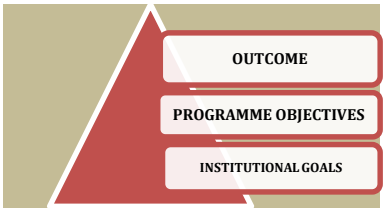
LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

FOR UNDERGRADUATE EDUCATION



INTERNAL QUALITY ASSURANCE CELL

GOVT. MADHAV SCIENCE P.G.COLLEGE UJJAIN

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

FOR UNDERGRADUATE EDUCATION

SECTION A

1.1 Introduction

Fostering quality Higher Education across campus is a high priority task for any HEI. Further improvement of quality of higher education is considered critical for enabling effective participation of young people in knowledge production and participation in the knowledge economy, improving national competitiveness in a globalized world and for equipping young people with skills relevant for global and national standards and enhancing the opportunities or social mobility. Sustained initiatives are required for institutionalizing an outcome-oriented higher education system and enhancing employability of graduates through curriculum reform, based on a learning outcomes-based curriculum framework, improving/upgrading academic resources and learning environment, raising the quality of teaching and research across all higher education institutions; technology use and integration to improve teaching-learning processes and reach a larger body of students through alternative learning modes such as open and distance learning modes and use of MOOCs.

Other priority areas of action for fostering quality higher education include translation of academic research into innovations for practical use in society and economy, promoting efficient and transparent governance and management of higher education system, enhancing the capacity of the higher education system to govern itself through coordinated regulatory reform and increasing both public and private sector investment in higher education, with special emphasis on targeted and effective equity-related initiatives.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution

College being an Affiliated college focuses on Curriculum Enrichment and Execution rather than Curriculum planning and Development.

The fundamental premise underlying the learning outcomes-based approach to curriculum Enrichment and Execution is that higher education qualifications such as a Bachelor's Degree programmes and PG Programmes are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge,

understanding, skills, attitudes and values measurable through Internal Examination CCE modes and experiential activity modules) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study.

It may be noted that the learning outcomes-based curriculum framework in this college not only intend to promote designing of a syllabus for a programme of study or learning contents of courses within each programme of study or to prescribe a set of approaches to teaching-learning process and assessment of student learning levels. Instead, they are intended to allow for flexibility and innovation in (i) programme design and syllabi development by higher education institution for self-finance subjects (ii) Enrichment of Execution process of Syllabi (ii) teaching-learning process, (iii) assessment of student learning levels, and (iv) periodic programme review within a broad framework of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes.

The overall objectives of the learning outcomes-based curriculum framework are to:

- Help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes that are expected to be demonstrated by the holder of a qualification;
- Enable prospective students, parents, employers and others to understand the nature and level of learning outcomes (knowledge, skills, attitudes and values or attributes), a graduate of a programme should be capable of demonstrating on successful completion of the programme of study;
- Maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility; and
- Provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

1.3 Key outcomes underpinning curriculum enrichment and execution

The learning outcomes-based curriculum framework for undergraduate education is a framework based on the expected learning outcomes and academic standards that are expected to be attained by graduates of a programme of study and holder of qualification. The key outcomes that underpin curriculum enrichment and execution

at the undergraduate level include Graduate Attributes, Qualification Descriptors, Programme Learning Outcomes, and Course Learning Outcomes:

1.3.1 Graduate attributes

The graduate attributes reflect the particular quality and feature or characteristics of an individual, including the knowledge, skills, attitudes and values that are expected to be acquired by a graduate through studies at the institution.
The graduate attributes include capabilities that help strengthen one's abilities for widening current knowledge base and skills, gaining new knowledge and skills, undertaking future studies, performing well in a chosen career and playing a constructive role as a responsible citizen in the society. The graduate attributes define the characteristics of a student's university degree programme and describe a set of characteristics/competencies that are transferable beyond study of a particular subject area and programme contexts in which they have been developed. Graduate attributes are fostered through meaningful learning experiences made available through the curriculum, the total college experiences achievable through Flagship programmes and a process of critical and reflective thinking developed therein

The learning outcomes-based curriculum framework is based on the inherent principle that every student and graduate is unique. Each student or graduate has his/her own characteristics in terms of previous learning levels and experiences, life experiences, learning styles and approaches to future career-related actions. The quality, depth and breadth of the learning experiences made available to the students while at institution help develop their characteristic attributes. The graduate attributes reflect both disciplinary knowledge and understanding, generic skills, including global competencies that all students in different academic fields of study should acquire/attain and demonstrate. Some of the characteristic attributes that a graduate should demonstrate are as follows:

- ***Disciplinary knowledge:*** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.
- ***Communication Skills:*** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one‟s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
- ***Critical thinking:*** Capability to apply analytic thought to a body of knowledge

- analyse and evaluate evidence, arguments, claims, beliefson the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theoriesby following scientific approach to knowledge development.
- ***Problem solving:*** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one‟s learning to real life situations.
- ***Analytical reasoning****:* Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyse and synthesize data from a variety of sources; drawvalid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
- ***Research-related skills:*** A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.
- ***Cooperation/Team work****:* Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group,and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
- ***Scientific reasoning:*** Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
- ***Reflective thinking:*** Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.
- ***Information/digital literacy:*** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
- ***Self-directed learning:*** Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
- ***Multicultural competence:*** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
- ***Moral and ethical awareness/reasoning:*** Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work.

- avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
- ***Leadership readiness/qualities:*** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.
- ***Lifelong learning:*** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

1.3.2 Qualification descriptors

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification (for eg. a bachelor's degree or a Postgraduate degree). The qualification descriptors also describe the academic standard for a specific qualification in terms of the levels of knowledge and understanding, skills and competencies and attitudes and values that the holders of the qualification are expected to attain and demonstrate. These descriptors also indicate the common academic standards for the qualification and help the degree-awarding bodies in designing, approving, assessing and reviewing academic programmes. The learning experiences and assessment procedures are expected to be designed to provide every student with the opportunity to achieve the intended programme learning outcomes. The qualification descriptors reflect both disciplinary knowledge and understanding as well asgeneric skills, including global competencies that all students in different academic fields of study should acquire/attain and demonstrate.

Qualification descriptors for a Bachelor's Degree programme : The students who complete three years of full-time study of an undergraduate programme of study will be awarded a Bachelor's Degree. Some of the expected learning outcomes that a student should be able to demonstrate on completion of a degree-level programme may include the following:

- Demonstrate (i) a fundamental/systematic or coherent understanding of an academic field of study, its different learning areas and applications, and its linkages with related disciplinary areas/subjects; (ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject areaof study, including research and development, teaching and government and public service; (iii) skills in areas related to one's specialization and current developments in the academic field of study.
- Use knowledge, understanding and skills required for identifying problems and issues, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, and their application, analysis and evaluation using methodologies as appropriate to the subject(s) for formulating evidence-based solutions and arguments;
- Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the subject(s);
- Meet one's own learning needs, drawing on a range of current research and development work and professional materials;
- Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts, rather than replicate curriculum content knowledge, to identify and analyse problems and issues and solve complex problems with well-defined solutions.
- Demonstrate subject-related and transferable skills that are relevant to some of the job trades and employment opportunities.

1.3.3 Programme learning outcomes

The outcomes and attributes described in qualification descriptors are attained by students through learning acquired on completion of a programme of study. The term 'programme' refers to the entire scheme of study followed by learners leading to a qualification. Individual programmes of study will have defined learning outcomes which must be attaind for the award of a specific certificate/diploma/degree. The programme learning outcomes are aligned with the relevant qualification descriptors.

Programme learning outcomes will include subject-specific skills and generic skills, including transferable global skills and competencies, the achievement of which the students of a specific programme of study should be able to demonstrate for the award of the certificate/Diploma/Degree qualification. The programme learning outcomes would also focus on knowledge and skills that prepare students for further study, employment, and citizenship. They help ensure comparability of

learning levels and academic standards across colleges/universities and provide a broad picture of the level of competence of graduates of a given programme of study.

1.3.4 Course learning outcomes

The programme learning outcomes are attained by learners through the essential learnings acquired on completion of selected courses of study within a programme. The term 'course' is used to mean the individual courses of study that make up the scheme of study for a programme. Course learning outcomes are specific to the learning for a given course of study related to a disciplinary or interdisciplinary/multi-disciplinary area. Some programmes of study are highly structured, with a closely laid down progression of compulsory/core courses to be taken at particular phases/stages of learning. Some programmes allow learners much more freedom to take a combination of courses of study according to the preferences of individual student that may be very different from the courses of study pursued by another student of the same programme.

Course-level learning outcomes will be aligned to programme learning outcomes. Course- level learning outcomes are specific to a course of study within a given programme of study. The achievement by students of course-level learning outcomes lead to the attainment of the programme learning outcomes. At the course level, each course may well have links to some but not all graduate attributes as these are developed through the totality of student learning experiences across the years of their study. Teaching - learning process

The *Learning Outcomes-Based Approach* to curriculum planning, Enrichment, and transaction requires that the teaching-learning processes are oriented towards enabling students to attain the defined learning outcomes relating to the courses within a programme. The outcome- based approach, particularly in the context of undergraduate studies, requires a significant shift from teacher-centric to learner-centric pedagogies, and from passive to active/participatory pedagogies. Planning for teaching therein becomes critical. Every programme of study lends itself to well-structured and sequenced acquisition of knowledge and skills. Practical skills, including an appreciation of the link between theory and experiment, will constitute an important aspect of the teaching-learning process. Teaching methods, guided by such a framework, may include: lectures supported by group tutorial work; practicum and field-based learning; the use of prescribed textbooks and e-learning resources and other self-study materials; open-ended project work, some of which may be team-based; activities designed to promote the development of generic/transferable and subject-specific skills; and internship and visits to field sites, and industrial or other research facilities etc.

