analog Circuits and their applications using Active Devices
2. To learn basic function of single stage amplifier, multistage amplifier and power Amplifier and their working principle.
3. To understand basic construction of feedback circuits and their application in Oscillators
4. understand basic amplifier and oscillator circuits and their application in analog circuits.

### **ELE 6: Instrumentation**

*On completion of the course, students are able to:*

1. To understand Basic Analog and digital meters for measurement of various electrical parameter.
2. To learn basic test instruments such as power supply ,function generator, DFM and CRO and their construction and working principle.
3. To understand basic principle of transducers and their construction, Working principle, classification and application in various fields.
4. Students understand the construction of data convertor circuits and their applications in digital circuits.

### **ELE 7: LINEAR INTEGRATED CIRCUITS & APPLICATIONS**

*On completion of the course, students are able to:*

1. To understand Basic differential amplifier and their applications in linear Integrated circuits
2. To learn basic function of operational amplifier, Ideal and practical characteristics and their mathematical application.
3. To understand basic construction of active filters ,comparators and their application in electronics.
4. Students understand different types of multivibrator and wave form generator using IC555.

### **ELE 8: 8085 Microprocessor**

*On completion of the course, students are able to:*

1. To understand the basic architecture of 8- bit microprocessors.
2. Able to write programs on 8085 microprocessor based systems.
3. Identify the addressing modes of an instruction.
4. Develop programming skills in assembly language.

**ELE 9: Semiconductor Devices Objectives:**

1. To enrich the understanding of fundamentals of semiconductor devices.
2. To have an awareness of IC fabrication techniques.

*On completion of the course, students are able to:*

1. Understand the fundamental concept of semiconductor like crystal structure, energy band gap, charge carrier statistics.
2. Understand the physics, basic characteristics and operation of semiconductor devices such as p-n junctions and Zener diodes
3. Have knowledge of fabrication technology for semiconductor devices and integrated circuits

**ELE 10: Basic Communication Systems Objectives:**

1. To learn the concepts of communication system.
2. To know the various modulations and demodulation techniques.
3. To learn the radio wave propagation

*On completion of the course, students are able to:*

1. Understand the basic concept of communication system.
2. Understand AM , FM and demodulation.
3. Understand antenna and radio wave propagation used in communication system.

**ELE 11: Advanced Communication Systems Objectives:**

1. To learn the digital communication.
2. To learn the telephony systems
3. To learn the Fiber optic communications.
4. Introduction to computer network and security

*On completion of the course, students are able to:*

1. Understand basic concept of digital communication system.
2. Understand the fiber optic communication.
3. Understand computer network and security.

**ELE 12: 8086 Microprocessor Objectives:**

1. To learn the architecture of 8086.
2. To learn the assembly language programming of 16 bit microprocessor.

*On completion of the course, students are able to:*

1. To understand basic architecture of 16 bit microprocessors.
2. Able to write programs on 8086 microprocessor based systems.
3. Illustrate the organization of registers and memory in microprocessors.
4. Differentiate Minimum and Maximum Mode bus cycle.
5. Identify the addressing mode of an instruction.
6. Develop programming skills in assembly language.

**ELE 13: Microprocessor Interfacing Techniques and Advanced Microprocessors**

**Objectives:**

1. To learn the interfacing of I/O devices with microprocessor.
2. To learn interfacing techniques.
3. Introduction to Advance Microprocessors.

*On completion of the course, students are able to:*

1. Understand interrupt and interrupt service routine.
2. Understand I/O interfacing and techniques.
3. Understand advance microprocessor.
- 4.

**ELE 14: The C Programming Language Objectives:**

1. To learn the basics of “C” programming language
2. Development of programming skill to write simple “C” programs.

*On completion of the course, students are able to:*

1. Understand basic of the programming language
2. Able to switch any other programming language
3. Able to write C program for simple real life applications using structures.

**ELE 15: Numerical Simulation in Electronics Objectives:**

1. To learn the different numerical methods.
2. To study application of numerical methods to electronic circuits.

*On completion of the course, students are able to:*

1. Find root of equation by different numerical methods
2. Find out differentiation and integration of equation
3. Solve linear equation system.
4. Simulate electronic circuits numerically.

**ELE 16: Microcontroller 8051 Objectives:**

1. To learn the architecture of 8051 microcontroller.
2. To learn the programming of 8 bit microcontroller

*On completion of the course, students are able to:*

1. Ability to differentiate microprocessor and microcontroller.
2. Describe the architecture of 8051
3. Able to write assembly language program for 8 bit microcontroller

**ELE 17: Embedded Systems Objectives:**

1. To know about advanced microcontroller programming
2. To learn the 8 bit microcontroller interfacing.

*On completion of the course, students are able to:*

1. to write interfacing programming.
2. to identify embedded systems in various applications.
3. to write advanced microcontroller programming for real life application.

**ELE 18: Advanced Digital System Design Objectives:**

1. To study the principles required for designing of advanced digital systems.
2. To acquire basic knowledge of Hardware Description Languages(HDL).
3. To know designing of combinational and sequential logic circuits using VHDL.

*On completion of the course, students are able to:*

1. To design advanced digital systems.
2. Understand the Hardware Description Languages(HDL).
3. Design combinational and sequential logic circuits using VHDL.

**ELE 19: Power Electronics Objectives:**

1. To know about power semiconductor devices frequently used in industries.
2. To have an idea about the principle and operation of circuits using power semiconductor devices to control various operations in industries.

3. To acquaint with industrial and domestic applications of power semiconductor devices.

*On completion of the course, students are able to:*

1. Understand power semiconductor devices used in industries.
2. Understand the construction and working of different power semiconductor devices
3. Analyze various triggering circuits used for different semiconductor devices
4. Design power electronic circuit for real time application like rectifier and convertor etc.

## **Botany**

### **Programme Specific Outcome**

1. Know the characteristics, systematics, morphology, structure and life cycle pattern of Viruses, Mycoplasma, Bacteria, Cyanobacteria, Algae, Fungi, Lichens, Bryophytes and Pteridophytes.
2. Understand the diversity, systematics and biology of seed plants.
3. Understand the nature and basic concepts of cell biology, genetics, anatomy, morphology, Biochemistry, Physiology, Taxonomy and ecology.
4. Analyze the interrelationships among prokaryotic and eukaryotic organisms
5. Study of organization and function of the gene, genome, cell, tissue, organ and organ-system including development, reproduction, ecological and physiological adaptations and behavior of different forms of life.
6. Understand the importance of plants, their diversity and its conservation.
7. Achieve pure and applied botanical knowledge.
8. Perform procedures as per laboratory standards in the areas of Biochemistry, Physiology, Biotechnology, Taxonomy, Economic Botany and Ecology
9. Demonstrate hands on skill in the experimental techniques and methods of analysis in various field of Botany.

10. Generate test hypotheses, observations, data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context.

11. Promotes stewardship responsibility, entrepreneurship skill, research and career opportunities.

## COURSE OUTCOMES

<b>B.Sc. SEMESTER-I</b>	<b>PAPER-I (Viruses, Prokaryotes &amp; Algae)</b>	<ul style="list-style-type: none"> <li>• To study in depth about Viruses, Prokaryotes &amp; Algae.</li> <li>• To gain knowledge about microbial diversity.</li> <li>• To Know the General characteristics, systematics, morphology, Ultramicroscopic cell structure and life cycle pattern of Viruses, Mycoplasma, Bacteria, Cyanobacteria and Algae.</li> <li>• To Understand the useful and harmful activities of Viruses, Mycoplasma, Bacteria, Cyanobacteria and Algae.</li> <li>• Learn about the General characteristics, Classification (Fritsch 1954) of Algae.</li> </ul>
	<b>PAPER-II (Fungi, Lichen, Plant- Pathology&amp; Bryophyta)</b>	<ul style="list-style-type: none"> <li>• To give information about Fungi, Lichen, Plant Pathology&amp;Bryophyta and their life cycle.</li> <li>• Know the General characteristics, Classification of Fungi &amp; Bryophyta.</li> <li>• To make them Understand the Life history of <i>Albugo</i>, <i>Mucor</i>, <i>Puccinia</i>, <i>Cercospora</i>, <i>Riccia</i>, <i>Anthoceros</i>, <i>Funaria</i>.</li> <li>• To explore host, pathogen, symptoms, Causes and Control of Leaf curl of Papaya, Citrus canker and Red rot of Sugarcane</li> <li>• To Understand the types, Reproduction in Lichens.</li> <li>• Know about the Economic importance of Fungi, Lichen and Bryophyta</li> </ul>
<b>PRACTICAL PAPER I &amp; II</b>		<p><b>Students should understand,</b></p> <ul style="list-style-type: none"> <li>• Study of Bacterial forms, <i>Nostoc</i>, <i>Oedogonium</i>, <i>Chara</i>, <i>Vaucheria</i>, <i>Ectocarpus</i>.</li> <li>• Study of <i>Albugo</i>, <i>Mucor</i>, <i>Puccinia</i>, <i>Cercospora</i>, Lichen, Plant pathology, <i>Riccia</i>, <i>Anthoceros</i> and <i>Funaria</i>.</li> <li>• Botanical Excursions</li> </ul>
<b>B.Sc. SEMESTER -II</b>	<b>PAPER-I (Pteridophyta &amp; Gymnosperm)</b>	<ul style="list-style-type: none"> <li>• Know about the Classification system General characters, Economic importance, alternation of generation of Pteridophyta and Gymnosperms.</li> <li>• To make them know the life history of <i>Rhynia</i>, <i>Selaginella</i>, <i>Equisetum</i>, <i>Cycas</i>, <i>Pinus</i>, and <i>Cycadeoidea</i>.</li> </ul>

		<ul style="list-style-type: none"> <li>To study the concepts of Apogamy, Apospory, Stelar system in pteridophytes, heterospory and seed habit.</li> </ul>
	<b>PAPER-II (Palaeobotany &amp; Morphology of Angiosperms)</b>	<ul style="list-style-type: none"> <li>Study of geological time scale, fossilization, types of fossils and fossil plants.</li> <li>Understand the fossil genera <i>Glossopteris</i> representing fossil groups.</li> <li>To Understand the Root, Stem and Leaf Morphology of Angiosperms.</li> <li>To be familiar with types Inflorescence and details of typical flower including various parts.</li> <li>To provide information about classification and types of fruits.</li> </ul>
<b>PRACTICAL PAPER I &amp; II</b>		<ul style="list-style-type: none"> <li>To learn about the structure and reproduction of certain selected species of Pteridophytes and Gymnosperms.</li> <li>To Study Fossils, types forms, and modification of Root, Stem, Leaf, Inflorescence, Flowers and Fruits.</li> <li>Study Tour</li> </ul>
<b>B.Sc. SEMESTER -III</b>	<b>PAPER-I (Angiosperm Taxonomy)</b>	<ul style="list-style-type: none"> <li>To study Origin and Phylogeny of Angiosperm &amp; Fossil Angiosperms</li> <li>Comprehend the concepts of plant taxonomy and classification of Angiosperms.</li> <li>To give knowledge about Phytochemistry cytology and evolutionary relationship among taxonomic groups.</li> <li>To understand the comparative account of selected angiosperms families and its economic value.</li> </ul>
	<b>PAPER-II (Cell Biology, Plant Breeding &amp; Evolution)</b>	<ul style="list-style-type: none"> <li>Cell biology give knowledge about structure of typical plant cell, cell organelles &amp; their structure, chemistry and functions.</li> <li>To study chromosome organization and cell division in plants and their significance.</li> <li>To understand the various techniques in plant breeding, biostatistics and theory of evolution.</li> </ul>
<b>PRACTICAL PAPER I &amp; II</b>		<ul style="list-style-type: none"> <li>Study of Angiospermic Families- Malvaceae, Brassicaceae, Fabaceae (Papilionoideae, Caesalpinioideae, Mimosoideae), Asteraceae, Asclepiadaceae, Euphorbiaceae and Poaceae.</li> <li>Study of fossil Angiosperms micropreparation and specimens: <i>Sahianthus</i>, <i>Enigmocarpon</i></li> <li>To study Cell division- mitosis &amp; meiosis in plant material.</li> <li>To calculate Mean, Mode, Median, standard error, the student's t-value.</li> <li>Botanical Excursion</li> </ul>
<b>B.Sc. SEMESTER- IV</b>	<b>PAPER-I (Angiosperm Anatomy &amp;)</b>	<ul style="list-style-type: none"> <li>To describe Angiosperm Anatomical &amp; Embryological characters related to study of plants.</li> <li>To study tissues and their functions.</li> </ul>

	<b>Embryology)</b>	<ul style="list-style-type: none"> <li>• Understand the various components of root &amp; stem and its primary and secondary growth.</li> <li>• Types of vascular bundles- dicots and monocots in dicot and monocot plants; Secondary growth and anomalous secondary growth in <i>Bignonia</i> and <i>Dracaena</i> stem.</li> <li>• Anatomy of leaf: Dicot (<i>Nerium</i>), monocot (<i>Maize</i>).</li> <li>• Learn about double fertilization and their significance. Be enlightened about the mechanism of pollination and basic structure and development of the embryo.</li> </ul>
	<b>PAPER-II (Genetics &amp; Molecular Biology)</b>	<ul style="list-style-type: none"> <li>• Knowledge about Mendelism, genes interaction, linkages, crossing over, chromosome variation</li> <li>• To understand the biochemical nature of nucleic acids, their role in living systems.</li> <li>• To understand the process of gene expression synthesis, genetic code and operon concept.</li> </ul>
<b>PRACTICAL PAPER I &amp; II</b>		<ul style="list-style-type: none"> <li>• To Study simple tissue, complex tissue and secretory tissue, types of vascular bundles, internal structure of dicot and monocot root - <i>Sunflower, Maize.</i>, internal structure of dicot and monocot stem - <i>Sunflower, Maize</i>, internal structure of secondary growth and anomalous secondary growth - <i>Bignonia</i> and <i>Dracaena</i> stem, internal structure of leaves- <i>Nerium, Maize</i>.</li> <li>• To Study of types of ovules, anther structure, pollen grains, adaptations for pollination</li> <li>• To calculate the percent pollen germination in the given anthers.</li> <li>• To prove the Mendel's law of segregation and independent assortment with the help of coloured beads.</li> <li>• To workout the type of gene interaction in the given cross.</li> <li>• Visit to Research Laboratories, Industries, Nurseries, Field visit.</li> </ul>
<b>B.Sc. SEMESTER -V</b>	<b>PAPER-I Biochemistry &amp; Plant Physiology-I</b>	<ul style="list-style-type: none"> <li>• To give knowledge about Biochemistry &amp; Plant Physiology-I</li> <li>• Study of Carbohydrates, Lipids and Amino acids and basics of Enzymology.</li> <li>• To study Plant-water relations and mineral nutrition.</li> <li>• Study the process of respiration and photosynthesis in higher plants</li> <li>• Know the nitrogen metabolism and its importance.</li> </ul>
	<b>PAPER-II Plant Ecology I</b>	<ul style="list-style-type: none"> <li>• To study of basics of ecology and environmental factors</li> <li>• To provide knowledge about natural resources and their importance in sustainable development.</li> <li>• Know the importance of ecosystem-components, Food chain, Food web, Ecological pyramids.</li> <li>• Understand plant communities, Climatic &amp; Phytogeographic regions of India.</li> </ul>
		<ul style="list-style-type: none"> <li>• To understand by performing some physiological and ecological experiments</li> <li>• To study the effect of various chemicals on permeability of</li> </ul>