1.4 Assessment methods

A variety of assessment methods that are appropriate to a given disciplinary/subject area and a programme of study are used to assess progress towards the course/programme learning outcomes. Priority will be accorded to formative assessment. Progress towards achievement of learning outcomes is assessed using the following: time-constrained examinations; closed-book and open-book tests; problem based assignments; practical assignment laboratory reports; observation of practical skills; individual project reports (case-study reports); team project reports; oral presentations, including seminar presentation; viva voce interviews; computerised adaptive testing; peer and self- assessment etc. and any other pedagogic approaches as per the context .

Course wise Learning Outcomes

Course/Learning outcomes

B. Sc. Chemistry

Class: B.Sc. First Year

Paper: Physical Chemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course, the students will be able to-
Unit I (A)	Mathematical concept:	• Use the knowledge of logarithm, differentiation and integration for understanding derivations in different chapters.
Unit I (B)	Gaseous State and Molecular Velocities:	• Understand relationship between kinetic energy and temperature of a gas. • Calculate the partial pressure, and use of kinetic theory of gases to understand the nature of gases.
Unit II (A and B)	A) Liquid State B) Solid State:	• Differentiate among solid, liquid and gases through different models and objects. • Students will also be able to learn the nature of intermolecular forces and dependent properties like viscosity, surface tension and capillary action and their practical applications. • This study will help the students during post graduation and also for industrial application.
Unit III	Chemical Kinetics	• Understand that how to determine reaction rate and factors affecting the rate of reaction. • Calculate rate constant and order of reaction for different kind of reactions. • The students will be able to apply the concepts to solve the numerical problems during post graduation and competitive examinations.
Unit IV	Radioactivity and Nuclear Chemistry	• Learn the different kinds of nuclear reactions and their mechanism. • Learn the mechanism of radioactivity and its measurement.

		• Basic understanding of chemical consequences of interaction of radiation with nucleus. • Learn the applications of nuclear chemistry in theoretical and nuclear power plant. • Apply the concepts encountered in the text or unit in post graduation level.
Unit V	A) Chemical Equilibrium: B) Colloidal Solutions:	• Understand different properties of colloids, different examples of colloidal dispersion and uses. • Utilize this knowledge for further study or for the research purpose especially in the field of nanotechnology.

Class: B.Sc. First Year

Paper: Inorganic Chemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	A) Atomic Structure B) Periodic Properties:	• Understand the meaning of four quantum numbers and different atomic theories, concept of nuclear charge, ionization energy, electron affinity and different parameters. • They will be able to apply the quantum mechanics for the energy calculation of different energy states of an atom in post graduation studies and other competitive examination
Unit II	Chemical Bonding- Part I:	• Understand the structure of a chemical substance in terms of bonds. • Apply VSEPR theory to determine the geometry of a molecule. • Imagine the molecule in three dimension structure and will be able to utilize this knowledge at their post graduation level and also for competitive examination.
Unit III	Chemical Bonding- Part II:	• Differentiate bonding amongst ionic and covalent compounds. • Understand that how lattice energy is correlated with physical properties of ionic compounds like solubility. The students will be able to utilize the knowledge of semiconductors at industrial level.
Unit IV	A) s-Block Elements B) p-Block Elements Part-1	• Understand the general trends of s block and p block elements in periodic table and study different compounds of s block and p block elements. • Know the significance of alkali and alkaline earth metals in biological system. • Utilize the knowledge of compounds of metals, nonmetals like boron, carbon, aluminum and different alloys at industrial level.
Unit V	p-Block Elements Part-2	• Understand the structure and synthesis of boranes and silicates and their application at industrial and research level.

Class: B.Sc. First Year

Paper: Organic Chemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Structure and Bonding:	• Recognize the difference between aliphatic and aromatic compounds. • Correlate the stability of organic molecules with aromaticity. • Gain the knowledge of different kinds of reaction mechanism. On the basis of knowledge of intermediate formation and mechanism of reaction students will be able to predict the final product during post graduation and higher studies.
Unit II	Alkanes and Cycloalkanes:	• Different reactions of alkanes and cycloalkanes. • Different kinds of strain through conformational studies of cycloalkane and stability of different conformers. • This study will help the students during post graduation and competitive examinations.
Unit III	Alkenes Cycloalkenes Dienes	• Understand the different kinds of reactions of alkenes and cycloalkenes. • Apply these methods in multistep synthesis of useful compounds at industrial and research level.
Unit IV	Alkynes and Alkyl Halides	• Learn the skill of writing mechanism of reaction through different reactions of alkyl halides. • Able to understand different synthetic methods and reaction and will be able to apply these methods in multistep synthesis of useful compounds at research and industrial level.
Unit V	Stereochemistry of Organic	• Predict whether an organic compound is chiral or achiral. • Recognize different elements of symmetry in chiral

	Compounds	compound. • Recognizing and assigning stereochemical designations of organic compounds, which will help in next level of graduation (stereochemistry of amines, stereochemistry of carbohydrates) and also during post graduation.

Class: B.Sc. Second Year

Paper: Physical Chemistry

Units	**Course content**	**Course/Learning Outcomes:** After completion of course the students will be able to-
Unit I	A) Thermodynamics B) Thermochemistry	• Understand the different thermodynamic properties. • Apply the law of thermodynamics to the real systems. • Understand different thermodynamic cycles.
Unit II	A) Phase Equilibrium B) Solid Solution C) Liquid-Liquid Mixture D) Partial Miscible Liquids	• Understand different terminologies of phase equilibrium. • Apply the concepts of text lecture in practical and post graduation level
Unit III	Electrochemistry- I	• Understand different types of conductance. • Construct an electrochemical cell. • Calculate EMF of a cell through standard reduction potential data. • Understand different electrode reactions. • Apply these concepts to study the next unit.
Unit IV	Electrochemistry-II	• Understand the redox reaction occurring at electrode. • Know the different kinds of electrodes and use of electrodes in different electrochemical equipments. • Understand the mechanism of buffer action.
Unit V	A) Surface Chemistry B) Catalysis	• Differentiate the mechanism of adsorption and absorption. • Understand different methods of determination of surface area and able to utilize it during research. • Learn phenomenon of catalysis and application.

Class: B.Sc. Second Year

Paper: Inorganic Chemistry

Units	**Course content**	**Course/Learning Outcomes:** After completion of course, the students will be able to-
Unit I	Chemistry of Elements of First Transition Series:	• Different periodic properties of d-block elements of first transition series. • Learn the chemistry of binary compounds. • Understand the chemistry of these metal ions for the syntheses of different metal complexes in next units.
Unit II	Chemistry of Elements of Second and Third Transition Series	• Compare the trends between 3d, 4d and 5d series like stability of complexes in high and low oxidation states, magnetic, spectral and other properties. • Understand the role of transition metals in electronic, biomedical, analytical, and catalytic and various applications. • They will able to utilize this knowledge in research as well as industrial area.
Unit III	A) Coordination Compounds B) Oxidation and Reduction	• Understand the basic concepts of coordination chemistry and role of d-electrons and d- orbitals in bonding. • Differentiate among different theories of bonding. • Apply the concepts encountered in this unit to the next level of graduation (Metal-ligand bonding). • They will learn different techniques of extraction which will be useful for mining processes.
Unit IV	General Chemistry of f-Block Elements	• Understand the spectral magnetic and general properties as well as the role of actinides as nuclear fuel, in laser techniques, in batteries and for other purposes. • Utilize this knowledge during post-graduation level and also for research and industrial area.
Unit V	A) Acids and bases B) Nonaqueous Solvent	• Understand the different theories of acids and bases. • Learn about different non aqueous solvents and able to use their knowledge in analytical chemistry.

Class: B.Sc. Second Year

Paper: Organic Chemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Electromagnetic Spectrum: Absorption Spectrum	• Compare all the electromagnetic radiations in terms of energy and wavelength. • Understand the handling of UV and IR instruments. • Understand that, why some compounds are colored and some are colorless. • Interpret UV and IR spectra. • Develop problem solving skills and able to use it at next level of spectroscopy.
Unit II	A) Alcohols B) Phenols	• Know the different methods for the syntheses of alcohols and phenols which they can use in multistep synthesis at industrial level. • Learn the orientation effect on phenol. This study will help the students during post graduation and competitive examinations. • Use different reactions for further research.
Unit III	Aldehydes and Ketones	• Learn the IUPAC naming of aldehydes and ketones. • Compare the reactivity of different aliphatic and aromatic aldehydes and ketones. • Write the mechanism of different condensation reactions. • Develop the skills of synthesizing new condensation compounds for research purpose as well as for other applications at industrial level.
Unit IV	A) Carboxylic Acids B) Ether	• Compare the reactivity of different aliphatic and aromatic carboxylic acids. • Learn the handling of carboxylic acids in practical laboratory by knowing their physical and chemical properties

		• Learn different reactions for synthesis of acid and acid derivatives. • Utilize this knowledge during further higher studies and also during research.
Unit V	Organic Compounds of Nitrogen	• Compare the basicity of different types of amines. • Stereochemistry of amines and their stereo chemical designation. • Different kinds of reactions and their mechanism. • Know the practical applicability of different nitro and amine compounds at industrial as well as research laboratory.

Class: B.Sc. Third Year

Paper: Physical Chemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	A) Elementary Quantum Mechanics B) Molecular Orbital Theory	• Solve Schrodinger equation to obtain wave functions. • Understand the application of Schrödinger equation to find out the allowed energy level of atoms. • Calculate the energy levels from wave functions. • This learning will help the students to solve the problems during higher studies.
Unit II	Spectroscopy: A) Introduction B) Rotational Spectrum C) Vibrational Spectrum	• Understand the role of microwave spectroscopy for determination of molecular structure, dipole moment and bond length. • Understand the role of Vibrational spectroscopy in functional group identification. • Students will utilize the knowledge for structural analysis of given unknown molecule.
Unit III	A) Raman Spectrum B) Electronic Spectrum C) UV spectroscopy	• Understand the role of spectroscopic techniques for the characterization of materials which will help them in research level.
Unit IV	Photochemistry	• Understand different photochemical process through Jablonski diagram. • Learn the different photochemical reactions of simple organic compounds. • Utilize this knowledge during post graduation and higher studies.
Unit V	Physical Properties and Molecular Structure:	• .understand different magnetic behavior of molecules. • Learn the different techniques of measurement of dipole moment

Class: B.Sc. Third Year

Paper: Inorganic Chemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	A) Hard and Soft Acids and Bases B) Silicones and Phosphazenes	• Understand the trends of acidity and basicity in periodic table. • Learn the stability of salts through HSAB theories. • Learn the syntheses and reactions of silicones and Phosphazenes. • Understand the applicability of these silicones and Phosphazenes at industrial level.
Unit II	A) Metal Ligand Bonding B) Thermodynamics and kinetics	• Understand the bonding in metal complexes. • Understand the difference between VBT and CFT. • Learn that how geometries affect splitting and stability of d-orbital's. • Understand the structure, color, magnetism and different behavior of complexes through CFT model. • Understand the stability of complexes on the ground of thermodynamic and kinetic aspects. • Know the role of complexes in biomedicine, environmental cleaning and drug delivery system.
Unit III	Magnetic properties of Transition Metal Complexes	• Understand the relation between the electronic arrangement and magnetic behavior of complexes. • Learn about the magnetic moment and their determination through different methods. • Calculate the ground state term symbol for different d electronic systems.
Unit IV	Electronic Spectra of Transition metal complexes	• Understand the spectroscopic notations. • Able to relate the electronic configuration of metal ion with spectral properties of complex.

		• Understand the role of ligands in appearance of color of complex. • Predict simple electronic spectrum of metal complex through Orgel diagram. • Develop the skills for synthesis and characterize a coordination complex during research for desired application.
Unit V	Bioinorganic Chemistry	• Understand the role of elements in biological system. • Learn the mechanism of functioning of these metal coordinated biomolecules. • Know the application of these metal coordinated biomolecules in electron transfer mechanism, toxicology, as diagnostic agent and many more.

Class: B.Sc. Third Year

Paper: Organic Chemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Nuclear Magnetic Resonance Spectroscopy	• Understand the basic principle of NMR spectroscopy. • Able to interpret the simple NMR spectrum of organic compounds. • Able to use the concepts of shielding, deshielding and coupling constant to elucidate the structure of given organic compound. • Apply the knowledge of spectroscopy during post graduation and higher studies.
Unit II	A) Organo metallic Compounds B) Organo sulphur Compounds	• Know the different methods for the syntheses of Grignard reagent, organo lithium, organo sulphur and organo zinc compounds. • Know the uses and applications of these compounds in various chemical reactions at industrial as well as research level. • Learn the different kinds of polymers, their synthesis and uses at industrial level for various applications.
Unit III	Carbohydrates	• Able to classify different carbohydrates. • Understand the role of carbohydrates for maintaining human health. • Learn the structure, functions, different reactions and stereochemistry of carbohydrates • Understand the mechanism of cleansing action of soap and detergents and able to apply the knowledge of this mechanism at industrial level.
Unit IV	Amino Acids, Peptides, Protein	• Understand the essential and non essential amino acids. • Understand the stereochemistry of amino acids.

	and Nucleic Acids	• Learn the types and structure of proteins. • Learn that how structure of proteins affect functioning. • Understand the composition of nucleic acids and able to distinguish the structural features of RNA and DNA. • Able to apply the knowledge in genetic studies during post graduation and research area.
Unit V	A) Synthetic Dyes B) Pericyclic Reactions	• Learn the different methods and reactions of different dyes. • Know the usefulness of different dyes at industrial level as coloring agent. • Synthesize the different dyes at industrial level. • Know the different pericyclic reactions and the rules governing these reactions.

Course- B. Sc. Mathematics

B. Sc. I Year

Paper-I **ALGEBRA AND TRIGNOMENTARY**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Rank of Matrix, Normal & Echelon form of a matrix. Characteristic equation of a matrix, Eigen values. Eigen vectors. Linear Independence of row and column matrix.	Student must be able to: • Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations • How to find the Eigen values and Eigen vectors which are used in various branches of engineering. •How to apply linear independence of row and column matrix.
UNIT-II	Cayley Hamilton theorem and its use in finding inverse of a matrix. to solve a system of linear (homogeneous and non homogeneous) equations. Theorems on consistency and inconsistent of a system of linear equations. Solving linear equations upto three unknowns.	• Students able to test the consistency and inconsistency of system of equations. • Students can solve a system of linear equations in three variables .Systems of linear equations can be used to solve resource allocation problems in business and economics.
UNIT-III	Relation between the root and coefficients of general polynomial equation in one variable. Transformation of equations. Reciprocal equations. Descarte's rule of signs.	The course will enable the students to: •Understand relation between root and coefficients of Polynomial. •How to Transforms an equation. • How to apply Descarte's rule of signs.
UNIT-IV	Logic- logical connectives. Truth table, Tautology, Contradiction, Logical equivalence. Algebra of proposition. Boolean Algebra-definition and properties. Switching circuits and its applications. Logic gates and circuits.	•Students learnt about statements, logical connectives, Logical equivalence. Algebra of proposition. •Using truth table to prove statement is Tautology or Contradiction. •How to check the statements are logical equivalence. •Boolean algebra is used to analyse and simplify the digital (logic) circuits.
UNIT-V	De- Movier's theorem and its applications, direct and inverse circular and hyperbolic functions. Expansion of trigonometric functions. Logarithm of complex quantities. Gregory's series. Summation of trignometrical series.	• De- Movier's theorem used in obtaining relationships between trigonometric functions of multiple angles (like sin 3x, cos 7x) and powers of trigonometric functions (like $\sin^2 x$, $\cos^4 x$). •Another important use of De Moivre's theorem is in obtaining complex roots of polynomial equations. • Understands the Logarithm of complex quantities. •How to use Gregory's series summation of trignometrical series.

B. Sc. I Year

Paper-II **CALCULUS AND DIFFERENTIAL EQUATIONS**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Successive differentiation, Leibnitz's theorem Maclaurin's and Taylor's series expansions, Asymptotes.	Student must be able to: • The notion of successive differentiation. • Find the Maclaurin's and Taylor series expansions of given functions • Taylor's series can be used to solve ordinary differential equations, to find the sum of series, evaluation of limits. Most important application of Taylor's series is to use partial sums to approximate functions. • Leibnitz's theorem is used to find the value of n^{th} derivative at zero of function which can be express as a product of two functions. •How to compute Asymptotes.
UNIT-II	Curvature, tests for concavity and convexity, points of inflection, multiple points, tracing of curves in Cartesian and polar coordinates.	In this section student will learn the following : • Draw the graph of some curves using curve tracing. •Understand the concept of curvature & calculate curvature of curve in Cartesian or polar form. • Curvature is used in differential geometry & in a three part equation for bending of beams. It is also applied to measurements of the stress in the semiconductor structures.
UNIT-III	Integrations of transcendental functions. Definite integrals, Reduction formulae, Quadrature Rectification.	The course will enable the students to: •Know about transcendental functions & how to integrate them. •Integration by reduction formula always helps to solve complex integration problems.
UNIT-IV	Linear differential equations and equations reducible to the linear form. Exact differential equations. First order and higher degree equations solvable for x, y and p. Claraiut's equation and singular solutions. Geometrical meaning of a differential equation. Orthogonal trajectories.	Student must be able to • How to solve linear differential equations and reducible to equations in the linear form. •Learn various techniques of getting exact solutions of first order linear differential equations and linear differential equations of higher degree. •Applications in fluid dynamics- Design of containers and funnels. •Applications in heat conduction analysis - Design of heat spreaders in microelectronics.
UNIT-V	Linear differential equation with constant coefficients. Homogeneous linear ordinary differential equations. Linear differential equations of second order. Transformation of equations by changing the dependent variable independent variable, method of variation of parameters.	The course will enable the students to: •Solve linear differential equation with constant coefficients and homo differential equation. •Students able to transform equation by changing the dependent variable independent variable. •Student must be able to find solution by the method of variation of parameters. •Second-order differential equations play a central role in the physical sciences. They are found, for example, in laws describing mechanical systems, wave motion, electric currents, and quantum phenomena.

B. Sc. I Year

Paper-III VECTOR ANALYSIS AND GEOMETRY

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Scalar and vector product of three vectors, products of four vectors. Reciprocal vectors, vector differentiation, Gradient, Divergence and Curl.	After learning the contents of this unit the student must be able to • Calculate the scalar & vector product of three and four vectors. •Find the gradient (Normal to the surface) of scalar function. It is used to compute directional derivative. • Find divergence and curl of vector field and prove identities involving them.
UNIT-II	Vector Integration. Theorems of Gauss, Green, stoke's(without proof) and problem based on them.	Students will able to •Interpret line, surface and volume integrals. Using line integral we will compute work done by a particle in moving along curve. • Evaluate integrals by using Green's Theorem, Stokes theorem, Gauss's Theorem. Gauss theorem is applying to calculate volume. •These theorems relate vector fields and integrals - Green's theorem for vectors in two dimensions, and the other theorems for vector fields in three dimensions.
UNIT-III	General equation of second degree, tracing of conics, system of conics, polar equation of conic.	Student must be able to •How to trace conics. •Graph the polar equations of conics. •Define conics in terms of a focus and a directrix.
UNIT-IV	Equation of cone with given base, generators of cone, condition for three mutually perpendiculars generators, right circular cone, equation of cylinder and its properties.	The course will enable the students to: • How to find equation of cone with given base •Understands Condition for three mutually perpendiculars generators. • Students able to find the equation of Right circular cone. •Students know about Cylinder and its properties.
UNIT-V	Central coincoids, Paraboloids, plane sections of concoids, generating lines.	Student must be able to •Get an idea of central conicoids, parabola, and plane section of coincoids. • Understands the concept of generating lines.