<b>PRACTICAL PAPER I &amp; II</b>		<p>membranes, the ascent of sap in suitable plant material, to separate chlorophyll pigment by paper chromatography, to determine the RQ of given plant material, to perform microchemical tests for determination of reducing and non-reducing sugars, starch, cellulose, oils and proteins, to study the effect of light intensity and quality, CO<sub>2</sub> concentration and temperature on rate of photosynthesis by suitable method, to determine osmotic potential of the cell sap by plasmolytic method, to study the activity of enzyme amylase, catalase and peroxidase.</p> <ul style="list-style-type: none"> <li>• To determine frequency, density, abundance of the community by quadrat method, to determine the homogeneity of vegetation by Raunkiers frequency diagram, to determine the water holding capacity of the given soil samples, to determine the water rising capacity of the given soil samples, to determine the soil moisture of the given samples.</li> <li>• Botanical Excursion.</li> </ul>
<b>B.Sc. SEMESTER- VI</b>	<b>PAPER-I Plant Physiology- II &amp; Biotechnology</b>	<ul style="list-style-type: none"> <li>• Know the scope of plant physiology &amp; biotechnology.</li> <li>• To understand Growth Concept, Phytochromes, biological clock, plant growth regulators and plant movements.</li> <li>• Understand the concept of Photoperiodism and vernalization,</li> <li>• To learn Seed dormancy and plant defence mechanism.</li> <li>• Understand the basics of genetic engineering and tissue culture techniques and its application.</li> </ul>
	<b>PAPER-II (Plant Ecology- II, Techniques &amp; Utilization of Plants)</b>	<ul style="list-style-type: none"> <li>• Understand the Plant succession, Morphological, Anatomical &amp; Physiological adaptations.</li> <li>• Learn about Environmental Pollution, management, natural and resources.</li> <li>• Learn skill on working Principles, types and application of: microscopy, centrifugation, electrophoresis, spectroscopy, chromatography, pH meter.</li> <li>• Knowledge about utilization of plants and ethno botany to enable the student about utility in life.</li> </ul>
<b>PRACTICAL PAPER I &amp; II</b>		<ul style="list-style-type: none"> <li>• Learn about the ecological adaptations and human interference in environment as analysis of water samples provides great concern towards environmental audit.</li> <li>• To determine seed viability, the effect of various plant growth regulators on the growth and development of plants.</li> <li>• To study the morphological and anatomical characteristics hydrophyte and xerophytes, the morphological characteristics of cladode, phylloclade, phyllode and pneumatophores.</li> <li>• To determine the DO, salinity (chlorides), transparency, pH and temperature of water samples different sources.</li> <li>• To study the dust holding capacity of leaves, the percent leaf-area injury of different leaf samples collected around polluted sites.</li> </ul>

	<ul style="list-style-type: none"> <li>• Learn about the utilization of Plants: Morphology, Utilization and Important chemical constituents of plants.</li> <li>• To study the plants of Ethnobotanical importance.</li> <li>• Electrophoretic/chromate graphic separation of amino acids carbohydrates.</li> <li>• Botanical Excursions</li> </ul>
--	---

## Zoology

### *Program Specific Outcome (PSO)*

A broad understanding of animal diversity, including scientific classification and evolutionary relationships of major phyla/groups of animals is the prime objective. The structural and functional relationships at different levels of biological organization (e.g., molecular-, cellular-, tissue-, organ-, organismal-, population-, and species-level organizations) with respect to major phyla/groups of animals is conceptualized in order to understand the life and its prevalence.

To study the interactions of biological, chemical, and physical features of environment or the habitat (e.g., terrestrial, freshwater, marine, host) among living organisms is also emphasized upon. To get aware of the animal growth n development, metabolism and propagation of pre-existing life forms is predominantly included.

A latest elementary understanding of **genetics** and inheritance; **molecular** concepts; micro-techniques; **biotechnical** procedures; **immunological** interactions; **bio-statistics** and **bio-informatics** related to the living forms and their progression is not left out.

Further, the students are made aware of the application of zoology in different facets of mankind environment under the banner of economic zoology such as **seri-culture**, **api-culture**, **lac-culture**, **aquaculture**, Industrial **microbiology**, **rDNA technology**, medicines and **vaccines** of different nature/origin and of course a voluntary effort of briefing of the related **career opportunities**.

***Course Outcome (CO): Zoology (Semester-wise)***

***Semester 01***

*Paper – I : Life and Diversity of Animals-Nonchordates (Protozoa to Annelida)*

*Paper -II : Environment Biology*

*Practical - I (Based on Paper I & II)*

**The prime objective of paper I and Paper II is to provide fundamental knowledge of animal (without cord), diversity and to provide a much needed environmental awareness and conservation instincts among the students.**

1. To make students familiar with the non-chordate (without cord) animals that surrounds us starting from protozoans to annelid group of animals;
2. To reach out to their life cycles of key animals and evolutionary aspects including the connecting animals between two phyla/groups;
3. To understand the environment in different spheres like atmos-, litho- and hydro-sphere; and ecology in interaction with animals and of course conservational aspects of both;
4. To technically/scientifically make the students able to identify the non chordate/invertebrates and classify them up to the class level with the basis of systematic and to comment upon them;
5. To make practically aware of evaluating the animal interactions with environmental parameters and their basic assessment procedures such as pH, oxygen demand and plankton counts in waters;
6. To expose students to the various research-labs/-institutions or animal culture centers/museums/social outreach points if any in and around city per two semesters.

***Course Outcome (CO): Zoology (Semester-wise)***

***Semester 02***

*Paper - III : Life and Diversity of Animals- Non-chordates (Arthropoda to Hemichordata)*

*Paper - IV : Cell Biology*

*Practical - II (Based on Paper III & IV)*

**The prime objective of paper III and Paper IV is to provide fundamental knowledge of remaining animals (without cord), diversity and to provide a basic know-how of the structural & functional unit of life, the cell.**

1. To make students familiar with the non-chordate (without cord) animals that surrounds us starting from arthropods to hemichordate group of animals;
2. To reach out to their life cycles of key animals and evolutionary aspects including the connecting animals between two phyla/groups;

3. To understand the structure of living cell and its organelles in relation to structure and function in significant types of cells such as prokaryotic- and eukaryotic-; plant- and animal-cell;
4. To know the cellular cycle of propagation, cell-divisions (mitosis & meiosis), -ageing and -death with an elementary introduction of cancer and its causative agents;
5. To technically/scientifically make the students able to identify the non chordate/invertebrates and classify them up to the class level with the basis of systematic and to comment upon them;
6. To have hands on experience/usage of pH-meter, microscopes and micrometer, weighing balance, solution making, staining and mounting of materials in practical sessions;
7. To expose students to the various research-labs/-institutions or animal culture centers/museums/social outreach points if any in and around city per two semesters.

***Course Outcome (CO): Zoology (Semester-wise)***

***Semester 03***

*Paper - V : Life and Diversity of Animals-Chordates (Protochordata to Amphibia)*

*Paper - VI : Genetics*

*Practical - III (Based on Paper V & VI)*

**The prime objective of paper V and Paper VI is to provide fundamental knowledge of animal with cord diversity and to provide with a basic set of doctrines of genetics and its components.**

1. To make students familiar with the chordate (with cord) animals that surrounds us starting from protochordates to amphibian group of animals;
2. To reach out to their life cycles of key animals and evolutionary aspects including the connecting animals between two phyla/groups;
3. To understand the process of development of animals; gametogenesis; fertilization; embryogenesis specially in frog including blastula, gastrulation and so on;
4. To impart the basic knowledge of genetics and Mendelian-, cellular- and extracellular-inheritance, linkage and crossing over concepts of genetic code and chromosomal-studies, -aberrations, -abnormalities and including applied aspects of genetics such as DNA fingerprinting, karyotyping used for identifying genetic disorders/syndromes and counseling for public awareness is also made aware to students;

5. To technically/scientifically make the students able to identify the chordate/vertebrates and classify them up to the class level with the basis of systematic and to comment upon them;
6. To have known practically about the hybrids and their ratio in genetics, karyotype studies of various syndromes, population genetic equilibrium with additional staining and mounting of materials for slide preparations;

***Course Outcome (CO): Zoology (Semester-wise)***

***Semester 04***

*Paper - VII : Life and Diversity of Animals-Chordates (Reptilia, Aves and Mammals)*

*Paper - VIII : Molecular Biology and Immunology*

*Practical - IV (Based on Paper VII & VIII)*

**The prime objective of paper VII and Paper VIII is to provide fundamental knowledge of remaining animals (with cord) diversity and to provide with a basic know-how of molecular biology and immunology and techniques involved to inculcate the research interest/inclination.**

1. To make students familiar with the chordate (with cord) animals that surrounds us including reptiles, birds and mammals;
2. To reach out to their life cycles of key animals and evolutionary aspects including the connecting animals between two phyla/groups;
3. To understand the process of development of animals; embryonic membrane development; embryogenesis especially in hen/fowl, mammalian placental structure n functions and additionally stem cell concept;
4. To have the elementary knowledge of molecular concept in biology including DNA, RNA and recombination, replications and protein synthesis, the basic natural phenomena occurring inside the cell and immunological aspects of human antigens and antibodies and the immune responses through T cells, B cells, cytokines and immune disorders;
5. To technically/scientifically make students able to identify the chordate/vertebrates and classify them up to the class level with the basis of systematic and to comment upon them including the bones and the embryo developmental stages of frog and fowl and the knowhow of the immune organs and interactions of antigen and antibody *in vitro* in practical sessions.

***Course Outcome (CO): Zoology (Semester-wise)***

***Semester 05***

*Paper - IX :General Mammalian Physiology I*

*Paper - X : Applied Zoology I (Aquaculture and Economic Entomology)*

*Practical - V (Based on Paper IX & X)*

**The prime objective of paper IX and Paper X is to provide fundamental knowledge of comparative physiology of different systems in the living body and to provide an idea of applied aspects of zoology.**

1. To make them explore the general human physiology such as digestion, respiration, circulation and the enzyme and hormones involved in these processes;
2. To make students know about the applied aspects of zoology by studying the various culture practices such as seri-, api-, lac-, pisci-, prawn-, pearl-culture and equipment n processes involved in them;
3. To make them understand the economic significance, maintenance and the obstacles and diseases related to these practices and their management and control through chemicals or biological indicators;
4. To make them practically know how the practices are carried out, students are taken to the practice sites nearby; experimentally estimating vitamins, foodstuffs in tha samples, the enzyme activities, blood cells counting for identifying diseases, identifying various pests and their control;
5. To expose students to the various research-labs/-institutions or animal culture centers/museums/social outreach points if any in and around city per two semesters.

***Course Outcome (CO): Zoology (Semester-wise)***

***Semester 06***

*Paper - XI : General Mammalian Physiology II*

*Paper - XII : Applied Zoology II (Biotechniques, Microtechnique, Biotechnology, Bioinformatics and Biostatistics)*

*Practical - VI (Based on Paper XI & XII)*

**The prime objective of paper XI and Paper XII is to provide fundamental knowledge of comparative physiology of remaining systems in the living body and to provide an idea of applied techniques used to elevate enthusiasm towards higher education and research in zoology.**

1. To make them explore the general human physiology such as neuron coordination, ecretion, endocrinology and reproduction to understand a human body in a better way;
2. To make students know about the another advanced applied aspects of zoology by studying the micro technique for section cutting, double staining and preparation of permanent slides for study and research purposes, different separation processes such as chromatography and electrophoresis, estimating different molecules of need through colorimeter or spectrophotometer and regular or basic bio-statistical, bio-technical and

bio-informational tools for advance studies and research methodologies, conclusively this paper pops up a research temperament in the students;

3. To create further interest into research, students are practically exposed to the different basic bio-statistical, bio-technical and bio-informational tools used in today's research scenario such as data handling, analysis, database searches with the help of various advanced protocols and tools available on wordl wide web.
4. To expose students to the various research-labs/-institutions or animal culture centers/museums/social outreach points if any in and around city per two semesters.

## Statistics

### **Programme Specific Outcome:-**

Statistics is an interdisciplinary subject and has wide applications in all the subjects in Physical Sciences, Life Sciences and Social Sciences.

1) Statistics as one of the subjects with a combination of two more from Physics, Mathematics and Computer Science is a nice group of subjects to pursue the under-graduate course.

2) The study of subject Statistics enables students to understand concepts in Physics such as Classical Mechanics, Quantum Mechanics and Thermodynamics.

These concepts are well explained with the help of probability theory.

Fluid Mechanics can not be studied without Mathematics and the concept of Stochastic Processes which is a part of Statistics.

3) The type or form of relationship between two or more variables is of significant importance in all disciplines and walks of life. This can be efficiently done with the help of Regression Analysis which is covered in an undergraduate course in Statistics.

4) The Statistical tools and/or methods such as Testing of Hypothesis and Theory of Estimation are of prime importance in Physics as well as Computer Science.

5) Statistical tools have enabled designing of computer software whereas Computer Science has helped analyse voluminous data efficiently and precisely.

6) Combination of Statistics, Mathematics and Computer Science with advanced software does help social scientists undertake large scale studies or survey to solve social problems.

7) Undergraduate course in Statistics, Mathematics and Computer Science enables students to start working as data analyst, Quality Control Consultant, Manager in Industrial Organization. It will also enable students to plan, design and execute sample survey.

## **Course Outcome:-**

### **Semester I:-** (Probability Theory and Descriptive Statistics I)

Understand how to deal with random experiments and comprehend crucial measure of uncertainty. Develop an ability to understand probability models.

Know about different types of data their merits and demerits. Ability to scientifically collect and effectively present data. Understand Controlled Experiments and Observational studies.

### **Semester II:-** (Probability Distributions and Descriptive Statistics II)

Understand standard univariate probability models – discrete and continuous and their characteristics. Gain knowledge of elementary methods used for analysis of statistical data.

### **Semester III:-** (Statistical Methods and Economic Statistics)

Understand drawing of random samples from populations having different density functions. Understand bivariate probability distributions and sampling distributions. Comprehend application of Statistics in Economics.

### **Semester IV:-** (Statistical Inference and Applied Statistics)

Understand inductive logic i.e. ability to draw conclusion about population on the basis of sample and assess the associated risk. Gain adequate knowledge of Inferential Statistics. Application of Statistics in Demography and Psychology.

### **Semester V:-** (Statistical Quality Control and Linear Programming Problem; Survey Sampling Techniques)

Comprehend Application of Statistics in Industrial sector, Business Organizations, Agriculture and Pharmacy. Gain an ability to choose appropriate sampling method, design and execute Sample Survey.

### **Semester VI:-** (Operations Research, Experimental Designs)

Acquire managerial ability to manage small sized conventional and nonconventional projects, to save cost and time of completion. Acquire ability to carry out scientific study of different treatments enabling valid comparison between them.



# Biotechnology

## COURSE OUTCOME

### SEM I

#### PAPER 1-MICROBIOLOGY

**Course objectives:** To give students a generalized idea about microbiology its basic aspects so that they can be able to relate them with their upcoming research projects in BSC and can use microbes in their research purposes. Students will gain awareness about the microbes present in the environment and their impact. Course will provide practical knowledge about different types of bacteria, virus and fungi found in environment.