B. Sc. II Year

Paper-I **ABSTRACT ALGEBRA**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Definition and basic properties of groups, subgroup, subgroup generated by subset, Cyclic groups and simple properties.	The course will enable the students to: • Group & its properties. • Subgroups, Cyclic groups and simple properties.
UNIT-II	Coset decomposition, Lagrange's theorem and its corollaries including Fermat's theorem, Normal subgroups, and Quotient groups.	• Use Lagrange's theorem to determine information about the order of a subgroup of a group and powers of elements of a group. •Understands Fermat's theorem •Explain the significance of the notions of cossets, normal subgroups, and Quotient groups. • Recall and use of definition & properties of cosets and subgroups.
UNIT-III	Homomorphism and Isomorphism of groups, fundamental theorem of homomorphism. Transformation and permutation group Sn (various subgroups of Sn, n<5 to be studied), Cayley's theorem.	• Understands the concepts of Homomorphism and isomorphism of groups. •definition of Permutation group and its subgroups. • Understands Cayley's theorem and its applications.
UNIT-IV	Group Automorphism, inner Automorphism, group of Automorphisms, Conjugacy relation and centraliser. Normaliser, Counting Principle, class equation of a finite group, Cauchy's theorem for finite abelian groups and non abelian groups.	• Understand definition of group Automorphism, inner Automorphism • How to define Conjugacy relation and centraliser. •Define Normaliser, Counting Principle • Understands Cauchy's theorem for finite abelian & non abelian groups.
UNIT-V	Definition and basic properties of Rings. Ring homomorphism, subrings, Ideals and Quotient rings, Polynomial rings & its properties, Integral domain and field.	The course will enable the students to: • Definition of Ring, subring & Ring homomorphism • Understands Ideals and Quotient rings. • Understands Integral domain and field.

B. Sc. II Year

Paper-II **ADVANCED CALCULUS**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Definition of a sequence, Theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion, series of non negative terms, comparison test , Cauchy's Integral test, Cauchy's Root test, ratio tests, Raabe's tests, logarithmic tests, Alternating series, Leibnitz's test, Absolute and conditional convergence	• Understands the notions of limit of a sequence, bounded and monotonic sequences, Cauchy's convergence criterion. • Understands the convergence of a series of real numbers by comparison test , Cauchy's Integral test, Cauchy's Root test, ratio tests, Raabe's tests, logarithmic tests. •How to applied Leibnitz's test for alternating series. •To acquaint the student with mathematical tools available in Statistics needed in various field of science and engineering.
UNIT-II	Continuity of functions of single variable, sequential continuity. Properties of continuous functions. Uniform continuity, chain rule of differentiability, Mean value theorems and their geometrical Darboux's intermediate theorem for derivatives	The course will enable the students to: • Define continuity of functions of single variable and properties of continuous functions. • Understands sequential continuity , uniform continuity. • Applying Chain rule of differentiability. •Understand the consequences of various mean value theorems for differentiable functions.
UNIT-III	Limit and continuity of functions of two variables, Partial differentiation, Change of variable, Euler's theorem on homogeneous functions, Taylor's theorem for function of two variables, Jacobians.	• How to calculate the limit and examine the continuity of a function at a point. • Euler's theorem is very useful to proving complicated problem based on partial differentiation in simpler manner. • How to apply Taylor's theorem •Definition of Jacobians and it can be used to check variable are independent or dependent.
UNIT-IV	Envelopes, Evolutes, maxima and minima of functions of two variables, Lagrange's multiplier method, Beta and Gamma functions	• What is maxima and minima of function? How to find maxima and minima of functions of two variables. Finding maxima or minima also has important applications in linear algebra and game theory. •Derive relation between Beta and Gamma functions. • Evaluate integrals by using Beta and Gamma functions.
UNIT-V	Double and triple Integrals, volumes and surfaces of solid of revolution, Dirichlet's integrals, change of order of integration in double integrals	•Evaluation of Line, Double integral, Triple integrals and Change of variables in integral. • Apply double and triple integral to find Area, Volume, Total mass, Centre of gravity and Moment of inertia. • Understand to the Change the order of integration in double integral. It s very useful to compute the value of some difficult integral in easier manner.

B. Sc. II Year

Paper-II **DIFFERENTIAL EQUATIONS**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Series solution of differential equations, Power series method, Bessel and Legendre equations, Bessel and Legendre functions and their properties recurrence and generating function, Orthogonality of functions.	The course will enable the students to: •Find the series solution of differential equations for ordinary and regular singular points. • Bessel's and Legendre' functions generating function. • Orthogonality of functions.
UNIT-II	Laplace transformation, Linearity of Laplace transformation, Existence theorem for Laplace transform, Laplace transforms of derivatives and integrals, shifting theorems, differentiation and integration of transforms.	•Students enable to compute Laplace transforms using various properties. • Understands Existence theorem for Laplace transforms. • Differentiation and integration of transforms. • How to solve differential equations by using Laplace Transform. How to find transfer function of mechanical system, How to use Laplace Transform in nuclear physics as well as Automation engineering, Control engineering and Signal processing.
UNIT-III	Inverse Laplace transforms, convolution theorem, Application of Laplace transformation for solving initial value problems of second order linear differential equations with constant coefficients.	•How to apply inverse Laplace transform to solve differential equations. •Students can find inverse Laplace transform using convolution theorem of function which can be expressed as a product of two functions. •Inverse Laplace transformation and Fourier Transform which are used in various branches of engineering.
UNIT-IV	Partial differential equations of the first order, Lagrange's solution, some special types of equations which can be solved easily by methods other than the general method, Charpit's general method.	•How to form partial differential equations by eliminating arbitrary constant or functions. • Find the solution of First order linear partial differential equations (Lagrange's PDE). • Find the solution of First order non linear partial differential equations (Standard forms & Charpit's methods).
UNIT-V	Partial differential equation of second and higher orders, Classification of partial differential equations of second order, Homogeneous and non-homogeneous equations with constant coefficients, equation of vibrating string, heat equation Laplace's equation and their solutions.	The course will enable the students to: • Classify the PDE. •Solve Homogeneous and non-homogeneous equations with constant coefficients. • Learn the use of the separation of variable technique to solve partial differential equations relating to heat conduction in solids and vibration of solids in multidimensional systems.

B. Sc. III Year

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

Paper-I LINEAR ALGEBRA AND NUMERICAL ANALYSIS

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Definition and examples of Vector spaces, subspaces, sum and direct sum of subspaces, Linear span, Linear dependence, independence and their basic properties, Basis, Existence theorem for basis, Dimension, Finite dimensional vector spaces, existence of complementary subspaces of a subspaces of a finite dimensional vector space, Dimension of sum of subspaces, Quotient space and its dimension.	Student must be able to • know about vector spaces, subspaces, sum & direct space of subspaces. • How to check vectors are L.D. Or L.I. •know about Basis, Existence theorem. • Define FDVS, Quotient space and its dimension. • Linear and abstract algebra is one of the cornerstones of mathematics and it is at the heart of many applications of mathematics and statistics in the sciences and engineering.
UNIT-II	Linear transformations and their representation as matrices, Algebra of linear transformations, Rank-Nullity theorem, change of basis, dual space, bi-dual space and natural isomorphism, adjoint of a linear transformation, Diagonalisation, Bilinear, Quadratic and hermitian forms.	•Students understand linear transformations and their representation as matrices. • Applying Rank-Nullity theorem. • How to use Diagonalisation. •Bilinear, Quadratic and hermitian forms.
UNIT-III	Inner Product Space- Cauchy- Schwartz inequality, orthogonal vectors, orthogonal complements, orthogonal sets and bases, Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process.	•Understands the definitions of inner product space • How to use Cauchy- Schwartz inequality • Recall Orthogonal vectors, orthogonal complements, orthogonal sets and bases. •Gram-Schmidt orthogonalization process.
UNIT-IV	Solution of Equations: Bisection, Secant, Regula-Falsi, Newton's Methods. Roots of second degree polynomial equations. Interpolation: Lagrange interpolation, Divided differences, Interpolation formula using Differences. Numerical Quadrature. Newton's-Cote's formulae, Gauss Quadrature formulae.	The course will enable the students to: •How to solve algebraic & transcendental equation numerical methods. • Understand the concepts of interpolation & how to use for equal & unequal intervals. • How to apply Newton's-Cote's, Gauss Quadrature formulae.
UNIT-V	Linear equations direct methods for solving systems of linear equations (Gauss elimination, LU decomposition, Cholesky decomposition), Iterative methods(Jacobi, Gauss Seidal reduction methods.). Ordinary differential equations: Euler's method, single step method, Runge-Kutt's method, Multistep methods, Milne Simpson method. Methods based on Numerical integration, Methods based on numerical diff.	•Understands various methods to solve systems of linear equations. •Iterative methods to solve systems of linear equations. •how to apply Numerical Method to solve ODE •Understands Numerical Integration •Understand Numerical Differentiation Understands the applications of numerical integration in various fields of science & engineering.

B. Sc. III Year

Paper-II REAL AND COMPLEX ANALYSIS

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Riemann integral, Integrability of continuous and monotonic functions. The fundamental theorem of integral calculus. Mean value theorems of integral calculus, Partial derivatives and differentiability of real-valued functions of two variables. Schwarz's and Young's theorem. Implicit function theorem.	Student must be able to •Understands the Riemann integral. • The fundamental theorem of integral calculus. •Mean value theorems of integral calculus. • Understands Schwarz's and Young's theorem. Implicit function theorem.
UNIT-II	Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests. Frullani's integral as a function of a parameter. Continuity, derivability and Integrability of an integral of a function of a parameter. Fourier series of half and full intervals.	• Test the convergence of Improper integrals using Comparison tests, Abel's and Dirichlet's tests. • Continuity, derivability and Integrability of an integral of a function of a parameter. • Fourier series of half and full intervals.
UNIT-III	Definition and examples of metric spaces. Neighbourhoods. Limit points. Interior points. Open and closed sets. Closure and interior Boundary points. Subspace of metric space, Cauchy sequences, Completeness, Cantor's intersection theorem. Contraction principle, Real number as a complete ordered field. Dense subsets. Baire Category theorem. Separable, second countable and first countable spaces Continuous functions, Uniform continuity, Properties of continuous functions on Compact sets.	•Definition of metric space and subspace of metric space. • Known about Limit points. Interior points. Open and closed sets. • Define Cauchy's sequence and completeness. • Cantor's intersection theorem and Baire Category theorem. • understands Second countable and first countable spaces. • Definition of Continuous functions, Uniform continuity. •Properties of continuous functions on Compact sets.
UNIT-IV	Continuity and differentiability of complex functions. Analytic functions, Cauchy- Riemann equations, harmonic functions, Cauchy's Theorem, Cauchy's Integral formula.	• Understands concepts of continuity and differentiability of complex functions. • How to check function is analytic or not? •Evaluation of integrals using Cauchy's theorem & Cauchy's Integral formula.
UNIT-V	Power series representation of an analytical function, Taylor's series Laurent's series, Singularities, Cauchy's Residue Theorem, contours Integration.	• How to represents analytic functions as power series • Know about Taylor's, Laurent's series. • How to find singular point & Compute residue at which. •Evaluation of contours Integration using Cauchy's Residue Theorem.

B. Sc. III Year

Paper-III STATISTICAL METHODS

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	COURSE CONTENTS	COURSE LEARNING OUTCOMES
UNIT-I	Frequency distribution-Measures of central tendency, Mean, Median, Mode, G.M., H.M., Partition values, Measures of dispersion-Range, Interquartile range, Mean deviation, Standard deviation, Moments, Skewness and Kurtosis.	•How to compute & uses Measures of central tendency & Measures of dispersion •M.D. & S.D. •how to find Moments about mean & about origin. • Understands Skewness and Kurtosis.
UNIT-II	Probability- Event, Sample space, Probability of an event, Addition and multiplication theorems, Baye's theorem, Continuous Probability-Probability density function and its application for finding mean, mode, median and standard deviation of various continuous Probability distributions. Mathematical expectation, Expectation of sum and product of random variables, Moment generating function.	Students will be able to: • To understands the concepts of Probability. •Compute a conditional probability for an event. • Use Baye's theorem to compute a conditional probability. •Calculate the expected value of an event. • Apply the knowledge gained in Probability theory in Medical Sciences, Life Sciences and Engineering fields.
UNIT-III	Theoretical distribution- Bionomial, Poisson, rectangular and exponential distributions, their properties and uses.	•Understand theoretical distribution, their properties and uses. • Find the probability using Bionomial, Poisson distributions.
UNIT-IV	Methods of least squares, Curve fitting, co-relation and regression, partial and multiple correlations (upto three variables only),	Students will able to • Fit a straight line. •Calculate the correlation coefficient for the given data. • Compute regression lines for the given data.
UNIT-V	Sampling- Sampling of large samples, Null and alternative hypothesis, Errors of first and second kinds, Level of significance, Critical region, Tests of significance based on chi-square, t, F and Z-statistics.	•Understands Null and alternative hypothesis. •Errors of fist and second kinds. • level of significance, critical region •Tests of significance based on chi-square, t, F and Z-statistics. •The researcher apply Z-test, which is appropriate to test the existence of population mean difference in the case of large sample size and the t-test is for small sample size. Moreover, F-test is used for test of several mean and variance, while Chi-square test is for testing single variance, goodness of fit and independence.

Program Learning outcomes

M. Sc.

M.Sc. First Semester

Paper: Inorganic Chemistry I (MCH-401)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Stereochemistry and Bonding in Main Groups Compounds:	• Predict the geometries of anions, cations and neutral inorganic molecules through VSEPR. • Learn the methods to predict the geometries of polyatomic molecules. • Calculate binding energy through Walsh diagram. • This learning will help them to prepare for competitive examinations like CSIR-NET and SET also
Unit- II	Metal-Ligand Equilibrium in Solution	• Understand the formation and stability of complex in solution and factors affecting it. • Understand the chelate effect and its effect on stability. • Understand the role of potentiometry and spectrophotometry for the determination of formation constant.
Unit-III	Reaction Mechanism of Transition Metal Complexes	• Learn the mechanism of different kinds of reactions of metal complexes. • Understand the thermodynamic and kinetic lability and inertness. • Develop their critical thinking through the discussions of possible reaction mechanisms.
Unit- IV	Metal Ligand Bonding	• Apply the quantum mechanical approach to derive molecular orbitals from atomic orbitals. • Compare the MO diagrams for octahedral, tetrahedral and square planar complexes.
Unit-V	HSAB Theory	• Learn the different concepts of acids and bases and the basis of Hard and Soft Acid and Base theory. • Learn the stability of salts through HSAB theories.

Paper: Organic Chemistry I (MCH-402)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Nature of Bonding in Organic Molecules	• Learn about bonding in organic molecules. • Compare the stability among different systems. • Calculate resonance energy of different systems through HMO diagram. • Able to correlate the shielding and deshielding phenomena of NMR spectroscopy with aromaticity.
Unit- II	Stereochemistry	• Understand the enantiotopic and diastereotopic atoms, groups and faces. • Distinguish stereoselective and stereospecific synthesis. • Understand the role of stereoselective synthesis in drugs designing. • Determine optical activity in biphenyls, allenes and spiranes.
Unit-III	Conformational analysis and linear free energy relationship	• Know the conformational study of cycloalkanes and decalins. • Understand the effect of conformation on reactivity of a given group. • Learn the generation and stability of different intermediates.
Unit- IV	Reaction Mechanism: Structure and Reactivity	• Understand different types of reactions and mechanism. • Learn the methods of determining mechanism of reactions. • Utilize the knowledge of reaction mechanism to synthesize compounds at research or industrial level.
Unit-V	Aliphatic Nucleophilic Substitution	• Learn the mechanism and stereochemistry of different types of nucleophilic substitution reactions. • Predict the mechanism of unknown reaction and main product on the basis of knowledge of stability of intermediate formation • Understand the effect of solvent and nucleophile on the rate of substitution and neighboring group participation, which help them to synthesize the organic compounds at industrial level.

Paper: Physical Chemistry I (MCH-403)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Introduction to exact Quantum Mechanical results	• Explain the structure of molecules and spectroscopic behavior of atoms and molecules through quantum mechanical results
Unit- II	Approximate methods	• These methods are used when exact solutions of Schrödinger equations cannot be found.
Unit-III	Angular Momentum	• This learning will help the students to understand and measure the momentum of rigid bodies in rotation
Unit- IV	Classical Thermodynamics	• Understand the efficiency of engine, laws of thermodynamics in refrigeration and air conditioning, thermal power plants, nuclear power plants, solar wind geothermal.
Unit-V	Statistical Thermodynamics	• Use this knowledge in interpreting partition functions and in application of entropy relationships.

Paper: Group Theory & Spectroscopy I (MCH-404)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Symmetry and Group Theory in Chemistry	Various physical systems such as crystals and hydrogen atom can be modeled by symmetry groups.
Unit- II	Microwave Spectroscopy	Used in determining molecular structure, dipole moment, bond angle, bond length.
Unit-III	Infrared Spectroscopy	Apart from functional groups of the molecule this technique is used in quality control and dynamic measurements and in forensic analysis as well.
Unit- IV	Raman Spectroscopy	Rapid characterization and chemical composition and structure of given sample may be solid liquid gas or powder.
Unit-V	Molecular Spectroscopy Photoelectron Spectroscopy	Used in determining relative energies of atoms and molecules, elemental composition of materials and in characterization of bonding.

Paper: Mathematics for Chemists (MCH-405 (a))

(For students without mathematics in B.Sc.)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Vectors, Matrix Algebra	Use of vector will simplify higher mathematical equations. This learning will help in understanding the position, velocity and momentum of a particle.
Unit- II	Differential Calculus	Many chemical process and phenomena can be described by first order differential equation. Knowledge of different equation will help to understand various natural laws.
Unit-III	Integral Calculus	Scattering in quantum mechanics conformal mapping leads to creation of integral equation.
Unit- IV	Elementary Differential Equations	Knowledge of different equation will help to understand various natural laws.
Unit-V	Permutation and Probability	Permutation and combination helps in organic synthesis and in arrangement of objects in a definite order.

Paper: Biology for Chemists (MCH-405(b))

(For students without biology in B.Sc.)

Unit	Course Content	Course/Learning outcomes
Unit-I	Cell structure and functions	Cells provide structure for a body intake of nutrients for food and carry out important functions
Unit- II	Carbohydrates	Carbohydrates provide fuel for central nervous system and energy for muscles. Information about fat metabolism
Unit-III	Lipid	Lipids have major cellular function as structural components. Shock absorber to protect vital organs.
Unit- IV	Amino-acids, Peptides and Proteins	The important nutrition, fertilizers and food technology, used in drugs biodegradable plastics.
Unit-V	Nucleic Acids	Therapeutic use in making insulin in making cancer drugs and in forensic to identify DNA.