**Learning outcomes:** On completion of the courses

- Students will apply the principle and application of various types of Microscopy to Classify and explain the structure and general characteristics of Microorganisms.
- Students will understand the historical background of microbiology.
- Students can prepare various Bacteriological, Algal, and Fungal Media.
- Students can understand the classification of microorganisms through Bergey's manual and apply basic knowledge of nutrients required by different microorganisms for their growth
- Students perform various type of staining techniques and identify various cell organelles like endospores types, structure germination, basis of resistance

#### PAPER 2-MACROMOLECULES

**Course objectives:** To make students aware and to give them the basic knowledge of different macromolecules like nucleic acids protein which are the basis of existence of the cell.

**Learning outcomes:** On completion of the courses

- Students will describe the structure and function of DNA and RNA in the cell
- Students will differentiate the structure of nucleic acid, types of Nucleic acid and its Forms
- Students will describe how DNA is replicated in the cell
- Students will differentiate between eukaryotic and prokaryotic chromosomal structure
- Students will describe the structure of proteins, including the significance of amino acid R-groups and their impact on the three-dimensional structure of proteins.
- Students will have knowledge on biomolecules, their importance and Classification ,forces stabilizing their structures, write and relate the role of them with day to day life.

#### PRACTICAL

**Course outcomes-** Students will be able to quantitatively and qualitatively estimate protein, nucleic acids in any samples by various methods and also will be able to perform the basic staining techniques to identify different organisms and grow them in different media required for their optimal growth under optimal conditions.

### SEM II

## **PAPER 1-MICROBIOLOGY AND CELL BIOLOGY**

### **Course objectives:**

The objective of this course is to have a firm foundation in the fundamentals of Cell Biology. Deep understanding of advantages and hazards of microbial world. Advanced knowledge for growth and control microorganisms for wealth production. This course will aid students to acquire skills and competency in microbiological laboratory practices applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.

### **Learning outcomes:** On completion of the courses

- Students develop an understanding of the Cytoskeleton and Cell Membrane & discuss the structure of Microtubules, microfilaments & can differentiate the organisms by its cell structure
- Students can explain various process in cell division.
- Students apply the concept, principle and types of sterilization methods while performing microbiological experiments.
- Students apply the concept and characteristics of antiseptic, disinfectant and their mode of action in day to day life.
- Cultivate various bacteria, yeast, fungi and virus by different methods.
- Students will apply principle, working and applications of instruments viz, laminar air flow, autoclave, hot air oven etc.
- Students will explain the mechanism of cell injury while using different antibiotics against microbes..

## **PAPER 2-CELL CONSTITUENTS AND ENZYMOLOGY**

### **Course objectives:**

The objective of this course is to familiarize students with the Biomolecules, enzymes and related mechanism through which they work. Upon successful completion of this course, the student will learn, the major classes of enzyme and their functions in the cell. The course also provides information pertaining to role of co-enzyme cofactor in enzyme catalyzed reaction, properties of enzymes and regulation of biochemical pathways. Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic data and estimate important parameter ( $K_m$ ,  $V_{max}$ ,  $K_{cat}$  etc).

### **Learning outcomes:** On completion of the courses

- By acquiring the knowledge of different biomolecules their definition, classification, biological function and chemical and physical properties they can relate these in day to day life
- Students can apply this knowledge of biomolecules in the research of molecular biology.
- Students perform assay of various enzymes according to their properties and can analyse their kinetics data.

**PRACTICAL-** Students will be able to quantitatively and qualitatively estimate protein and sugars can differentiate samples by doing different test. They will be able to give the quality index of fats, can be able to perform assay of different enzymes and measure their activity. Can see the effect of various factors on enzyme activity. They will know different stages of cell division.

### **SEM III**

#### **PAPER I –METABOLISM**

**Course objectives:** To acquaint students with the concept of bioenergetics and various metabolic processes taking place inside the human body.

**Learning outcomes:** On completion of the courses students will be able

- To know the concept of bioenergetics, various terminologies related to it and concept of high energy molecules and bonds
- Develop an understanding of various metabolisms in cell
- They will know the formation and the breakdown of different biomolecules and the places where it took place
- Various physiological and pathological aspects of byproducts of metabolic pathways and their regulations and relate with various industrial processes.

#### **PAPER II –BIOPHYSICAL TECHNIQUES**

**Course objectives:** The objective is to enrich students' knowledge about various techniques used in biological research and also their implementation in various fields of research.

**Learning outcomes:** On completion of the courses

- Students will know the concept of electromagnetic radiation, absorption spectrum, Beer's law and Lamberts law
- Students can apply the principle, working and applications of various spectrophotometers and AAS, concept of various spectrometry and can handle them.
- Students will know the concepts of chromatography and concept of partition coefficient and perform various chromatographic techniques
- Students can explain the relationship between absorbance and transmittance in spectrophotometry
- Students can explain the relationship between the concentration of H<sup>+</sup> and OH<sup>-</sup> ions in acids and bases
- Students can describe the proper way to use pH paper and pH meters and which should be used in a specified situation
- Students will justify the need for buffers, describe how buffers are prepared, and calculate the amount of buffering agent needed when making a particular buffer

**PRACTICAL**-Students will be able to perform estimation of macromolecules and find out the purity of that macromolecule in a sample. They will be acquainted with various tests for marker enzyme, do cell fractionation, titration of acids and bases also they will come across various techniques for the identification and separation of macromolecules.

## **SEM IV**

### **PAPER I-IMMUNOLOGY**

**Course objectives:** The objective of this course is to familiarize students with the Immune system, hypersensitivity and vaccination, Immune Effector Mechanisms, hybridoma technology and various Immunotechniques and immunodiagnosis. The course will provide technical knowledge as to how different diseases are caused and various responses mediated by living cells to combat pathogen attack. At The course will provide sound knowledge of how immune system deals with various pathogens, different processes and cell types involved in prevention of disease. Along with this the students will become aware about concept, synthesis and action mechanism of vaccines.

**Learning outcomes:** On completion of the courses students will be able to understand

- Students will explain immune system, properties of immune system, types of immunity, pathways of complement systems
- Students will know the concept of antigen, antigenic determinants, haptens, factors affecting antigenicity in various diseases.
- Students will know immunoglobulin, structure, types and functions and can apply the concept of Hypersensitivity and vaccination while observing different diseased situation
- - Students will perform various immunological techniques .

### **PAPER II-BIOSTATISTICS AND BIOPHYSICAL TECHNIQUES**

**Course objectives:** The objective is to enrich students' knowledge about various techniques used in biological research and also their implementation in various fields of research. At the end of this course students would be able to understand the principle, working, maintain and calibrations of bioanalytical tools and techniques for industrial and research purpose.

**Learning outcomes:** On completion of the courses

- Students will know and apply the concept of electrophoretic mobility, migration of ions in electric field various types of electrophoretic techniques, their procedure, principle and applications
- Students will use detection and recovery methods of various macromolecules by electrophoretic methods by knowing their advantages and limitations .
- Students will apply basic concept of biostatistics for various research purpose.
- Students will have an insight of isotopic tracer technique and centrifugation their uses ,different isotopes and their use in radiology, limitations and principle of tracer technique ,limitations and application part of it, scintillation counters and can relate them with various tests performed during diagnosis of various disease like cancer.

**PRACTICAL-**Students will be able to perform various basic pathological test like test for pregnancy, blood test, widal test and also they will be able to learn how electrophoresis can be used for research purpose and to use the technique.They will also know the basic statistical data analysis.

## **SEM V**

### **PAPER I-MOLECULAR BIOLOGY**

**Course objectives:** To acquaint the students with basic and advanced knowledge of molecular biology.

**Learning outcomes:** On completion of the courses

- Students will be able to understand molecular Biological processes like DNA replication, transcription and repair systems
- Students will know how different genes are expressed and regulated in a cell by using operon model.
- Students will know use the DNA replication mutants in the study of replication .

### **PAPER II-MOLECULAR BIOLOGY AND r-DNA TECHNOLOGY**

**Course objectives:** To make the students familiar about the translation machinery and concept of r-DNA technology and their application in advanced research.

**Learning outcomes:** On completion of the courses students will be able to understand

- Students will be able to explain the concept of genetic code, decoding system, codon-anticodon interactions, selection of initiation codons ,Initiation, elongation, termination and also regulation of translation
- Students can give the introduction of r-DNA technology, basics of genetic engineering, various enzymes, concept of different vectors and their applications and can apply them further.
- Students discuss techniques used to probe DNA for specific genes of interest and apply the fundamental steps in a genetic engineering procedure
- Students will perform selection and screening of transformed cells and can know how to store transformed as well as whole genome of the organisms in compact form in the form of library
- Students will apply the concept of PCR, its applications, general features of expression vectors-advantages and problems and various applications of r-DNA technology while performing experiments in r-DNA technology.

**PRACTICAL-**Students will know how to isolate nucleic acids, to perform plating techniques and will be able to demonstrate various blotting techniques.

## **SEM VI**

### **PAPER I-APPLICATIONS OF BIOTECHNOLOGY**

**Course objectives:** To give an insight and advanced learning of application of Biotechnology in research development in various field.

**Learning outcomes:** On completion of the courses

- Students will give examples of how RNA technologies impact research and development in industry and food technology.
- Students will describe how biotechnologies are being used to understand and protect the environment, treatment given to sewage and understanding the concept of biodegradation, bioremediation and biotransformation, Domestic waste water treatment, Classification Of Waste water treatment
- Students will know about different fermenters, isolation of industrially important microbes and their screening, production of cheese, and study quality assurance in food and pharmaceutical

industry, microbial analysis of Microbial production of fermented food viz. cheese, bread etc and can perform these things while they go to any industry further.

- Students will study industrial awareness on quality control and good practices in manufacturing processes in industry .
- Students will know the primary Source of microbes in various foods
- Students will know causes of food spoilage, Spoilage of fruit, Vegetables, Dairy product basic knowledge of food Preservation –Chemical Method, Physical method and apply them in food industries further.
- Students can apply the knowledge of Biodegradation, Bioremediation, Phytoremediation, Xenobiotic biodegradation, Herbicide Degradation ,Metabolism of Xenobiotic while working in environmental research institutes and also relate these aspects in day to day life.

## **PAPER II-PLANT AND ANIMAL BIOTECHNOLOGY**

**Course objectives:** To make students aware of various tissue culture techniques and their application in biotechnology for commercial purpose.To acquaint students with applications of genetic engineering like transgenic plants, animals.The course will provide complete exposure as how plant and animal cells are isolated, cultured and genetically manipulated in laboratory. Also the course will provide information hoe cell suspension cultures can be utilized for molecular farming for commercially synthesizing products such as vaccines, hormones, proteins, enzymes, etc

**Learning outcomes:** On completion of the courses students will be able

- Students will understand principles of plant and animal culture, media preparation and can explain In-vitro fertilization and embryo transfer technology.
- Students can describe and perform meristem culture and clonal propagation of plants on a commercial scale.
- Students will have an insight in applications or recombinant DNA technology in agriculture, production of therapeutic proteins and can describe commercial production of fuels, microbial enzymes and can apply them in research work.
- Students explain the microbial degradation of pesticides, Bioremediation& Bio-fertilizers.
- Students apply the principle, merits and demerits of plant cell,animal cell and tissue culture. Perform Cell lines, application of animal cell and tissue culture by applying biohazards and Biosafety.
- Students will know how transgenic animals, cryopreservation, apoptosis, animal cloning, cell transformation, DNA microinjection, production of vaccines is done.
- Students can give specific examples of agricultural and horticultural biotechnology applications, including genetically modified organism (GMO) crops, hydroponics, and plant-made pharmaceuticals
- Students can isolate genomic and plasmid DNA from cells, including the additional steps required for plant cell DNA isolation
- Students can purify proteins of interest from plant samples and perform assay of DNA or protein samples for their concentration and purity

- Students describe the role that *Agrobacterium tumefaciens* plays in producing genetically modified plant crops will know the methods used to produce transgenic plants, and explain the selection processes for identifying transformed plant cells
- Students describe the role of biotechnologies in food production, food processing, and food security

**PRACTICAL**-Students will be able to prepare media for plant and animal tissue culture. They will perform various culture techniques for different part of plant body, will be able to make cell count using haemocytometer, determine the quality of water and isolate various industrially important enzymes and organisms and also the organisms present in it indicating its quality.

### **PROGRAM SPECIFIC OUTCOMES (PSOs)**

- Students will be able design, conduct experiments, analyze and interpret data for investigating problems in Biotechnology and allied fields.
- Demonstrate proficiency in basic science and foundation biotechnology course.
- Demonstrate a working knowledge of advanced biological sciences.
- Demonstrate competence in application of engineering principles to biological systems.
- Higher education preparedness: Demonstrate an ability to appear for National level examination to pursue higher studies. Demonstrate practical and theoretical knowledge essential for pursuing higher studies. Several career opportunities are available for students with biotechnology background abroad especially in countries like Germany, Australia, Canada, USA and many more where biotechnology is a rapidly developing field after perusing their higher education.
- Biotechnology industry oriented preparedness: Demonstrate an ability to identify careers in biotechnology, domain like Pharmaceutical, Food Industry etc, and skills required to work in a biotechnology laboratory or manufacturing facility.
- Some of the major pharmaceutical and drug companies' hiring biotechnological professionals include Dabur, Ranbaxy, Hindustan Lever and Dr Reddy's Labs, food processing industries, chemical industry and textile industry as well. Beside this industries also employ biotechnological professionals in their marketing divisions to boostup business in sectors where their products would be required.
- Association activities Genes association of our department will carry out active research with illustrations from different spectrums in the field of Biotechnology. The association will also organize special guest lectures regularly with eminent resource persons from industry and academia.
- Entrepreneurship ventures such as consultancy and training centers can be opened

# **BIOCHEMISTRY**

## **PROGRAM OUTCOMES**

- ❖ BSc Biochemistry graduates will be able to correlate biochemistry with other branches of the life sciences.
- ❖ BSc Biochemistry graduates will be able to understand the basic mechanisms of actions related to research oriented work.
- ❖ BSc Biochemistry graduates will be able to impart the knowledge in industries and able to work in filed works also.
- ❖ BSc Biochemistry graduates will be having complete knowledge about the basics of chemistry required to understand the basic biological phenomenon.
- ❖ BSc Biochemistry graduates will be able to work on computational biology. Immunology. Agricultural sciences, pharmaceutical sciences, animal husbandry, medical sciences, molecular biology, biotechnology and in other field of biology.
- ❖ BSc Biochemistry graduates will be able to use their knowledge for drug discovery via bioinformatics approaches.
- ❖ BSc Biochemistry graduates will be able to solve any biological related problem and will have ability work in team.
- ❖ BSc Biochemistry graduates will be able to design, analyze and interpret any kind of biological data.
- ❖ BSc Biochemistry graduates will be able to justify, social, ethical and legal issues with respect to their subject.
- ❖ BSc Biochemistry graduates will be able to join in medical testing labs directly and able to get jobs in different national and international laboratories.



## **LEARNING OUTCOMES**

Upon completion of Biochemistry degree students will be able to:

1. Exhibit effective oral and written communication skills.
- 2 Exhibit critical reading, thinking and problem solving skills.
3. Demonstrate quantitative and qualitative reasoning skills.
4. Utilize scientific methods to explore biological phenomena and parameters.
5. Exhibit a solid foundation in Chemistry, Organic Chemistry and Biology.
6. Demonstrate basic laboratory skills necessary for clinical biochemistry related research.
7. Exhibit a base of knowledge in Biology, Molecular Biology, Microbiology, Immunology, Chemistry, Biotechnology etc.

## **PROGRAM SPECIFIC OUTCOMES (PSOs)**

- Students will be able to appear in various national and international competitive examinations.
- Students will be able to explore their knowledge in the subject in any conference, debate competition and seminars.
- Students will be able to face interview in different industries.
- Students will be able to demonstrate knowledge in advanced biological researches.
- Students will be able to show their proficiency in interdisciplinary sciences.
- Students will be able to enter for higher education in different national and international institutes.
- Students will be able to develop their society where they live with social harmony and equivalence.
- Students will be able to apply their knowledge in day to day life and may aware others about any superstitions by knowing them about the actual science.
- Students will be able to implicate their knowledge to develop new innovative ideas in the field of biological sciences for the betterment of human life and the development of nation.

# COURSE OUTCOMES

## SEM I

### PAPER 1- BIOMOLECULES & HUMAN PHYSIOLOGY

**Course objectives:** To give students a generalized idea about the basic aspects of biomolecules and its involvement in human physiology. This course offers interlinking phenomenon of biomolecules and human physiology so that students can be able develop research ideas to solve physiological related problems. Students will aware about how a complex mechanism of physiology governs by various macromolecules. Course provides practical approach and knowledge about various physiological aspects and biomolecules present in the body.

**Learning outcomes:** On completion of the courses

- Students will be able to know about various biomolecules present in the nature and they will able to classify them into different categories.
- Students will know how complex biomolecules like carbohydrates and lipids have their symmetry, arrangement, stoichiometry and how they modulate themselves in order to get metabolized.
- Students will know that how different biomolecules can be determined with the help of various tests and what should be the concentration in the cell.
- Students will know how good and bad biomolecules can be classified and they can affect the biochemistry of the cell.
- Students will know how cell can maintain its balance and ultimately the complete homeostasis of the human beings.
- Students will know about the different macromolecules involved in the muscle contraction and how its molecular mechanism will govern the complete locomotion.
- Students will understand the basic principal of various ions required to maintain proper ionic concentration in and out of the cell.
- Students will be able to know the complete biochemistry involved in human physiology through the actions of biomolecules.

## **SEM I**

### **PAPER 1I- MICROBIOLOGY & VIROLOGY**

**Course objectives:** This paper will give a generalized idea about various microbiological aspects to students. This course will offer a complete knowledge on microbial history, microscopes, staining, microbial growth, microbial classification etc.

**Learning outcomes:** On completion of the courses

- Students will know about the history and development of microbiology.
- Students will know about the different types of microscopes.
- Students will know about the principle, structural arrangement and applications of various microscopes routinely used in the field of microbiology.
- Students will know the biochemistry of microorganisms in a very simplified way.
- Students will know that how various types of microorganisms can be identified and classified on the basis of temperature, gases and hydrogen ion concentration.
- Students will aware about the progression of various viruses via lytic and lysogenic cycles.
- Students will know about the basic features of growth and development of various microorganisms.
- Students will know about the gram positive and gram negative microorganisms.

**Practicals:** Students will know about the qualitative analysis of proteins, lipids, carbohydrates etc. Protein estimation method, isolation of Bacteria on nutrient agar plate from water, air, skin, teeth samples etc., simple staining of Bacterial pure culture, Gram staining of bacterial pure culture. Etc.

## **SEM II**

### **PAPER I- HUMAN PHYSIOLOGY**

**Course objectives:** The objective of this course is to provide detailed knowledge to students about excretion, hematology, neurobiology, reproduction and endocrinology. This course offers complete mechanisms of action involved in the human physiology in order to maintain homeostasis of the body.

**Learning outcomes:** On completion of the courses

- Students will know about the mechanism of urine formation and how it maintains the acid and base concentration inside the body.
- Students will know about the various organs and hormones involved in the process of reproduction.
- Students will aware about the various functions and components of blood and its coagulation with the involvement of many kinds of factors.
- Students will know about the neurons and its structure and function. In addition students will know that how different ions and their concentrations maintain the complete anatomy and the physiology of the brain.
- Endocrine glands perform various functions inside of the body. Students will know about the various endocrine glands and hormones secreted by them with specific functions.

## **SEM II**

### **PAPER II- MICROBIOLOGY & IMMUNOLOGY**

**Course objectives:** This course offers the complete information related to microbial control and immunology. Students will able to correlate between pathological role of microorganism and defense mechanism via various cells and organelles. Practicals provide laboratory approaches to understand the basic mechanisms of antigen, antibody and microbial pathology.

**Learning outcomes:** On completion of the course

- Students will know about the nutritional requirement and nutritional classification of microorganisms.
- Students will know about the chemical, physical and various chetherapeutic agents to control microbial growth.
- Students will know about the basic concepts of the immunology and its various terminologies.
- Students will know about the various types of antibodies and their structures.
- Students will be informed about the production of artificial monoclonal antibodies with their various applications.
- Students will be able to correlate microbiology with immunology through various practicals.

**Practicals:** Students will know about the measurement of blood pressure by sphygmomanometer, differential leucocyte count of blood, WBC count, Estimation of urine / serum creatinine, antibiotic sensitivity of bacterial pure culture, oligodynamic activity test of copper / metal, pregnancy test, ouchterlony immunodiffusion etc.

**SEM III**

**PAPER I: MACROMOLECULES**

**Course objectives:** To offer students, knowledge about the macromolecules like protein and nucleic acids. This course provides a better understanding to students about the complex structures and functions of proteins and nucleic acids along with their complete cellular and biochemical aspects. This course allows students to develop research aptitudes required to link these macromolecules with other relevant topics or branches.

**Learning outcomes:** On completion of the course

- Students will know about properties of proteins and various biochemical reactions involved in the determination of amino acid composition.
- Students will know about the primary, secondary, tertiary and quaternary structures of the proteins.
- Students will be able to understand the basics about the DNA and its various forms.
- Students will come to know about the various DNA sequencing techniques with principle, procedure and applications.

### **SEM III**

#### **PAPER II: BIOPHYSICAL TECHNIQUES I**

**Course objectives:** This course offers techniques required to understand biochemistry in different systems. Determination of macromolecules and other physiological molecules can be determined using these techniques. It allows students to measure and quantify different parameters. It provides strong base to students to enter in the field of research.

**Learning outcomes:** On completion of the course

- Students will know about the concepts, principle, working, detection system and applications of various spectrophotometers.
- Students will know about the mechanism of action of buffer and their various types and equations.
- Students will know about the concepts, principle, working, detection system and applications of various chromatography methods.
- Students will know about HPLC and their various applications.
- Students will know about estimations and identification of various biochemical reactions and macromolecules.

**Practicals:** Students will know about the quantitative estimation of amino acids using Ninhydrin reaction, estimation of DNA by diphenylamine reaction, estimation of RNA by orcinol reaction, determination of albumin and A / G ratio in serum the validity of Beer's law for colorimetric estimation of creatinine etc.

## **SEM IV**

### **PAPER I: ENZYMOLOGY**

**Course objectives:** The objective of this course is to have complete information about the fundamentals of enzymes. This course makes students familiar to basic concepts and mechanism of action through which various enzymes work. Course also provides knowledge about kinetics equations and derivations to the students. This course makes students more familiar to enzyme related research at industrial level.

**Learning outcomes:** On completion of the course

- Students will know about various terminologies used in enzymology and will familiar with various models required to explain enzyme substrate complex.
- Students will know about enzyme regulation and their types.
- Students will able to understand the basic mechanisms underline the action of some specific enzymes like chemotripsin and ribonuclease.
- Vitamins are required for the proper functioning of the enzymes. Hence students will know about various vitamins required as a precursor for enzymes.
- Students will come to know about different mathematical equations required to explain enzymes through graphs (Ex LB plots) and what kind of inhibitors govern them.
- Students will be able to understand the purity and homogeneity of enzymes with their proper uses.

## **SEM IV**

### **PAPER II: BIOPHYSICAL & BIOCHEMICAL TECHNIQUES**

**Course objectives:** This course offers techniques like electrophoresis, centrifugation and isotopic tracer required to understand biochemistry in all kind of living cells. This course allows students to become familiar with isolation, identification and characterization of biochemical compounds. This course offers information about various immunological techniques required to link biochemistry and immunology. In addition, this course also offers knowledge about isotopic tracer techniques required to develop modern and upgraded research aptitude in students.

**Learning outcomes:** On completion of the course

- Students will be able to know about principle, procedure, uses and applications of various electrophoresis techniques.
- Students will know about the SDS PAGE electrophoresis; a most common technique routinely used in laboratories for the identification and determination of proteins.
- Students will know about the various immunological techniques like ELISA and RIA.
- Students will know about radioactive compounds and their uses to treat diseases.
- Students will come to know about the measurement of radioactivity through GM counters.
- Students will know about principle, procedure, uses and applications of various tracer techniques.
- Students will know about principle, procedure, uses and applications of various centrifuges commonly used in clinical and other laboratories.

**Practicals:** Students will know about the isolation of casein by isoelectric precipitation method, estimation of proteins by Folin-Lowry's method, fractionation of proteins by ammonium sulphate and determination of its purity by PAGE electrophoresis, SDS-PAGE of BSA & comparison of results with (PAGE) experiment etc.



## **SEM V**

### **PAPER I: METABOLISM I**

**Course objectives:** The main objective of this course is to offer complete and detailed knowledge about metabolic processes and mechanisms; through bioenergetics, metabolic techniques and glucose oxidation. This course gives an example of carbohydrate to explain metabolism to students at very basic and deep level with the complete physiology of mitochondria and electron transport chain. This course provides a strong research base to students to understand biochemistry in metabolic diseases through good and innovative practical approaches.

**Learning outcomes:** On completion of the course

- Students will know about the concepts of bioenergetics being the basic principle of all kind of metabolism.
- Students will have a detailed knowledge about the high energy compounds like ATP, GTP and creatine phosphate and the association of ATP and ADP cycle.
- Students will know about the principle, procedure, uses and applications of various metabolic techniques in different organisms and cells.
- Students will have detailed knowledge on glucose metabolism through glycolysis, PDH complex and TCA cycle.
- Students will have complete information related to glucose oxidation and its re-synthesis and the account of energy generation and utilization.
- Students will be able to correlate between interlinked metabolic cycles like malate and glycerophosphate shuttle system.
- Students will know about the complete physiology and mechanism of the electron transport chain required to synthesis energy in the form of ATP.

## **SEM V**

### **PAPER II: MOLECULAR BIOLOGY**

**Course objectives:** The main objective of this course is to provide a detailed knowledge to students regarding very basic concepts of molecular biology i.e replications and transcription in prokaryotes. This course makes the basic concepts clear to students so that they can apply this knowledge in molecular biology research and acquiring complete insights on the fundamentals of genetics. Relevant practicals suitable to topic make students more familiar with replication and transcription.

**Learning outcomes:** On completion of the course

- Students will know about the basic features of replications, semi conservative replications with experimental evidence and different models of replication.
- Students will have a complete knowledge about replication initiation, elongation and termination.
- Students will know about mechanism of action of DNA polymerases and different kinds of DNA damages and repairs.
- Students will know the basics about the process of transcription and the role of RNA.
- Students will know about the initiation, elongation and termination of transcription.
- Students will have detailed information about inhibitors of prokaryotic transcription: e.g. rifamycins, regulation of gene expression in prokaryotes: Lac Operon & Trp operon and reverse transcription.

**Practicals:** Students will know about the concentration of DNA & RNA by UV spectrophotometry, estimation of protein by Bradford method, UV spectrophotometric estimation of a given protein by E 280\260 method, colorimetric estimation of inorganic phosphate in serum by Fiske-Subbarow method, isolation of glycogen from liver source and its estimation by anthrone method, determination of true glucose by Glucometer/Glucose oxidase method, determination of glucose by Folin-Wu method.

## SEM VI

### PAPER I: METABOLISM II

**Course objectives:** This course provides a detailed knowledge about the metabolism of complex macromolecules like lipids, proteins and nucleic acids. Also, it gives a complete account on mechanism of their metabolism, energy generation and utilization. Along with this students aware about the metabolic disturbances, resulting in diseases. This course not only explains the involvement of Biochemistry in metabolism but also the various interlinked pathways. To train students in metabolic research is also the aim of this course. Relevant practicals mentioned in the course offer fundamental understanding about the topics.

**Learning outcomes:** On completion of the course

- Students will be able to know about triglycerides, Beta oxidation, HMP shunt and its connection with lipid metabolism.
- Students will know the concepts of ketogenesis, ketoacidosis and ketosis with pathology.
- Students will know about the biosynthesis of fatty acids, triglycerides and phospholipids.
- Students will be aware about the Urea cycle, transmethylation, decarboxylation and oxidative and non oxidative de-amination responsible for the protein metabolism.
- Students will know about the linkage between TCA cycle and the urea cycle, which will increase their understanding about the protein metabolism.
- As far as nucleic acid is concerned, students will know about biosynthesis of purines and pyrimidines through D Novo synthesis process.
- Students will have knowledge about gout disease and will know that how ribonucleotide converts into the deoxyribonucleotides.
- Students will know the role of cyclic AMP in the process of metabolism.
- Students will know that how the proteins and lipids which they intake via their food can be metabolized and how the protein can act as a source for the synthesis of nitrogenous bases like purines and pyrimidines.

## **SEM VI**

### **PAPER II: MOLECULAR BIOLOGY & rDNA TECHNOLOGY**

**Course objectives:** The main aim of this course is to offer a scientific technological approach towards the applications of molecular biology and rDNA technology in the field of biological sciences using fundamental principles of biochemistry. This course offers complete information about the genetic code, decoding system, the process of translation, restriction enzymes, vectors, CDNA and genomic DNA required to build a scientific temperament in students. This course fills the gap between the student knowledge and the industries demands. However, topic related practicals mentioned in the course allow students to know subject more scientifically.

**Learning outcomes:** On completion of the course

- Students will know about the features of the genetic code and wobble hypothesis.
- Students will be able to read and decode the genetic code.
- Students will know about the complete process of translation through its initiation, elongation and termination.
- Students will know about the types and use of restriction endonucleases, joining of DNA and types of vectors and their uses in rDNA technology.
- Students will have a complete knowledge about the principle, procedure and applications of PCR.
- Students will be able to know about the maintenance of gene libraries like cDNA and genomic.
- Students will know about the applications rDNA in genomic research.

**Practicals:** Students will know about the estimation of serum urea by diacetyl monoxime method, assay of activity of SGOT & SGPT, assay of activity of serum acid & alkaline phosphatase, inhibition of alkaline phosphatase activity by EDT, assay of activity of papain, determination of serum phospholipids determination of serum lipase, demonstration of isolation of genomic DNA etc.

# Computer Application

## PROGRAM SPECIFIC OUTCOME

**PSO 1.** Focuses on preparing students for roles pertaining to computer Applications and IT Industry.

**PSO2.** Developing programming skills, networking skills, packages, programming languages and modern techniques of IT.

**PSO3.** Professional skills: Attain the ability to design and develop computer applications, evaluate and recognize potential risks and provide innovative solutions.

**PSO4.** Successful Career and Entrepreneurship: Explore technical knowledge in diverse area of Computer Applications and experience an environment conducive in cultivating skills for successful career, entrepreneurship and higher studies.

**PSO 5.** Evolve as globally competent computer professionals possessing leadership skills for developing innovative solutions in multidisciplinary domain.

**PSO 6.** A few of them being like Software Programmer, System and network Administrator, Web Designer, faculty of Computer Science and Applications.