M.Sc. Second Semester

Paper: Inorganic Chemistry II (MCH-406)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Electronic Spectral Studies of Transition Metal Clusters	• Predict the electronic transitions occurring in the molecule through Orgel and Tanabe Sugano diagram. • Analyze the complexes showing d-d transitions and charge transfer spectra. • Discuss the electronic spectrum of given transition metal complex during research.
Unit- II	Magnetic Properties of Transition Metal Complexes	• Understand magnetic behavior of complexes. • Explain what anomalous magnetic moment is and what factors responsible for it. • Calculate spin only magnetic moment for various transition metal complexes.
Unit-III	Metal π-complexes	• Correlate the reactivity and properties of transition metal complex with their structure and bonding. • Elucidate the structural features through spectroscopic techniques. • Learn the industrial applications of organometallic compounds. • Utilize the knowledge of this organometallic chemistry at research level also.
Unit- IV	Metal Clusters	• Understand metal metal bonding. • Learn preparative methods of different metal clusters. • Learn various kinds of metal cluster reactions and stability of clusters on the basis of 18 electron rule. • Utilize knowledge of these methods at research and industrial level.
Unit-V	Optical Rotatory Dispersion and Circular Dichroism	• Learn about optical rotatory dispersion and circular dichroism curve. • Discuss cotton effect. • Assign absolute configuration of chiral

		coordination complexes.

Paper: Organic Chemistry II (MCH-407)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Aromatic Electrophilic Substitutions	• Understand that why aromatic compounds give electrophilic substitution reactions. • Write the mechanism of electrophilic substitution. • Learn about the different name reactions and application at research and industrial level.
Unit- II	Free Radical Reactions	• Predict the main products of free radical mechanism on the basis of reactivity and selectivity. • Learn about the different examples of neighbouring group assistance and bridgehead systems. • Discuss the stereochemistry of free radical reactions.
Unit-III	Addition Reactions	• Write the mechanism of *syn* and *anti* addition. • Understand the difference between regioselectivity and chemoselectivity. • Learn the mechanism of addition reaction on cyclic system and aromatic ring.
Unit- IV	Addition to Carbon- Hetero Multiple bonds	• Learn the applications of Grignard and other organometallic reagents in reaction mechanism. • Write the mechanisms of condensation reactions. • Know the application of condensation products at industrial level. • Identify that given reaction is substitution or elimination depending on substrate, reagents and conditions.
Unit-V	Pericyclic Reactions	• Differentiate among different kinds of pericyclic reactions and rules governing them. • Understand the orbital interaction and orbital symmetry of various kinds of pericyclic reactions. • Develop skills to solve the problems based on FMO approach.

Paper: Physical Chemistry II (MCH-408)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Chemical Dynamics	Understand chemical reaction kinetics in the form of mathematical models, in understanding ozone depletion food decomposition.
Unit- II	Surface Chemistry	In enzymatic reactions, in electronics, microchips used in computers, surface film coating.
Unit-III	Macromolecules	Learn the applications of plastics, fibers and elastomers
Unit- IV	Non-Equilibrium Thermodynamics	In biological system, protein folding unfolding and transport through membrane
Unit-V	Electrochemistry	Electrical batteries galvanic cell fuel cell lithium ion battery.

Paper: Spectroscopy II and Diffraction Methods (MCH-409)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course the students will be able to-
Unit-I	Nuclear Magnetic Resonance Spectroscopy	• Develop skills to correlate different NMR parameters such as chemical shift, coupling constant, splitting pattern with the molecular structure. • Interpret Simple NMR spectra of organic compounds. • This learning will enable the students to work on NMR spectrometer.
Unit- II	Nuclear Quadrupole Resonance Spectroscopy	• Understand the basic principle of NQR spectroscopy. • Learn the application for molecular structure determination as well as in drug development.
Unit-III	Electron Spin Resonance Spectroscopy	• Learn the hyperfine splitting and application of ESR spectroscopy in free radicals, inorganic and organic compounds having one electron and inorganic transition metal ions. • Apply the knowledge of this technique for those sample analysis where conventional magnetic technique fails. (in the field of medicines and research field)
Unit- IV	X-ray Diffraction	• Learn the application of crystallography in crystal structure analysis. • Utilize the knowledge in determination of particle size and structure of unknown compounds in research field and in validation of drugs in pharma industry.
Unit-V	Electron Diffraction	• Basic principle of electron diffraction techniques. • Learn the applications of electron diffraction method like TEM and SEM in surface structure determination. • Apply these techniques in solid state chemistry and research field especially in field of nanotechnology.

Paper: Computers for Chemist (MCH-410)

Unit	**Course Content**	**Course/Learning outcomes :** After completion of course the students will be able to-
Unit-I	Introduction to computers and computing	• To gain the basic knowledge of computers and functioning. • Understand the role of output, input devices and CPU. • Develop computational skills.
Unit- II	Computer Programming in FORTRAN/C/BASIC	• Learn programming languages like FORTRAN/C/BASIC • Role of FORTRAN and other programming in scientific computing.
Unit-III	Programming in Chemistry	• Different programming can be used for electronic structure calculation, to draw the structure, kinetics study and many more.
Unit- IV	Use of Computer Programs	• They will be able to write independent programs and correctly compile them. • To gain knowledge about different softwares related to chemistry, which help them in research studies.
Unit-V	Internet	• Work on different search engines for searching different programs on chemistry. • Hands on practice on MS office and other programs.

M. Sc. III Semester

Paper I: Application of Spectroscopy-I (MCH-501)

Unit	Topic	Outcome
Unit - 1	Electronic Spectroscopy	After studying this unit students will: • Understand the basics of electronic spectroscopy. • Understand the spectral properties of various electronic configurations of d-block transition metals. • Understand the applications of electronic spectroscopy for octahedral, tetrahedral etc. structures of complexes and molecules. • Use knowledge of electronic spectroscopy in further study and research work.
Unit - 2	Vibrational Spectroscopy	After studying this unit students will: • Learn basics of vibrational spectroscopy. • Understand symmetry and shapes of various molecules by using this technique. • Learn the mode of bonding in the complexes of various multidentate ligands. • Learn the applications of Raman spectroscopy. • The knowledge of vibrational spectroscopy and Raman spectroscopy is beneficial in further advanced study and research.
Unit - 3	Nuclear Magnetic Resonance Spectroscopy-I	After studying this unit students will: • Understand the basic concept of NMR. • Learn shielding and deshielding mechanism. • Understand the correlation of chemical shift with various functional groups and other nuclei. Study NMR spectroscopy will facilitate the students in advanced study and research work.
Unit - 4	Nuclear Magnetic Resonance Spectroscopy-II	After studying this unit students will: • Understand the chemical exchange and effect of deuteration. • Understand complex spin-spin interaction between more than one nuclei. • Learn coupling constant and its use in NMR interpretation. • Understand NMR shift reagents, solvent effects and NOE. • Unitize this knowledge in advanced study and research work.

Unit - 5	Mössbauer Spectroscopy	After studying this unit students will: • Understand basic principle and structural parameters of Mössbauer spectroscopy. • Learn the application of this technique in understanding bonding and structure of iron complexes. • Use this technique in understanding metal ligand bonding and coordination no. in tin complexes. • This unit will enhance the knowledge of students for the further advanced study and research.

Paper II: Photochemistry (MCH-502)

Unit	Topic	Outcome
Unit - 1	Photochemical Reactions	After studying this unit students will: • Understand the basics of photochemical reactions. • Enhance the knowledge of students for studying the photochemical reactions of various molecules. • Understand, why a photochemical reaction occurs and how the changes occur in the molecule in presence of light. • Use knowledge of photochemical reactions in further advanced studies and in research work.
Unit - 2	Determination of Reaction Mechanism	After studying this unit students will: • Learn to understand the basics of reaction mechanism of photochemical reactions. • Understand how to determine the rate constant for the photochemical reaction. • Able to learn the types of photochemical reactions. • Understand reactions and mechanism and apply them in the study of the photochemical reaction of alkenes, carbonyls, aromatic compounds etc. • The knowledge of reaction mechanismis beneficial in further advanced study and research.
Unit - 3	Photochemistry of Alkenes Photochemistry of Aromatic Compounds	After studying this unit students will: • Understand the reactions and mechanisms of alkenes in presence of light. • Learn photochemical rearrangements in this unit. • Also understand the isomerism in the aromatic compounds in presence of light. • Learn photochemical addition and substitution reactions of aromatic compounds.

Unit - 4	Photochemistry of Carbonyl Compounds	After studying this unit students will: • Understand the intermolecular and intramolecular reactions of carbonyl compounds in presence of light. • Learn photochemical rearrangements, cyclization and dimerization reaction. • Learn photochemical reactions of saturated and unsaturated compounds and their mechanisms. • Study of photochemistry of carbonyl compounds will facilitate the students in advanced study and research work.
Unit - 5	Miscellaneous Photochemical Reactions	After studying this unit students will: • Understand the mechanism of important photochemical reactions. • These reactions are important for advanced study as well as research work. • Pharmaceutical, chemical, pesticide etc. industries use photochemical reactions for the formation of their products. • This unit will enhance the knowledge of students for the further advanced, research and in industries.

Paper-III: Environmental Chemistry (MCH-503)

Unit	Topic	Outcome
Unit - 1	Atmosphere Atmospheric Chemistry Tropospheric Photochemistry	After studying this unit students will: • Understand earth's atmosphere, its layers, temperature, pressure, biogenomical cycle of carbon etc. and it will develop their thoughts and ideas about the environment. • Have better knowledge of atmospheric chemistry and will learn to connect chemistry with the environment. • Learn the chemistry happening in various layers of atmosphere. • Use this knowledge of atmospheric chemistry in further advanced study and research work.
Unit - 2	Air Pollution Acid Rain Stratospheric Ozone Depletion Greenhouse Effect Urban Air Pollution	After studying this unit students will: • Understand the causes of air pollution and it will develop their thoughts and awareness about it. • Learn the chemistry behind the acid rain its adverse effects on the environment. • Learn the chemistry of ozone depletion and understand its mechanism. • Understand that how to control ozone depletion and also learn about the greenhouse effect. • This unit will make students aware about air pollution and cultivate the idea of controlling it. • The knowledge of air pollution and its chemistry will also help in advanced studies and environmental research.
Unit - 3	Aquatic Chemistry and Water Pollution	After studying this unit students will: • Understand Biological oxygen demand and chemical oxygen demand. • Learn the chemistry behind the water pollution and its treatment. • Become aware of water pollution and give their efforts to minimize it. • Learn the techniques of treatment and purification of waste or polluted water. • Study of this unit will encourage students to develop new cost-effective techniques for the purification and treatment of polluted water.