**PSO7.** Students can develop static and dynamic websites using web technologies such as HTML, CSS, ASP.Net, PHP and JAVA Script and providing connectivity with backend using Databases such as MS Access, SQL.

## COURSE OUTCOME

**Course:** C Programming[ Sem I]

### Objectives:

1. To understand the program logic.
2. To implement the program.
3. To understand the derived and user-defined data types.

**Outcomes:**

- CO1.** Before implementation of any program, student has to learn about the program logic by using program development tools like algorithm, flowcharts and pseudo code. We taught students by taking real life examples about algorithm, flowcharts and pseudo code. Now our students have learnt how to develop the logic of the program.
- CO2.** Once the algorithm/ flowchart/pseudo code part is over, the student has to implement the program code by understand the defining of variables, data types, control statements like if, while, do-while, for, switch etc. statements. They have to also type & run the program on computer. Now all the students have learnt how to write and execute the program.
- CO3.** The students have to learn about efficiency of program by understanding derived data types (array, string, function, pointers) and user-defined data types (structure, union). Students were efficiently writing the programs using derived and user-defined data types to save program execution time and memory.

**Course:** Object Oriented Programming in C++ [Sem II]

**Objectives:**

1. To understand Object oriented programming feature.
2. To implement the program using OOP concept.
3. To understand the exception handling in OOP.

**Outcomes:**

- CO1.** C++ is superset of C language. It provides the data hiding feature. Students learned the difference between C and C++. They also learn the features of OOP like classes, objects, data abstraction & encapsulation, inheritance, polymorphism, message passing & dynamic binding etc.
- CO2.** Students learned about program writing using concept of OOP by taking the example of real life applications. They also learned how to protect data from outside world using different types of visibility labels and converting C programs into C++ program.
- CO3.** When the exception is raised, program is abnormally terminated. For handling such exceptions during the execution of program, students have learned exception handling model.

**COURSE NAME :Computer Fundamentals [ BCA SEM. – I]**

**COURSE OBJECTIVE :**

- 1] To learn fundamental concepts of computers
- 2] Acquired knowledge of input and output devices
- 3] To learn operating system, programming languages and basic terminology of networking
- 4] To learn binary, octal and hexadecimal number system and its conversion

**COURSE OUTCOMES :**

- CO1 : Bridge the fundamental concepts of computers with the present level of knowledge of the students
- CO2 : Understanding the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming
- CO3 : Familiarise operating systems, programming languages, peripheral devices, networking, multimedia and internet
- CO4 :Understand binary ,octal and hexadecimal number systems and their arithmetic

**Course Objective:**

The objective of the course is to provide knowledge to students

1. To understand basic concept of Propositions, Predicates, Boolean algebra, Logic
2. To demonstrate the knowledge of set notation and set theory.
3. To understand the concept of permutation, combination and functions.
4. To study Relations, Functions and its types and apply counting principles to solve problems
5. To determine Semi group and groups and solve problems on lattices.
6. To study graph Theory and Trees and analyze Euler and Hamiltonians path and circuit.

**Course Outcome:-**

CO 1:- Students will be able to solve problems based on Proposition, Predicates and Logic. Logic topic will

help them a lot in Digital Electronics which they will be learning in further semester.

CO 2:- Students will be able to perform various operations based on Sets theory.

CO3:- To understand and solve the problems related to relations and functions.

CO 4:- To Comprehend with Group, Lattices and its Properties.

CO 5:- Students will be able to solve problems on graph theory .the Graph theory has application in various field of computer science like, Computer Graphics ,Data Structure, Artificial Intelligence etc. All these Topics will help the students to understand various important concepts of other subject of the course in higher studies.

## **Course:E-commerce [Sem II]**

### **Course Objective:**

- 1) To study the fundamental principles of e-commerce and e-business and the role of management.
- 2) To study relationship including Business to Consumer, Business to Business.
- 3) To study the technical foundation for understanding information system.
- 4) To study implement strategy in the new economy.

### **Course Outcome:**

- CO1 The students learned the impact of information and communication technology specially of the internet in business operation.
- CO2 The students learned analyzing branding and pricing strategies and they also learned determining the effectiveness of market search. They also learned internet trading relationship including Business to Consumer, Business to Business and intra organizational.
- CO3 The students learned how to be aware of the ethical, social and security issues of information system.
- CO4 The students learned the insight on how to implement strategy in the new economy. Provide analytical tools to understand the opportunities in un-served and new economy market

## **COURSE NAME : Linux Operating System [ BCA SEM.- II]**

### **COURSE OBJECTIVE:**

- 1] To learn linux utilities, file processing operations, directory structure and security issues.
- 2] To learn how to use Linux operating system which help us in office work, technical and software development task
- 3] To learn Linux commands and shell script programs to solve problems



## **COURSE OUTCOME**

CO1 : Students able to identified and used Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.

CO2 : Students effectively used the Linux Operating system to accomplished typical personal, office, technical, and software development tasks.

CO3 : Students able to choose appropriate Linux operating system commands to make effective use of the environment and write efficient, effective scripts with documentation to solve problems

## **Course Name: Office Automation [BCA SEM-I]**

### **Course objective:**

1. To get familiar with basics of the Windows operating System
2. To learn Word Processing software such as Microsoft word
3. To learn MS Excel and its features
4. To learn MS Power point presentation

### **Course Outcomes:**

**CO 1.** Students were able to understand working of windows operating system and got expertise in handling various windows operations & utilities

CO2.students were able to Create effective & efficient word documents using various

Feature of word.

CO 3. Students were able to create different spreadsheet like mark list, attendance sheet, balance sheet, budget .also they were able to create various charts

CO 4. Students were able to create effective power point presentation with various design and animation effects

### **Course Objective:**

The objective of the course is that the student will be able to know about

1. Basic concept and functions of modern operating system.
2. The concept of CPU Scheduling Algorithm.
3. What is deadlock and how to handle deadlock.

4. To learn the concept of I/O and file management.
5. To learn the concept of various memory management.
6. Students would learn the concept of security of operating system.

### **Course Outcome:-**

Upon the successful completion of this course, Student will be able to understand

CO 1:- Fundamental understanding the role, function and services of operating system.

CO 2:- Students would have acquired the knowledge related to CPU scheduling algorithms.

CO 3:-Students would be able to categorized the difference between different process, thread and multi- Threading.

CO 4:-Students will gain the knowledge about the concepts of deadlock in operating system and how they can be managed /avoided and implement them in multithreading system.

CO 5:- They will have the knowledge about the different types of I/O management, disk scheduling, and protection and security problems faced by operating systems and how to minimize these problems if occurred.

### **COURSE NAME: Statistical Methods [BCA SEM I]**

### **COURSE OBEJECTIVES:-**

1. Knowledge about different types of distribution.
2. Ability to estimate different distributions and knowledge about sampling methods.
3. Basic idea of permutations and combinations and probability concepts.
4. Knowledge regarding how to conduct hypothesis testing.
5. Evaluate expectations and conditional expectations of random variable.

### **COURSE OUTCOME:-**

CO 1.Evaluate the probabilities and conditional probabilities.

CO 2. Approximate the distribution of sum of random variable.

CO 3. Calculate the number of samples needed to construct mean and variance of a normal distribution.

CO 4. Use linear regression analysis to develop an empirical model of experimental data.

CO 5. An ability to design and conduct experiments as well as to analyze and interpret data.

## **Course: System Analysis and Design [Sem II]**

Throughout this course the students will try to learn:

### **Course Objective:**

- 1) To study the system, subsystem, SDLC, feasibility study and data collection techniques.
- 2) To study the tools and techniques of data analysis.
- 3) To study and understand the system testing and conversion methods.

After the completion of the course, the students must be able to:

### **Course Outcome:**

- CO5 The students learned about the system, the steps for building the system, the economic, technical and operational feasibility of the system. They learned and understands the different data collections methods for the system such as interviews, questionnaires and onsite observation.
- CO6 The students studied the Data Flow Diagram and the other tools required to design the system.
- CO7 The implemented system tested using different testing methods, such as unit testing, integeation testing, white box testing, black box testing etc.

### **Course Objective:**

The main objective of the course is to educate the students with fundamental concepts od Data Base management System, Data Models, Different data base languages, Relational Algebra and Normalization Techniques.

### **Course Outcome:-**

Upon the successful completion of this course, Student will be able to

CO 1:- To analyze data base design methodology.

CO 2:- Acquire Knowledge in Fundamental of data base management system.

CO 3:- Analyze the difference between the traditional file system and DBMS.

CO 4:- Handle with different data base languages.

CO 5:- Draw various data model using ER modeling for real life applications along with that they will be able to construct queries mathematically through relational algebra.

## **Course:**Data Structures [Sem III]

Throughout this course the students will try to learn:

### **Course Objective:**

- 1) To study how the data is stored in computers memory for easy access.
- 2) To study the linear data structures.
- 3) To study the non-linear data structures.

After the completion of the course, the students must be able to:

### **Course Outcome:**

- CO8 The students learned about storing data in computers memory for getting efficient access for programs.
- CO9 They learned and implemented the linear data structures such as linked list, stacks and queues. They handled the different operation on data structures such as insertion, deletion, searching, sorting and merging.
- CO10 They learned and implemented the non-linear data structures such as trees and graph. Also they studied the practical applications of these data structures.

## **Course:** Digital Electronics-I [Sem III]

### **Objectives:**

1. To understand number systems.
2. To convert one number system to another.
3. To understand logic gates and designing of logic circuits.
4. To understand binary arithmetic.

### **Outcomes:**

- CO1. The computer hardware uses different types of number systems like binary, octal, hexadecimal, ASCII code, BCD code, EBCDIC code, gray code etc. The students learned about different number system and their applications.

- CO2.** The students learned how to convert from decimal to binary/octal/hexadecimal number system & vice versa, from octal to binary/decimal/hexadecimal number system & vice versa, from hexadecimal to binary/decimal/octal number system and vice versa etc.
- CO3.** The students learned different types of gates like NOT, AND, OR , NOR, NAND, EX-OR, EX-NOR and their truth table, circuit diagram and symbol. They also learned how to design logic circuits using logic gates.
- CO4.** The students learned about the binary addition, binary subtraction using 1's and 2's complements.

## **Course:Digital Electronics II[Sem IV]**

### **Course Objective:**

- 1) To study sequential and combinational circuits
- 2) To study Architecture of 8086 microprocessor
- 3) Study of assembly level programming (8086 microprocessor)

### **Course Outcome:**

- CO11 The students learned about the construction and working of Adder, subtractor, multiplexer, demultiplexer, decoder, encoder, Flip flops, counters and shift register.
- CO12 The students learned about block diagram and pin diagram of 8086 microprocessor and the detail working of 8086.

The students first understood the instruction and the assembler directives set used in 8086. They executed the programs in **MASM** assembler. After executing the programs, the students understood the difference between Assembly level, machine level and high level programming languages.

## **COURSE NAME: Operations Research [BCA SEM. – III and IV]**

### **Course Objectives:-**

1. The goal of this course is to teach to formulate, analyze, solve mathematical models that represent real world problems.

2. It aims to use quantitative methods and techniques for effective decision making, model formulation and applications that are used in solving business decision problems.
3. To learn linear programming, network flow problems, integer programs, nonlinear program, dynamic programming and queuing models.

**Course Outcome:-**

CO 1. Formulate a real world problem as a mathematical programming model.

CO 2. Understand the theoretical workings of the simple method for linear programming.

CO 3. Understand the relationship between a linear program and its dual.

CO 4. Solving transportation and assignment models.

CO 5. Solving network models like shortest path, minimum spanning tree and maximum flow problems.

CO 6. To be able to solve theory of games.

**Course: Software Engineering[Sem IV and V]**

Throughout this course the students will try to learn:

**Course Objective:**

- 1) To study different changing Nature of Software.
- 2) To study how to apply Software Engineering lifecycle.
- 3) To study the process assessment and personal and team process model.
- 4) To understand the concept of design pattern.
- 5) To be capable of applying his knowledge to create software architecture.
- 6) To study black box testing techniques.

After the completion of the course, the students must be able to:

**Course Outcome:**

- CO13 The students learned the ability to work Significantly in all application domain from System Software to Embedded software to Artificial Intelligence and Robotics.
- CO14 They learned how to apply the software engineering lifecycle by Demonstrating the use of requirement analysis from Communication, Planning, Analysis design, Construction and Deployment.

- CO15 They learned to demonstrate and ability to use the techniques tools necessities for engineering practice and to work as an individual and as a part of multidisciplinary team to deliver quality software.
- CO16 They identified the appropriate design pattern to solve object oriented design problem and construct design solution by using behavioral patterns.
- CO17 The students learned to Understand the software architecture and build the system from the component.
- CO18 The students learned to test the software without the knowledge of internal structure of program or application.

### **Course Objective:**

The objective of the course is that the student should understand.

1. To build the strong foundation in database concept
2. Students will be able to learn the concept of View, Procedure, Cursor, Exception Handling.  
Functions, Triggers.

### **Course Outcome:-**

After undergoing the lab (practical) module the students should be able to

CO 1:- Understand the underlying concept of database technique.

CO 2:- Design and implementation of data base schema for a given problem domain.

CO 3:- Students will be able to handle with different database languages.

CO 4:- Students will be able to deal with Table, View, Procedures, Functions, Triggers.

CO 5:- Introduction to different database packages (Oracle/MYSQL/DB 2 etc).

CO 6:- Students will be able to use data base connectivity as front end.

CO 7. By the end Students will be able create projects.

**Course:** Theory of Computation [Sem IV]

### **Objectives:**

1. To understand finite automata and regular expression.
2. To understand context free grammar and pumping lemma.
3. To understand Pushdown Automata.

**Outcomes:**

- CO1.** Students learned about implementation of DFA (Deterministic Finite Automata) and NFA (Non-Deterministic Finite Automata). They also learned about regular expressions with the application on finite automata.
- CO2.** Students learned about how to design the new language by Context Free Grammar (CFG). They learned about applications of CFG i.e. Greibach Normal form (GNF) and Chomskey Normal Form (CNF).
- CO3.** Students learned about Push Down Automata and Context Free Language. They also learned pumping lemma for CFL.

**COURSE NAME :Visual Basic Programming [ BCA SEM.- III]****COURSE OBJECTIVE :**

- 1] Acquired knowledge of programming skill, essential features and capabilities of Visual Basic Programming and Graphical user interface
- 2] To learn programming concepts, programming logic and event driven programming
- 3] To develop application using Visual Basic programming

**COURSE OUTCOMES:**

- CO1 : Students acquired the skills and knowledge required to use essential features and capabilities of Visual BASIC, a programming system used to produce Graphical User Interfaces and applications in a Windows environment.
- CO2 :Students studied basic programming concepts, problem solving, programming logic, and the design of event-driven programming.
- CO3 :Develop and debug applications using Visual Basic Programming that runs under Windows operating system.

**Course Name: Web Technology I & II [BCA SEM-III & BCA SEM- IV]****Course objective:**

1. To get familiar with basics of the Internet Programming.
2. To acquire knowledge and skills for creation of web site considering both client and server side
3. To gain ability to develop responsive web applications



**Course Outcomes:**

- CO 1.Students Implemented interactive web page(s) using HTML, CSS and JavaScript.
- CO 2.Students were able to Design a responsive web site using HTML5 and CSS3.
- CO 3.Students were able to Demonstrate Rich Internet Application. Build Dynamic web site using DHTML , JSP.

**Course:** ASP.Net [Sem VI]

**Objectives:**

1. To understand XML.
2. To understand web development in ASP.Net.
3. To understand ADO.Net.

**Outcomes:**

- CO1.** Students learned about XML programming, XML schema, DTD, embedding XML with CSS with real life examples. They also learned about DOM Parser and SOAP.
- CO2.** Students learned about ASP.Net web programming with basic & rich controls like calendar, AdRotator etc by using validation controls. They also learned how to configure IIS Web Server and run the web application on browser.
- CO3.** Students learned about accessing data with ADO.NET relational database & SQL. They also learned about data-bound controls like Data Grid, Data List & Repeaters by using examples.

**Course:** Compiler Construction[Sem V]

Throughout this course the students will try to learn:

**Course Objective:**

- 7) To study about the compilers and other translators.
- 8) To study the different phases of compilation process.
- 9) To study the different parsing techniques.

After the completion of the course, the students must be able to:

**Course Outcome:**

- CO19 The students learned about of the machine converts high level language into machine language for the successful execution of the program. They also studied the other translators such as assembler and interpreter.
- CO20 They learned about the whole compilation process, all five phases of compiler in detail.
- CO21 They studied about, how the expression is evaluated by the compiler using different parsing techniques.

**COURSE NAME: Computer Graphics [BCA SEM. – V and VI]**

Course Objective:

Through this course student will try to learn:

1. To introduce the use of components of a graphics system and become familiar with building approach of graphic system components and algorithms related with them.
2. The basic principles of two dimension and three dimensional computer graphics.
3. To provide an understanding of how to scan convert the basic geometrical primitives, to transform the shapes, to fit them as per the picture definition.
4. Provide an understanding of mapping from world coordinate to device coordinates, clipping and projections.
5. To be able to discuss the applications of computer graphics concepts in the development of computer games, information visualization and business application.

Course Outcome:

After the completion of the course the student must be able to:

CO1. List the basic concepts used in Computer Graphics.

CO2. To implement various algorithms, to scan convert the basic geometrical primitives, transformation, Area filling and clipping.

CO3. To describe the importance of viewing and transformation.

CO4. To define fundamentals of animation.

CO5. To understand typical graphics pipeline.

**COURSE NAME: Data Communication and Network – I [ BCA SEM. – V]**

**COURSE OBJECTIVE:**

- 1 ] To learn fundamental concepts of computer networking
- 2] To learn basic taxonomy and terminology of the computer network area
- 3] To design and maintenance of individual network

**COURSE OUTCOMES:**

CO1 :Students were able to understand the fundamental concepts of computer networking.

CO2 : Students got familiarized with the basic taxonomy and terminology of the computer networking area.

CO3 : Students were able to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

**Course: Data Communication and Networks [Sem VI]**

**Course Objective:**

- 10) To study the OSI reference model in detail
- 11) To study ISDN

**Course Outcome:**

- CO22 The students learned about the services provided, protocols used, networking devices used and function of in each and every layer of OSI reference model.
- CO23 The students learned about the basics of Integrated Services Digital Network(ISDN), Interfaces of ISDN, Transmission structure, ISDN Protocols and broadband ISDN

**Course name : Java Programming [ BCA SEM-VI]**

**COURSE OBJECTIVE :**

- 1] To learn concept of Object Oriented Programming & Java Programming Constructs
- 2] To learn basic concepts of Java such as operators, classes, objects, inheritance, packages, Enumeration ,various keywords
- 3] To learn exception handling, Input/output operations, Java applet, Event Handling and Abstract Window Toolkit

## **COURSE OUTCOMES :**

- CO1 : Students were able to understand concept of Object Oriented Programming & Java Programming Constructs.
- CO2 : Students were able to understand basic concepts of Java such as operators, classes, objects, inheritance, packages, Enumeration and various keywords.
- CO3 : Students were able to understand the concept of exception handling and Input/ Output operations.
- CO4 : Students were able to design the applications of Java ,Java applet and analyze ,design the concept of Event Handling and Abstract Window Toolkit.
- CO5 : Students were able to write a project that may be selected from among the following: applets for inclusion in web pages; applets to access enterprise data bases in robust, enterprise three level applications; secure communications over the internet.

## **Course Name: PHP – I & II [BCA SEM-V & BCA SEM- VI]**

### **Course objective:**

1. To get familiar with server side web based programming
2. Gain the PHP programming skills needed to successfully build interactive, data-driven sites
3. Work with regular expressions, handle exceptions, and validate data

### **Course Outcomes:**

- CO 1. Students were able to develop server side application using PHP
- CO 2. Students were able to build Database, establish connectivity with databases like My SQL using PHP
- CO3. Students were able to handle data from user, validate data so that error free application being developed

## **Course: Software Engineering[Sem IV and V]**

Throughout this course the students will try to learn:

### **Course Objective:**

- 12) To study different changing Nature of Software.
- 13) To study how to apply Software Engineering lifecycle.
- 14) To study the process assessment and personal and team process model.
- 15) To understand the concept of design pattern.
- 16) To be capable of applying his knowledge to create software architecture.
- 17) To study black box testing techniques.

After the completion of the course, the students must be able to:

**Course Outcome:**

- CO24 The students learned the ability to work Significantly in all application domain from System Software to Embedded software to Artificial Intelligence and Robotics.
- CO25 They learned how to apply the software engineering lifecycle by Demonstrating the use of requirement analysis from Communication, Planning, Analysis design, Construction and Deployment.
- CO26 They learned to demonstrate and ability to use the techniques tools necessities for engineering practice and to work as an individual and as a part of multidisciplinary team to deliver quality software.
- CO27 They identified the appropriate design pattern to solve object oriented design problem and construct design solution by using behavioral patterns.
- CO28 The students learned to Understand the software architecture and build the system from the component.
- CO29 The students learned to test the software without the knowledge of internal structure of program or application.

**Course: Software Testing[Sem VI]**

Throughout this course the students will try to learn:

**Course Objective:**

- 18) To study the Role of Process in Software Quality and testing as a Process.
- 19) To study Origin of Defects? How to calculate the cost of Defect ?
- 20) To study different Defect Prevention Strategies methods.
- 21) To study Need of Level of Testing.
- 22) To study the Role of Three Group in Testing and Policy Development.

After the completion of the course, the students must be able to:

**Course Outcome:**

- CO30 The students learned about testing as a Process how it can be classified into Verification and Validation testing Process. They also learned and understand the different aspects of testing process the Technical Aspect, Managerial Aspect and Economic aspect of testing Process.
- CO31 The students studied the factors which causes the Defects to enter in software . The Impact the Defect have on Software Artifacts. And the Impact of Defect from users point of view. The students also learned how to calculate the real life Cost of the Defect in the Software Project.

- CO32 They learned the different Methods Such as Pareto Analysis and Fishbone Analysis and how it can be used in software and defect prevention techniques such as Review and Inspection , Walkthroughs Defect logging and Documentation.
- CO33 The students studied all the levels in testing Unit Testing , Integration testing ,System Testing and Acceptance testing. They learned how to Design and Plan each of this test and record there results in Test Logs.
- CO34 The students studied the Role of Managers , Developers / Tester and User Client in Software Development .

**Course:** Visual Basic.Net [Sem V]

**Objectives:**

1. To understand .Net framework and .Net programming
2. To understand interface design and implements.
3. To understand user interface, menus, toolbars & MDI application.

**Outcomes:**

- CO1.** The student learned .Net frameworks contain three major parts: common language runtime, the framework class library and ASP.Net. .Net provides the language interoperability because of which each language can be used in other languages. It mainly supports C#, VB, J# etc. They learned about Microsoft Visual Studio IDE for developing the .Net framework applications.
- CO2.** Students learned about implicit & explicit interface design and implements by understanding the concept of interfaces like ICloneable, IComparable etc.
- CO3.** Students learned how to design user interfaces using menus, toolbars and MDI application by taking real life examples like stop watch, designing of standard & scientific calculators, measurement converters of mass, temperature, volume, length etc.

# PG Science PO\_PSO\_CO

## M.Sc. Biotechnology

### *Goals of M.Sc. Biotechnology Course*

- To inculcate scientific temperament and problem solving skills in the field of Biotechnology among young graduates.
- To train graduates in developing research aptitude and encouraged to share and resolve their scientific curiosity through scientific method and critical and rational thinking.
- To train graduates in state of art laboratory skills so as to be able to perform proper experiments in laboratory, communication skill so as to convey their ideas and innovation and entrepreneur skill to generate self-employment.

### *Objectives of M.Sc. Biotechnology Course*

- To develop the scientific temper, critical thinking and communication skills in the field of Biotechnology
- To develop basic laboratory skill through individual hands on training.
- To develop understanding of scientific foundation of Biotechnology and its application in the development of Nation.
- To develop attitudes for innovation and entrepreneurship in the field of Biotechnology.
- To develop disciplined, just and law abiding citizen.

### *Program Outcome of M.Sc.*

On the completion of M.Sc. student must be able to

1. Fulfill the Fundamental duties mentioned in The Constitution of India in article 51 A, focusing on clause 51 A (h) that is **“develop the scientific temper, humanism and the spirit of inquiry and reform.”**
2. Remember and comprehend major scientific phenomenon and apply them for their career advancement through competitive exams and get better positions.
3. Communicate their ideas clearly to people from all backgrounds in written and spoken format.
4. Collaborate with other fields for development of innovative solution for environmental, industrial and other problems.
5. Serve society for its advancement through constructive research and ethical practices.
6. Be job ready and work in any sector.

### ***Program Specific Outcomes of M.Sc. Biotechnology***

On the completion of M.Sc. Biotechnology students must be able to

1. Remember and Understand complex phenomenon in Life sciences and techniques in Biotechnology and apply this knowledge to understand the current scientific questions and find out the solution of complex scientific problems
2. Effectively communicate complex scientific concepts and his/her research to scientific community and general public. They must be able to understand and write scientific literatures and reports and make effective presentation.
3. Exhibit their knowledge about recent development in the field of Biotechnology
4. Be skillful to work in various sectors related to biotechnology like Pharmaceutical industries etc.
5. Investigate of complex scientific problems and construct proposal for effective solution
6. Be skillful in handling laboratory equipment and perform experiments in very controlled and systematic manner while taking care of instruments.
7. Be aware of societal problems which can be solved by biotechnology and develop solution for it.
8. Be sensitive towards environmental issues
9. Practice ethical principles and bind to professional ethics and responsibilities and norms in every walks of life
10. Work in as an individual as well as as a team member.
11. Be a lifelong learner.

### ***Course Outcomes of M.Sc. Biotechnology***

M.Sc. Biotechnology is 4 semester course conducted by Dr. Ambedkar College, Deekshabhoomi, Nagpur as per the syllabus provided by Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur. Each semester students have to take four theory paper, two Practicals based on four theory papers and a Seminar. Fourth semester have a six month Research Project Work. Course work is according to theory paper, practicals and seminar conducted throughout the program.

## **M. Sc. BIOTECHNOLOGY**

### **Semester I**

#### **Paper – I (Code: 1T1) Cell Biology and Enzymology**

*Course outcome Students will be able to*

- Remember and understand the structure and function cells, sub cellular organelles Cellular communication and Cell cycle.
- Remember and understand the Basic concepts of Enzymology and Enzyme Kinetics.



- Analyses the mathematical derivations in understanding enzyme kinetics and different transformation and its application.
- Understand the concept of Enzyme Engineering and immobilization

### **Paper – II (Code: 1T2)Molecular Biology**

*Course outcome Students will be able to*

- Remember and understand the fundamental concepts of Molecular Biology and the experiments involved in it.
- Relate the concepts of Molecular Biology in the development of Biotechnological.

### **Paper – III (Code: 1T3)Biomolecules**

*Course outcome Students will be able to*

- Remember and understand the biochemistry and diversity of Carbohydrates, Proteins, Lipids and Nucleic acids.
- Recognize their importance in Biotechnological processes

### **Paper – IV (Code: 1T4)Biophysical Techniques**

*Course outcome Students will be able to*

- Remember and comprehend techniques and instrumentation involved in studying basic biological phenomenon focusing on Spectrophotometry, Chromatography, Electrophoresis, Centrifugation viscosity and radioactivity.
- Evaluate the application of each technique in providing solution to biotechnological problems.

### **LAB I (Code: 1P1)Cell Biology and Enzymology**

*Course outcome Students will be able to*

- Perform major experiments in cell biology and enzymology
- Work well and carefully in laboratory environment and with instruments

### **LAB II (Code: 1P2)Macromolecules & Analytical Techniques**

*Course outcome Students will be able to*

- Perform major basic in biochemistry
- Perform basic techniques in understanding biomolecules and Biophysical techniques.

## **M. Sc. BIOTECHNOLOGY**

### **Semester II**

#### **Paper – I (Code: 2T1)Microbiology**

*Course outcome Students will be able to*

- Remember and Understand basic concepts of Microbiology
- Appreciate the diversity of microorganisms and their application in biotechnology.
- Comprehend the concept of chemotherapy and understand and evaluate the Drug resistance in Microbes.

#### **Paper – II (Code: 2T2)Immunology**

*Course outcome Students will be able to*

- Remember and Understand basic concepts of Immunology.
- Appreciate and assess the various immunological techniques used for public health.

#### **Paper – III (Code: 2T3) Fundamentals of Genetic Engineering**

*Course outcome Students will be able to*

- Remember and Understand fundamental concepts of Genetic Engineering
- Illustrate and compare different techniques involved in Genetic Engineering

#### **Paper – IV (Code: 2T4)Applied Molecular Biology**

*Course outcome Students will be able to*

- Gain knowledge of Recombination and Genome Mapping and its application in Biotechnology
- Comprehend the concept of Antisense, Ribozymes and Epigenetics and there application
- Understand basic concept of Cancer Biology and stem cells.

#### **LAB I (Code: 2P1)Microbiology & Immunology**

*Course outcome Students will be able to*

- Acquire basic Microbiology laboratory skills like bacterial pure culture isolation, microscopy and biochemical analysis of microbes
- Understand experiment in Immunology

#### **LAB II (Code: 2P2)Genetic Engineering & Applied Molecular Biology**

*Course outcome Students will be able to*

- Acquire laboratory skills involved in Genetic Engineering and Molecular Biology.
- Understand the handling of laboratory instruments and chemicals involved in Genetic Engineering.