		• Become interested in the advanced study and research in the field of environment chemistry.
Unit - 4	Environmental Toxicology Toxic Heavy Metals Toxic Organic Compounds Polychlorinated biphenyls Polynuclear Aromatic Hydrocarbons	After studying this unit students will: • Understand the toxic effects of heavy metals and toxic organic compounds. • Learn how these toxic metals and compounds are polluting water and soil. • Learn biochemical and damaging effects of various heavy metals. • Learn the sources and structures of various organic pollutants. • It will enhance the knowledge of students for the advanced study and environmental research work.
Unit - 5	Soil and Environmental Disasters	After studying this unit students will: • Understand the chemical composition of soil and micronutrients present in it. • Learn how the plastic, metal and fertilizers are polluting the soil and understand re-mediation of soil. • Understand world's biggest disasters caused by various chemicals and their effect on environment and living species. • It will enhance the knowledge of students for the further advanced study and research in soil science and environment.

Paper IV: Organotransition Metal Chemistry (MCH-504)

Unit	Topic	Outcome
Unit - 1	Alkyls and Aryls of Transition Metals Compounds of Transition Metal-Carbon Multiple Bonds	After studying this unit students will: • Learn the synthesis and chemistry of various organocopper compounds. • Understand the reactions and mechanism of low valent carbenes and carbynes of alkylidenes and alkylidynes. • Learn the use of low valent carbenes and carbynes in organic synthesis. • Use this knowledge of synthetic chemistry in advances study, pharmaceutical & chemical industries and in research.
Unit - 2	Transition Metal π-Complexes	After studying this unit students will: • Learn the synthesis of π-complexes of unsaturated organic molecules. • Understand the bonding and nature of transition metal π-complexes. • Learn the reactions and mechanisms of π-complexes. • The knowledge of transition metal π-complexes will be utilized in advances study, pharmaceutical & chemical industries and in research.
Unit - 3	Transition Organometallic Compounds	After studying this unit students will: • Understand the bonding and structural properties of transition metal boron compounds. • Learn the bonding and structural properties of transition metal silicon compounds. • Learn the chemistry and structural properties of hydrogen with bonds to transition metal. • Use this knowledge of synthetic chemistry in advances study, pharmaceutical & chemical industries and in research.
Unit - 4	Homogeneous Catalysis	After studying this unit students will: • Learn homogeneous catalytic reactions and polymerization reactions. • Learn the use of carbon monoxide as a homogeneous catalyst. • Learn hydrocarbonylation reactions and activation of C-H bonds. • Utilize this knowledge of synthetic chemistry in advanced stu

		pharmaceutical & chemical industries and in research.
Unit - 5	Fluxional Organometallic Compounds	After studying this unit students will: • Understand the fluxionality of various organometallic compounds. • Learn dynamic equilibrium in the organometallic compounds. • It will enhance the knowledge of students for further advanced study and research.

Paper V: Polymer (MCH-505)

Unit	Topic	Outcome
Unit - 1	Basics	After studying this unit students will: • Understand the basics concepts and importance of polymers. • Become familiar with the various type of polymers and their structures. • Understand the reaction and mechanism of polymerization. • It will enhance the knowledge of students for further advanced study.
Unit - 2	Polymer Characterization	After studying this unit students will: • Understand the concept of average molecular weight and viscosity average molecular weight. • Learn the practical significance of molecular weight. • Learnto measure molecular weight of a polymer by using various methods. • Utilize this knowledge of polymer characterization in in advanced study and polymer research.
Unit - 3	Analysis and Testing of Polymers	After studying this unit students will: • Learn to do chemical analysis of polymers. • Learn the use of spectroscopic methods and X-ray diffraction analysis for the testing and analysis of polymers. • Learn to analyze tensile strength, fatigue, impact, tear resistance etc. by using physical methods. • Utilize this knowledge of polymer analysis and testing in advanced study and polymer research.
Unit - 4	Inorganic Polymers	After studying this unit students will: • Understand the structure and classification of inorganic polymers. • Learn the structure, properties and applications of boron, boranes and carboranes. • Understand the structural properties and applications of silicon-based polymers. • It will enhance the knowledge of students for the advanced study and research in polymer and material chemistry.

Unit - 5	Structure, Properties and Application of Polymers	After studying this unit students will: • Understand the structural properties and applications of various phosphorous-based polymers. • Also learn the structure and properties of sulfur-based polymers. • Learn the synthesis, properties and applications of coordination polymers and metal chelate polymers. • Motivated for the further advanced study and research in the polymer and material chemistry.

M. Sc. Fourth Semester

Paper I: Application of Spectroscopy (MCH-511)

Unit	Topic	Outcome
Unit - 1	Ultraviolet and Visible Spectroscopy	After studying this unit students will: • Understand the basics of UV-Visible spectroscopy • Learn to derive structural information from the UV-Vis. Spectra of various molecules. • Understand the applications of this technique for various purposes. • The knowledge of ultraviolet and visible spectroscopy is beneficial in further advanced study and research.
Unit - 2	Infrared Spectroscopy	The students will acquire knowledge of: • Basics of IR Spectroscopy. • Become aware of starching and banding of various bonds. • Interpretation of organic and inorganic compounds using IR spectra. • Characterization of various molecules. • The knowledge of IR spectroscopy is beneficial in further advanced study and research.
Unit - 3	Nuclear Magnetic Resonance of Paramagnetic Substances in Solution	After studying this unit students will: • Understand the properties of paramagnetic substances using NMR. • Learn contact and pseudo contact shifts. • Learn applications of this technique for the biochemical systems. • Use this knowledge in further advanced study and research.
Unit - 4	Carbon-13 NMR Spectroscopy Two Dimensional NMR Spectroscopy	After studying this unit students will: • Understand the basics of carbon-13 NMR. • Learn to interpret C-13 NMR spectra of various molecules and use this technique for the characterization of the compounds. • Enquire the knowledge of coupling constant and its use. • Learn 2D NMR spectroscopic techniques like COSY, NOESY, DEPT, HMBC and HMQC. • Utilize this knowledge in further advanced study and research.

Unit - 5	Mass Spectrometry	After studying this unit students will: • Understand the basics and applications of mass spectrometry. • Enquire the knowledge of various fragmentation techniques. • Learn to interpret the mass spectra of different organic molecules and functional groups. • Learn structural elucidation of molecules using IR, UV-Vis, NMR and Mass spectrometric techniques. • Utilize this knowledge in further advanced study and research.

Paper II: Solid State Chemistry (MCH-512)

Unit	Topic	Outcome
Unit - 1	Solid State Reactions	The students will acquire knowledge of: • Basic principles and experimental procedure of solid state reactions. • Enhance the knowledge of students for studying the kinetics of solid state reactions. • Co-precipitation in solid state reactions. • Use knowledge in further advanced studies and in research work.
Unit - 2	Crystal Defects and Non-Stoichiometry	After studying this unit students will: • Understand the difference between perfect and imperfect crystals. • Learn various defects in the crystals. • Learn thermodynamics of Schottky and Frenkel defects. • The knowledge of crystal defects and non-stoichiometry is beneficial in further advanced study and research.
Unit - 3	Electronic Properties and Band Theory	The students will acquire knowledge of: • Insulators and semiconductors. • Learn band theory and structures of metal insulators and semiconductors. • Understand p-n junction and superconductors. • Learn optical properties and applications of electron microscopy. • Understand magnetic properties.
Unit - 4	Organic Solids	After studying this unit students will: • Understand the electrically conducting solids. • Learn about organic charge transfer complexes. • Learn new semiconductors. • Study of organic solids will facilitate the students in advanced study and research work.
Unit - 5	Liquid Crystals	After studying this unit students will: • Understand the properties and types of liquid crystals. • Learn about nematic and smectic phases of liquid crystals. • Understand LCD and its applications. • This unit will enhance the knowledge of students for the further advanced, research

		and in industries.

Paper-III: Biochemistry (MCH-513)

Unit	Topic	Outcome
Unit - 1	Metal Ions in Biological Systems Bioenergetics and ATP cycle Transport and Storage of Dioxygen	After studying this unit students will: • Understand the importance of bulk and trace metals present in the human body. • Learn ATP cycle and understand how metal complexes transfer energy in the biological system. • Understand the process of photosynthesis in detail. • Learn about the oxygen transportation and storage in the human body by metal complexes of iorn. • Use this knowledge further advanced study and research work.
Unit - 2	Electron Transfer in Biology Nitrogen Fixation	After studying this unit students will: • Understand the structure and functions of metal proteins. • Learn the synthetic model of iron-sulfur protein. • Understand biological nitrogen fixation and its mechanism. • Learn the chemical nitrogen fixation. • utilize knowledge of this unit in advanced studies and research.
Unit - 3	Enzymes Mechanism of Enzyme Action Kinds of Reactions Catalyzed by Enzymes	After studying this unit students will: • Understand chemical and biological enzyme catalysis process. • Learn enzyme kinetics. • Understand the mechanism of enzyme action. • Learn various reactions and their mechanism catalyzed by enzymes. • Learn isomerization and rearrangement reactions caused by enzymes. • Become interested in the advanced study and research in the field of enzyme catalysis.