## **M. Sc. BIOTECHNOLOGY**

### **Semester III**

#### **Paper – I (Code: 3T1) Genetic Engineering & its Applications**

*Course outcome Students will be able to*

- Understand the concepts of Prokaryotic and Eukaryotic Transformation and PCR
- Describe the expression of heterologous genes and the vectors involved in it.
- Appreciate technology involved in industrial products of Protein engineering.
- Explain and illustrate techniques like Phage display and gene therapy

#### **Paper – II (Code: 3T2) Plant Biotechnology**

*Course outcome Students will be able to*

- Remember and understand the concept of Plant Biotechnology
- Differentiate between different plant tissue culture techniques.
- Comprehend different techniques to produce better crop via applying the principles of biotechnology
- Understand concepts of Plant Metabolic Engineering

#### **Paper – III (Core Elective A) (Code: 3T3A) Industrial Biotechnology I**

*Course outcome Students will be able to*

- Remember and Understand the design and functioning of different types of Bioreactors and Downstream processing
- Evaluate the application of different types of Bioreactors including immobilization reactor system and its kinetics

#### **Paper – III (Core Elective B) (Code: 3T3B) Environmental Biotechnology I**

*Course outcome Students will be able to*

- Remember and Understand the principles of Environmental Science & Bioresources

#### **Paper – IV (Foundation Paper I) (Code: 3T4A) Introductory Biotechnology**

*This course is allowed for students of M.Sc. from subjects other than Biotechnology. Therefore the students in this course will be from field other than Biotechnology and will not have background of Biotechnology. Students will be able to*

- Comprehend the structure and function of macromolecules such as Proteins and Nucleic Acid and their arrangement in Cell
- Understand the concept of genes and enzymes

**Paper-IV: (Core Subject Centric I) (Code: 3T4B) Diagnostic Medical Biotechnology Molecular and Nanomolecular Diagnostics**

*Students who are not opting for foundation course in any other subject (other than Biotechnology) can opt for this course.*

*Course outcome Students will be able to*

- Demonstrate an understanding of Disease Diagnostic technology under medical Biotechnology and Molecular and Nanomolecular Diagnostics

**LAB I (Code: 3P1) Genetic Engineering & Plant Biotechnology**

*Course outcome Students will be able to*

- Skillfully perform basic experiments in Genetic engineering and plant Biotechnology
- Handle sophisticated laboratory equipment and reagents

**LAB II (Core Elective A) (Code: 3P2) Industrial Biotechnology**

*Course outcome Students will be able to*

- Skillfully perform basic experiment in Industrial Biotechnology

**LAB II (Core Elective B) (Code: 3P2) Environmental Biotechnology**

*Course outcome Students will be able to*

- Skillfully perform basic experiment in Environmental Biotechnology

**M. Sc. BIOTECHNOLOGY**

**Semester IV**

**Paper – I (Code: 4T1) Animal Biotechnology**

*Course outcome Students will be able to*

- Remember and Understand the Fundamental Concepts of Animal Cell Culture techniques.
- Understand and envision the future Commercial aspects of Animal Cell culture

**Paper – II (Code: 4T2)Biostatistics, Bioinformatics, Ethics & Patenting**

*Course outcome Students will be able to*

- Understand the underlined concepts of Biostatics, Bioinformatics, Ethics and patenting and its application in the field of Biotechnology

**Paper – III (Core Elective A) (Code: 4T3A)Industrial Biotechnology II**

*Course outcome Students will be able to*

- Remember and Understand the advanced concept of Industrial Biotechnology
- Evaluate the production of Primary and Secondary Metabolite

**Paper – III (Core Elective B) (Code: 4T3B)Environmental Biotechnology II Applied Environmental Biotechnology**

*Course outcome Students will be able to*

- Remember and Understand the advanced concept of Environmental Biotechnology and effects of xenobiotics in environment
- Evaluate the functioning of technology involved in Waste water treatment

**Paper – IV (Foundation Paper II) (Code: 4T4A)Basic rDNA Technology**

*This course is allowed for students of M.Sc. from subjects other than Biotechnology. Therefore the students in this course will be from field other than Biotechnology and will not have background of Biotechnology. Students will be able to*

- Comprehend the basics of recombinant DNA Technology
- Understand the concept of gene cloning

**Paper-IV: (Core Subject Centric II) (Code: 4T4B)Therapeutic Medical BiotechnologyMolecular Therapeutics and Drug Discovery**

*Students who are not opting for foundation course in any other subject (other than Biotechnology) can opt for this course.*

*Course outcome Students will be able to*

- Understand and evaluate the fundamental of Therapeutic Medical Biotechnology
- Illustrate the process of Drug Discovery and Clinical research

**LAB I (Code: 4P1)Animal Biotechnology, Biostastics, Bioinformatics, Ethics & PatentingAnd Industrial Biotechnology II or Environmental Biotechnology**

*Course outcome Students will be able to*

- Skillfully perform the experiments involving the fundamentals of Biostatistics, Bioinformatics, Animal Cell culture techniques and experiments related to the elective paper opted by them

**Project (Code: 4PROJ1)**

*Every student is required to carry out a project work in semester IV. The project can be of following types. A) Experimental Project Work; OR B) Field Based Project Work; OR C) Review writing based Project Work.*

*Course outcome: Students will be able to*

- Develop the critical thinking ability and communication skills.
- Understand and apply the scientific method.
- Develop the aptitude to work on a scientific problem and look for alternative solution.
- Write their finding in a form of a thesis and defend it by presenting it in front of their teachers and examiners.
- Experience and embrace the habit of ethical practice in performing experiments and communicating them

**Seminar (Code: 1S1, 2S1, 3S1 and 4S1)**

Class seminar are conducted every semester to develop communication skills of students. Students will be able to comprehend the current research and should be able to put forward major ideas in front of their colleagues and teachers. Students will be evaluated on the basis of their presentation and questions and answer session.

## M. Sc. Organic Chemistry

### Program Outcomes

The programme outcome enables the students of chemistry to:

- Understand about basic fundamentals and terminologies in organic chemistry.
- Prepare organic compounds of pharmaceutical and industrial applications.
- Understand about various name reactions and their mechanisms.
- Learn about different types of polymerization reactions.
- Characterization of organic compounds using Mass, UV, IR and NMR spectroscopy.
- Improve their laboratory skills and handling of chemicals safely.
- Acquire theoretical and practical knowledge of reaction methods and their mechanisms.
- Understand how to design the compound, synthesize it and purify it to determine the structure of the final compound.
- Improve their thinking power and skills in research area so they can apply for higher studies.
- Develop the skill and ability to clear competitive examinations.
- Learn ICT based tools, modern techniques, equipments and softwares.

### Program Specific Outcomes

- Students will demonstrate and understand the nature and bonding in organic molecules.
- Students will be able to understand the various types of elimination reactions, nucleophilic substitution reactions, electrophilic substitution reactions, molecular rearrangement.
- Students will be able to understand the mechanisms of the reactions and determine the structure of organic molecules.
- Students will learn the importance of green chemistry and its advantages.
- Students will demonstrate and understand the nature of free radical reactions and pericyclic reactions.
- Students will be able to understand oxidizing and reducing reagents.
- Students will demonstrate and understand the nature of P, S, Si, B and other organometallic compounds and transition metal in organic synthesis.
- Students will be able to understand isolation and synthesis of natural compounds with proper mechanism.

- Students will be able to understand about organometallic reagents and their application in organic synthesis.
- Students will be able to demonstrate and understand protection and deprotection of functional groups.
- Student will be able to learn disconnection approach for the synthesis of organic compounds.
- Student will be able to learn about how the enzymes have special effect on synthesis and their mechanisms.
- Student will be able to learn how to synthesize benzofused, heterocycles, diazines and azoles compounds.
- Students will be able to understand drugs activity, physiological activity to the drug therapy and pathological phenomenon.
- Understand good laboratory and best practices.
- Student will be able to learn about how to work on small research project.
- Understand and apply principles of organic chemistry for understanding the scientific phenomenon in reaction mechanism.

## Course Outcomes

### Semester 1

#### CH-101: Paper I (Inorganic Chemistry)

- CO-1. Learn about geometry, shape and structures by using VSEPR model.
- CO-2. Learn about bonding and molecular structures of coordination compounds by studying Crystal Field Theory & Molecular Orbital theory.
- CO-3. Learn molecular orbital of metal complexes and their stereochemical aspects.
- CO-4. Learn and understand structure, bonding in boranes and metal-metal clusters.
- CO-5. Find out reaction mechanism of transition metal complexes by the point group of inorganic molecules.
- CO-6. Understand spectrophotometric method (Job's and Mole ratio method) to know stability of metal-ligand complex.

#### CH-102: Paper II (Organic Chemistry)

- CO-1. Learn nature and bonding in organic Molecule, aromaticity and chemical reactions of various reaction intermediates.
- CO-2. Study about conformational analysis of organic molecules and their stereochemistry.
- CO-3. Study about types of reaction and mechanism and Curtin Hammet principle.
- CO-4. Learn  $S_N1$ ,  $S_N2$ , mixed  $S_N1$ ,  $S_N2$  and SET and  $S_Ni$  mechanisms.



**CO-5. Learn classical and non-classical carbocation, NGP by  $\pi$  and  $\sigma$  bonds.**  
**CO-4. Understand the concepts of Aromatic nucleophilic substitution and aromatic electrophilic substitution and understand their mechanism in different type of reactions.**

**CH-103: Paper III (Physical Chemistry)**

**CO-1. Study the terms ionic strength, activity coefficient, Carathéodory's principle and its applications.**  
**CO-2. Study recapitulation of surface tension, adsorption theories and effect of enthalpy and entropy.**  
**CO-3. Understand the adsorption of gases by solid isotherms.**  
**CO-4. Study about partial molar quantities and phase diagrams for two and three component systems.**  
**CO-5. Learn how to determine molecular mass of macromolecules.**  
**CO-6. Study about three theories of reaction rates and dynamics of unimolecular reactions.**

**CH-104: Paper IV (Analytical Chemistry)**

**CO-1. Understand the difference between qualitative and quantitative analysis and how to do statistical analysis and validation.**  
**CO-2. Know the principle of different separation techniques such as chromatography, ion exchange chromatography, solvent extraction and their application.**  
**CO-3. To give an extended knowledge about chromatographic techniques.**  
**CO-4. Study of volumetric and gravimetric analysis for quantitative determination of mixture.**  
**CO-5. Study of principle, instrumentation and application of conductometer and potentiometer.**  
**CO-6. To understand the chromatographic techniques.**  
**CO-7. Study the classical approach from aqueous extraction, SPE and MAE.**

**CH-105: Practical-I (Inorganic Chemistry)**

**CO-1. Study the volumetric and gravimetric analysis of alloy mixture.**  
**CO-2. Study qualitative semi-micro analysis of inorganic mixture.**  
**CO-3. Prepare various inorganic complexes and do quantitative analysis.**

**CH-106: Practical-II (Physical Chemistry)**

**CO-1. Study the variation of volume contraction.**  
**CO-2. Determination of activation parameters of viscous flow for a given liquid.**  
**CO-3. Learn to construct the phase diagrams.**  
**CO-4. Determination of thermodynamic properties.**  
**CO-5. Study the kinetics of the reaction and CST.**  
**CO-6. Determination the strength of monobasic and dibasic acid by conductometrically.**

## Semester II

### CH-201: Paper V (Inorganic Chemistry)

- CO-1. Understand electronic spectra of transition metal complexes.
- CO-2. Study the structure of atom, Hund's rule, term symbol, calculation of microstates and selection rule.
- CO-3. To determine the Energy terms for electronic configurations of metal complexes.
- CO-4. Learn the magnetic properties and electronic nature of metal complexes.
- CO-5. To understand Reaction mechanism of Transition Metal Complexes by considering substitution reaction and electron transfer.
- CO-6. To Understand the bonding, reaction property of metal carbonyl, metal nitrosyls and organometallic complexes.

### CH-202: Paper VI (Organic Chemistry)

- CO-1. Study the Addition to carbon-carbon multiple bond and carbon-hetero atom multiple bond.
- CO-2. Learn mechanism of molecular rearrangement and orientation in pyrolytic elimination.
- CO-3. Study the E<sub>1</sub>, E<sub>2</sub> and E<sub>1</sub>CB mechanisms and orientation of the double bond, Saytzeff and Hoffman's rule.
- CO-5. Understand Free radical reactions and Neighbouring group assistance
- CO-6. Understand microwave induced reactions and Solvent free reactions and Multi-component reactions (Biginelli, Ugi and Passerini reaction).

### CH-203: Paper VII (Physical Chemistry)

- CO-1. Understand about fugacity, concepts of ion atmosphere, electrophoretic effect and Debye Hückel theory.
- CO-2. Study about seven crystal system, HCP, CCP and crystal defects and Non-stoichiometry defects.
- CO-3. Know the quantum mechanics and application of Schrödinger wave equation to simple systems.
- CO-4. Study about statistical thermodynamics and Maxwell Boltzmann, Bose Einstein and Fermi Dirac statistics.
- CO-5. Learn about radiometric titration, Isotopic dilution analysis, NAA and GM counter.

### CH-204: Paper VIII (Analytical Chemistry)

- CO-1. Study about sampling, detection and quantification of the sample.
- CO-2. Learn stoichiometric and sub-stoichiometric reactions and calculations.
- CO-3. Understand the principle and instrumentation of sample injection system, columns for HPLC and GC, Solvent treatment system and choice of mobile phase in gas

chromatography and liquid chromatography.

CO-4. Learn about single beam and double beam spectrophotometer, role of organic ligands in spectrophotometric analysis of metal ions.

CO-5. Understand about Job's and mole ratio method and numerical problems.

CO-6. Study of polarographic method for analysis and amperometric titration as an analytical tool and their applications.

#### **CH-205: Practical-III (Organic Chemistry)**

CO-1. To perform qualitative analysis by separation, purification and identification of the binary mixture of two organic compounds

CO-2. Prepare various organic compounds of industrial and pharmaceutical use.

CO-3. To understand the chemical methods of analysis.

CO-4. Learn purification, crystallization, TLC and chromatographic techniques for organic compounds.

#### **CH-206: Practical-IV (Analytical Chemistry)**

CO-1. Understand about classical methods and separation techniques: calibration, validation and computers.

CO-2. Estimation of metal ion by complexometric titration

CO-3. Estimation of solvents by bromination methods.

CO-4. Estimation of metal using gravimetric technique.

CO-5. Qualitative separation of metal ions by separation techniques.

CO-6. Find out the acids strength by potentiometrically.

CO-7. Estimate about the metal ion and study the complex formation by colorimetry.

### **Semester III**

#### **CH-301: Paper IX (Special I-Organic Chemistry)**

CO-1 Study of photochemistry in organic synthesis and use of Norrish type I and & Norrish type II reactions.

CO-2. Learn photochemistry of Aromatic compounds with reference to isomerisation addition and applications of photochemical methods in synthesis: Isocomene, Cedrene, Hirsutene.

CO-3. Study of pericyclic reactions and FMO approach, Woodward-Hoffman correlation diagram method and perturbation of molecular orbital (PMO) approach of pericyclic reaction.

CO-4. Study of oxidizing and reducing agents.

CO-5. Study the preparation, properties, Synthesis, Mechanism, and importance of organoboranes.

CO-6. Study of chemistry of P, S and Si compounds and their applications.

**CH-302: Paper X (Special II-Organic Chemistry)**

- CO-1: Study the structure and synthesis of Haemoglobin and Chlorophyll.  
CO-2: Understand the biogenesis and synthesis of PGE<sub>2</sub> and PGF<sub>2</sub>α  
CO-3: Study of biogenesis of steroids, flavonoids and Shikimic acid Pathway.  
CO-4: Understand and learn the structure and synthesis of alkaloid and terpenoids.

**CH-303: Paper XI (Elective-Medicinal Chemistry)**

- CO-1. To study development of new drugs, drug design and structure activity relationship (SAR) method, theories of drug action.  
CO-2. To study pharmacokinetics and pharmacodynamics of drugs.  
CO-3. Understand enzymatic action and drug metabolism.  
CO-4. Study various diseases and understand the effect of analgesics and antipyretics, cardiovascular Drugs, antineoplastic agent, psychoactive drugs, coagulant and anticoagulants.  
CO-5. Study mode of action of various drugs and structure activity and drug targets

**CH-304: Paper XII (Core-Spectroscopy-1)**

- CO-1. Identifying the group based on symmetry elements and matrix representation of groups.  
CO-2. Study of mass spectrometry: Theory, instrumentation, various methods of ionization, FAB, MALDI, McLafferty rearrangement and mass spectral arrangements of organic compounds. Structure determination.  
CO-3. Learn Mössbauer spectroscopy, Microwave spectroscopy, Raman spectroscopy, ESR spectroscopy, IR spectroscopy and its applications.

**CH-305: Practical V –(Organic Chemistry Special)**

- CO-1. Estimation of Vitamin “C” by Iodometry.  
CO-2. Estimation of Phenol by KBrO<sub>3</sub>-KBr.  
CO-3. Isolation of caffeine from tea leaves.  
CO-4. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)  
CO-5. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and R<sub>f</sub> value reported.)  
CO-6. Separation of the components of a mixture of three organic compounds by qualitative analysis.

**CH-306: Practical VI (Elective-Medicinal)**

- CO-1. To study quantitative estimation of medicinal drugs from commercially available dosage forms by volumetric, conductometric, Colorimetric and potentiometric methods.

**CO-2. To prepare Synthesis and purification of medicinal drugs such as paracetamol, coumarin, aspirin and sulphonamides.**

**CO-3. To learn the pharmaceutically acquired techniques for drug synthesis.**

### **Semester IV**

#### **CH-401: Paper XIII (Special I-Organic Chemistry)**

**CO-1. Study carbanions in organic chemistry including various name reactions.**

**CO-2. Study about synthesis and applications of organo Li and organo Mg reagents.**

**CO-3. Learn the details of organozinc reagents and organo copper reagents.**

**CO-4. Study transition metals in organic synthesis such as organopalladium and applications of  $\text{Co}_2(\text{CO})_8$ ,  $\text{Ni}(\text{CO})_4$ ,  $\text{Fe}(\text{CO})_5$  in organic synthesis.**

**CO-5. Study advanced stereochemistry.**

**CO-6. Learn protection and deprotection of functional groups.**

**CO-7. Study disconnection approach including One Group C-C disconnections and two Group C-C disconnections.**

#### **CH-402: Paper XIV (Special II-Organic Chemistry)**

**CO-1. Study and understand nomenclature, classification, synthesis of enzymes and Co-enzymes.**

**CO-2. Learn synthesis of condensed five and Six membered heterocyclic compounds and their reactivity, aromatic character and importance of heterocyclic compounds.**

**CO-3. Learn the structure determination and synthesis of Vitamin A, E and H.**

**CO-4. Understand synthesis and application of Ciprofloxacin, Terfenadins, Methyldopa and Salbutamol.**

**CO-5. Understand basic structure, classification, synthesis and application of dyes.**

**CO-6. Understand about various pharmaceutical drugs and their applications.**

#### **CH-403: Paper XV (Elective-Medicinal Chemistry)**

**CO-1. To study laws and ethics by knowing Drug rules and drug acts.**

**CO-2. Study the causes, consequences and treatment for various diseases.**

**CO-3. Study mode of action of antidiabetic, antiviral, antimalarial, anthelmintic drugs.**

**CO-4. Study the synthesis and mechanism of action of antibiotics, antihistamines.**

#### **CH-404: Paper XVI(Core-Spectroscopy-II)**

**CO-1. Study UV and PES spectroscopy in detail and its application in the determination of structure of the organic compounds.**

**CO-2. Study  $^1\text{H}$  NMR Spectroscopy: Instrumentation, Chemical Shift, stereochemistry, Karplus equation.**

**CO-3. Understand the classification of molecules in NMR and shift reagent effect.**

**CO-4. Study of  $^{13}\text{C}$  NMR,  $^{19}\text{F}$  and  $^{31}\text{P}$  and structure determination of organic molecules.**

**CO-5. Study of 2D NMR spectroscopy: FT- NMR, COSY, HETCOR, NOSEY, DEPT,**

**INEPT, APT, INADEQUATE, NOE and use of NMR in medical diagnosis.**

**CO-6. Structure determination of organic molecules by using UV, IR, NMR and mass spectrometry.**

**CO-7. Study of X-Ray diffraction, electron diffraction and neutron diffraction techniques for crystal determination.**

**CH-405: Practical VII –(Organic Chemistry Special)**

**CO-1. Quantitative analysis of nitrogen, halogen and sulphur.**

**CO-2. Spectrophotometric/calorimetric estimation of streptomycin sulphate, vitamin B-12, amino acids, proteins, and carbohydrates.**

**CO-3. Perform organic multi-step preparations.**

**CO-4. Spectral interpretation of structure elucidation of organic compounds on the basis of spectral data (UV, IR,  $^1\text{H}$  and  $^{13}\text{C}$  NMR and Mass).**

**H-406: Practical VIII-Project**

**CO-1. Understand about how to select topic for project.**

**CO-2. Plan and execute the work.**

**CO-3. Analyze the project work and write the dissertation.**

## **Programme Outcomes: M.Sc. (Computer Science)**

### **Objectives:**

On the completion of the M.Sc. (Computer science) students are able to work as:

- 1) Programmer or Software Engineer
- 2) Computer Engineer
- 3) Web Designer
- 4) Hardware Designer/Engineer
- 5) Systems Engineer
- 6) System integrator
- 7) System Administration
- 8) Technical Support
- 9) Support Engineer
- 10) Technical Writer
- 11) Consultant
- 12) Management

- 13) Administration
- 14) IT Sales and Marketing
- 15) IT Officer
- 16) Computer Scientist
- 17) Research Staff Member
- 18) Systems Analyst
- 19) Logic Designer
- 20) Computer Scientist in research and R & D laboratories.

### **Goals:**

The Computer Science program provides a rigorous education that combines central topics in computing and specialization in a more focused area with added emphasis on the physical and architectural underpinnings of modern computer system design. Our graduates have the breadth of understanding a practice both in traditional areas of computing and in applications to other disciplines.

A graduate with a M.Sc. in Computer Science will have the ability to –

- (1) Communicate computer science concepts, designs, and solutions effectively and professionally;
- (2) Apply knowledge of computing to produce effective designs and solutions for specific problems;
- (3) Identify, analyze, and synthesize scholarly literature relating to the field of computer science.
- (4) Use software development tools, software systems, and modern computing platforms.
- (5) Practice and grow as computing professionals, conducting research and/or leading, designing, developing or maintaining projects in various technical areas of computer science.
- (6) Utilize knowledge and skills in Computer Science effectively for improving the society.
- (7) Use new technical advancements of Computer Science to produce tangible contributions in the profession.
- (8) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- (9) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- (10) Communicate effectively in a variety of professional contexts
- (11) Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles

- (12) Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline
- (13) Apply computer science theory and software development fundamentals to produce computing-based solutions

### **Program Learning Outcomes:**

Recipients of the M.Sc. in Computer Science degree at R.T.M. Nagpur University Nagpur are expected to have the following characteristics and experiences:

**PLO 1:** Proficiency with the fundamental knowledge in algorithms, programming languages, and architecture.

**PLO 2:** Proficiency with fundamental knowledge in at least one area of research.

**PLO 3:** Ability to apply reasoning, problem solving, and technical skills to solve a problem with minimal guidance.

**PLO 4:** Ability to communicate concepts and results to a technical audience in the form of a technical report and/or an oral presentation to a review committee.

### **Curriculum Alignment Matrix**

Table 1: Curriculum Alignment Matrix for MSc Computer Science Degree  
**I = Introduced; P = Practiced; D = Demonstrated.**

<b>Courses</b>	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>
Core 1 Paper 1: <b>Discrete Mathematical Structure</b>			I	I
Core 2 Paper 2: <b>Programming in Java</b>	I,P,D		P	
Core 3 Paper 3: <b>Digital Electronics and Microprocessor</b>	I,P,D		P	
Core 4 Paper 4: <b>Advanced DBMS and Administration</b>		I,P,D	P	P
Core 5 Paper 5: <b>Windows Programming using VC++</b>		I,P,D	P	P
Core 6 Paper 6: <b>Theory of Computation and Compiler Construction</b>		I,P,D	P	P
Core 7 Paper 7: <b>Computer Architecture and Organization</b>		I,P,D	P	P
Core 8 Paper 8: <b>Computer Graphics</b>		I,P,D	P	P
Core 9 Paper 9: <b>Data Communication and Networks</b>		I,P,D	P	P



Core 10 Paper 10: <b>SoftwareEngineering</b>		I,P,D	P	P
CoreElective 1Paper 11: <b>CE1-1 NeuralNetwork</b> <b>CE1-2MultimediaTechnologies</b> <b>CE1-3ASP.NET</b>		I,P,D	P	P
Core(Subject Centric)1 Paper 12: <b>CDC1-1MobileComputing</b> <b>CDC1-2Digital &amp; CyberForensics</b>		I,P,D	P	P
Core 11 Paper 13: <b>Data Mining</b>		I,P,D	P	P
Core 12 Paper 14: <b>ArtificialIntelligence &amp;Expert System</b>		I,P,D	P	P
CoreElective 2Paper 15: <b>CE2-1Design andAnalysis ofAlgorithm</b> <b>CE2-2EmbeddedSystem</b> <b>CE2-3PatternRecognition</b>		I,P,D	P	P
Core(Subject Centric) 2 Paper 16: <b>CDC2-1ParallelComputing</b> <b>CDC2-2Mobile &amp;Cyber Forensics</b>		I,P,D	P	P
<b>Seminar 1, Seminar 2, Seminar 3, and Seminar 4</b>				P
<b>Master's Project</b>	P	P	P	P

## Assessment Plan

Masters students are expected to complete 64 units of coursework. Each student must take and pass core courses, including algorithms, programming languages, architecture, which test for mastery of the fundamental knowledge, and the ability to use analytical and computational methods (PLO 1). MS students are also required to complete a Master's Project. The project test for mastery material in at least one area of focus (PLO 2). Students in the MSc project are required to complete a report on a topic which will be read and reviewed by a review committee before the award of the Master of Science degree (PLO 3 and PLO 4).

Computer Science students are primarily assessed using two techniques:

- A1.** Exposure to Knowledge Units, evaluated by examination taken by R.T.M. Nagpur University Nagpur.
- A2.** Substantial project work with written and oral presentation, examination taken by R.T.M. Nagpur University Nagpur.

Computer Science Program Goals are primarily introduced, reinforced and assessed in the following required courses:

Courses	CS Program Goals													Assessment
	1	2	3	4	5	6	7	8	9	10	11	12	13	
<b>C1</b>	x	x	x		x		x		x		x	x		<b>A1</b>
<b>C2</b>	x		x			x			x		x		x	<b>A1</b>
<b>C3</b>	x	x						x						<b>A1</b>
<b>C4</b>	x	x		x	x		x			x		x		<b>A1</b>
<b>C5</b>	x		x		x			x						<b>A1</b>
<b>C6</b>	x			x		x		x		x		x		<b>A1</b>
<b>C7</b>	x	x	x		x		x		x		x		x	<b>A1</b>
<b>C8</b>	x	x												<b>A1</b>
<b>C9</b>	x		x	x	x		x		x	x		x	x	<b>A1</b>
<b>C10</b>														<b>A1</b>
<b>CE1-1</b>	x		x		x			x			x		x	<b>A1</b>
<b>CDC1-1</b>		x	x		x	x			x	x		x		<b>A1</b>
<b>C13</b>	x	x		x	x		x	x		x	x		x	<b>A1</b>
<b>C14</b>	x		x		x		x	x	x		x	x		<b>A1</b>
<b>CE2-1</b>	x			x				x			x		x	<b>A1</b>
<b>CDC2-1</b>		x		x		x	x			x			x	<b>A1</b>
<b>Seminar</b>	x						x	x	x			x	x	<b>A2</b>
<b>Project</b>	x			x	x		x	x				x	x	<b>A2</b>

## **M. Sc. Physics**

### **Course outcomes (CO)**

On the completion of the course the students are able to:

1. Interpret and illustrate the spectroscopic techniques, spectra of alkaline earth elements and interaction energies in L-S and J-J couplings. Atomic and molecular physics.
2. Analyze the introductory idea about the X ray spectroscopy and solid state physics.
3. Explain the effect of ultrasonic wave on sound absorbing and attenuating materials.
4. Use the various physical techniques for their research purpose to understand the materials behaviour.
5. To know about the basic working principal of different kind of laser systems and use of it in practical applications.
6. Apply the basic ideas to create, solve and analyze the problems of interest in mathematical physics, complex analysis and numerical method.
7. Describe the principal and working of different kinds of analog and digital electronic devices.
8. Acquire basic knowledge about nuclear properties such as mass, spin, radius, binding energy etc, and nucleon-nucleon interaction.
9. Develop the understanding of matter at nano level and its industrial and domestic applications.
10. Learn about the concept of quantum mechanical systems, subatomic particle and quarks, conservation laws.
11. Calculate the Braggs conditions for X-ray diffraction in crystals.
12. Create understanding of electronic and vibrational properties of solid state systems.

## **Program Outcomes (POs)**

At the end of the program, students will be able to:

1. Provide high quality education in physics within an environment committed to excellence in both teaching and research.
2. Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid.
3. Enable students to develop transferable skills relevant to a wide range of professional careers.
4. Apply contemporary research methods, skills and techniques to conduct independent inquiry in a scientific discipline.
5. Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
6. Understand the issues of environmental contexts and sustainable development.
7. Educate students in the core of physics, including substantial practical and experimental physics, while enabling students to train in both the theoretical and practical aspects.

**Department of Physics, DACN**

## **Program Specific Outcome (PSO)**

1. Demonstrate the ability to plan, undertake, and report on a programme of original work; including the planning and execution of experiments, the analysis and interpretation of experimental results. Assess the errors involved in an experimental work and make recommendations based on the results in an effective manner.
2. Define the physical principles underlying a wide selection of physical phenomenon.
3. Describe and critically evaluate the current state-of-the-art in selected areas of physics.
4. To apply graduate-level knowledge and solve problems in the areas of Electrodynamics, Quantum Mechanics, Classical Mechanics, Statistical Mechanics, Mathematical Physics,.

Nuclear Physics, Solid State Physics, Spectroscopy, Acoustics and Nanoscience and Nanotechnology.

5. Graduates from this programme will be eligible to continue research at the higher degree (PhD) level. They will be well qualified to obtain employment in research and development, in the scientific or engineering industries.

## **ONE YEAR POST P.G.DIPLOMA IN NANOSCIENCE AND NANOTECHNOLOGY (NSNT)**

### **Course outcomes (CO)**

On the completion of the course the students are able to:

1. Explain the Basics of Nanoscience, Properties of Nanomaterials, Synthesis of Nonmaterial's, Bio-nanotechnology.
2. Analyze and characterize nanomaterials, Nonmagnetic, Nanocomposites and Nanoelectronics.
3. Develop and optimize the nanomaterials properties and behaviour.
4. Design and development of advanced and smart materials from application perspectives.

### **Program Outcomes (POs)**

At the end of the program, students will be able to:

1. Acquire the ability to moderate the properties of nanomaterials as per demand.
2. Apply contemporary research methods like physical, chemical methods to synthesize the nanomaterials at moderate temperature and other ambient surrounding.
3. Enable students to make carrier in design and development of materials.
4. Deal issues of environmental contexts and sustainable development.
5. Analyze the materials through various spectroscopic and other high end sophisticated techniques.

### **Program Specific Outcome (PSO)**

1. Students from this programme will be eligible to continue research at the higher degree

level. They will be well qualified to obtain employment in research and development, in the scientific or industries.

2. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
3. Can work independently on Project related with synthesis and characterization of nanomaterials for specific purpose.
4. Develop the capability to convert the task into an "Engineering and technological Problem".