Unit - 4	Co-Enzyme Chemistry Biotechnological Applications of Enzymes	After studying this unit students will: • Learn the structure and functions of coenzymes. • Learn the reactions catalyzed by the various cofactors. • Understand the host-guest chemistry. • Learn large scale purification and immobilization of enzymes. • Understand clinical uses of enzymes. • Applythis knowledge in advanced study and research work.
Unit - 5	Biological Cells and its Constituents Bioenergetics Biopolymer Interactions Cell Membranes and Transport of Ions	After studying this unit students will: • Learn structure and functions of various proteins. • Understand the structure and functions of DNA and RNA. • Understand free energy changes and hydrolysis of ATP in biological systems. • Understand the structure and functions of cell membranes. • It will enhance the knowledge of students for the further advanced study and research.

Paper IV: Analytical Chemistry (MCH-516)

Unit	Topic	Outcome
Unit - 1	Introduction	After studying this unit students will: • Learn analytical methods and types of instrumental analysis. • Understand the gravimetric and volumetric techniques of analysis in detail. • Learn calibration of glassware and sample preparation. • Learn precision and accuracy and types of errors. • Use this knowledge of analytical chemistry in advances study, pharmaceutical & chemical industries and in research.
Unit - 2	Food Analysis	After studying this unit students will: • Learn the analysis of moisture, ash, crude protein, fat, sodium, potassium etc. in food. • Learnto analyze contaminated food. • Learn the applications of HPLC and GC for food analysis. • Learn the use of TLC for the identification of chemical pesticides in food. • The knowledge of food analysis will be utilized in advances study, food industries& in research.
Unit - 3	Analysis of Water Pollution	After studying this unit students will: • Understand the types of water pollutants and their effect. • Learn to analyze turbidity, color, TDS, pH, conductivity, hardness etc. present in the water. • Acquire the knowledge of measuring DO, BOD and COD in water. • Learn to analyze pesticides present in water. • Use this knowledge of analysis of polluted water in advances study,chemical industries, pollution control board and in research.
Unit - 4	Analysis of Soil, Fuel, Body Fluids and Drugs	After studying this unit students will: • Learn to analyze moisture, pH, nitrogen, phosphate, sulfur, magnesia etc. present in the soil. • Learn to analyze liquid and gaseous fuels. • Understand the ultimate and proximate analysis of coal.

		• Understand and learn to analyze flash and fire point of various fuels. • Utilize this knowledge in advanced study, petroleum refineries, chemical industries and in research.
Unit - 5	Clinical Chemistry Drug Analysis	After studying this unit students will: • Understand the composition of blood and its prevention. • Learn the analysis of blood urea nitrogen, blood glucose, blood uric acid, albumin, globulins etc. • Learn the analysis of narcotics and dangerous drugs by TLC and spectrometric techniques. • It will enhance the knowledge of students for further advanced study, in narcotics department, clinical labs and in research.

Paper V: Medicinal Chemistry (MCH-518)

Unit	Topic	Outcome
Unit - 1	Structure and Activity	After studying this unit students will: • Understand the relation between chemical structure and biological activity. • Become familiar with the receptor theory and approach to drug design. • Understand QSAR-free-Wilson analysis. • It will enhance the knowledge of students for further advanced study.
Unit - 2	Pharmacodynamics	After studying this unit students will: • Understand the elementary treatment of enzymes stimulation andenzyme inhibition. • Understand the drug metabolism and its significant in medicinal chemistry. • Understand membrane active drugs and biotransformation. • Utilize this knowledge of pharmacodynamicsin advanced study and medicinal research.
Unit - 3	Antibiotics and Antibacterials	After studying this unit students will: • Understand antibiotics and antibacterials. • Learn synthesis, properties and activities of various antibiotics and antibacterials. • Learn about anticancer drugs. • Utilize this knowledge of antibiotics and antibacterialsin advanced study and medicinal chemistry research.
Unit - 4	Antifungal Antimalarial	After studying this unit students will: • Acquire knowledge of antifungal and antimalarial drugs. • Learn synthesis, properties and activities of various antifungal and antimalarial drugs. • Utilize this knowledge of antifungal and antimalarial in advanced study and medicinal chemistry research.
Unit - 5	Non-steroidal Anti-inflammatory Drugs Antihistamine and Antiasthmatic Agents	After studying this unit students will: • Understand non-steroidal and anti-inflammatory drugs like diclofenac sodium, Ibuprofen and Netopam. • Acquire knowledge of antihistamine and Antiasthmatic agents. • Learn structure, properties and activity of various antihistamine and Antiasthmatic agents.

		• Get motivated for the further advanced study and research in the medicinal chemistry.

Program- M. Sc. Mathematics

M. Sc. I Semester

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

Paper-I **ADVANCED ABSTRACT ALGEBRA – 1**

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Automorphisms, Normal and subnormal series of groups, composition series, Jordan-Holder Theorem	Student must be able to •Define Automorphisms and prove that the set of all automorphism of G is a group under composition of maps. •Explain Normal and subnormal series of groups. •Define Composition series •State and prove Jordan- Holder Theorem
UNIT-II	Commutator subgroup, Solvable series and Solvable groups. Central series and Nilpotent groups.	• Explain Commutator subgroup • Define Solvable series and solvable groups • Understands Central series and Nilpotent groups.
UNIT-III	Extension fields, Roots of polynomials, Algebraic and transcendental Extensions, Splitting fields, Separable and inseparable Extensions.	•Understands Extension fields, roots of polynomials •Define Algebraic and transcendental Extensions •Define Splitting Fields, Separable and inseparable Extensions.
UNIT-IV	Perfect fields, Finite fields, Algebraically closed fields.	• Understands field, Perfect fields, Finite fields. • Define Algebraically closed fields.
UNIT-V	Automorphism of Extensions, Galois extensions, Fundamental theorem of Galois theory, Solution of polynomial equations by radicals, Insolvability of the general equation of degree 5 by radicals	• Define Automorphisms of Extensions •State and prove Fundamental theorem of Galois theory • Solution of polynomial equations by radicals. •Insolvability of the general equation of degree 5 by radicals

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

M. Sc. I Semester

Paper-II REAL ANALYSIS

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Definition and existence of Riemann-Stieltjes integral, Properties of integral, integration and differentiation, the fundamental theorem of Calculus.	• Integrate functions a real variable in the sense of Riemann – Stieltjes. •Understands Properties of integral. • Applications of Integration and differentiation. •State of the fundamental theorem of Calculus.
UNIT-II	Integration of vector valued functions, Rectifiable curves. Rearrangement of terms of a series, Riemann's theorem. Sequences and series of functions, pointwise and uniform convergence.	• Understands how to integrate vector valued functions. • State & Apply Riemann's theorem. •Understands the concept of pointwise and uniform convergence applied in Sequences and series of functions.
UNIT-III	Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's test for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem,	•Understands Cauchy criterion for uniform convergence and how to apply Weierstrass M-test, Abel's and Dirichlet's test for uniform convergence. •Relation Between uniform convergence and continuity. •Understands uniform convergence and differentiation •State Weierstrass approximation theorem.
UNIT-IV	Power series, Uniqueness theorem for power series, Abel's theorem, Functions of several variables, linear transformations, Derivatives in an open subset of R", chain rule, partial derivatives, interchange of the order of differentiation, derivatives of higher orders. Taylor's theorem,	•Able to understands theorems on Power series. •Define linear transformations. • Apply chain rule in partial derivatives •How to compute derivatives of higher orders. •State Taylor's theorem and use it in power series problems.
UNIT-V	Inverse function theorem, Implicit function theorem, Jacobians, Lagrange's multiplier method, Differentiation of integrals, Partitions of unity, Differential forms, Stoke's theorem.	•State the Implicit function theorem, Jacobians •How to compute Jacobians and its application to show variables are independent or dependent. •How to differentiate integral •How to apply Stoke's theorem.

M. Sc. I Semester

Paper-III TOPOLOGY-I

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Countable and Uncountable sets. Infinite sets and the Axiom of Choice, Cardinal numbers and its arithmetic Schroeder-Bernstein theorem Cantor's theorem and the continuum hypothesis Zorn's lemma Well ordering theorem	•Understands Countable and Uncountable sets. •Definition of Infinite sets and the Axiom of Choice. •Cantor's theorem and the continuum hypothesis. •know about Zorn's lemma, Well ordering theorem.
UNIT-II	Defintion and examples of topological spaces Closed sets, Closure. Dense subsets, Neighbourhoods, Interior, exterior and boundary. Accumulation points und derived sets	•Define Topological spaces with examples. •Understand Closed sets, Closure. Dense subsets, Neighbourhoods •Interior, exterior and boundary. Accumulation points und derived sets
UNIT-III	Bases and sub bases. Subspaces and relative topology, Product Topology, Metric Topology, Continuous functions and homomorphism	• Definition of Bases and sub bases. • Knowledge about Subspaces and relative topology • Definition of Product Topology, Metric Topology •Theorems based on Continuous functions and homomorphism
UNIT-IV	First and Second Countable spaces, Covering and Lindelofs spaces, Separable spaces, second countability and Separability	•Understands the definition of First and Second countable spaces. •Know about Covering and Lindelofs spaces •Understands Separable spaces, second countability and Separability • known relation between them.
UNIT-V	Connected spaces, connectedness on real line, components, Path connectedness, locally connected spaces	•Understands definition of Connected spaces. • know about Connectedness on real line •Definition of Components, Path connectedness, locally connected spaces

M. Sc. I Semester

Paper-IV COMPLEX ANALYSIS-I

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Complex integration Cauchy-Gorsat Theorem Cauchy's integral Formula. Higher Order derivatives.	Student must be able to • understand the concept of complex integration. • State and use Cauchy's theorem, Cauchy's integral Formula to evaluate the complex integral. • Higher Order derivatives.
UNIT-II	Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of Algebra. Taylor's theorem.	•How to apply Morera's theorem, Cauchy's inequality. • State and use Liouville's theorem. • State and use The fundamental theorem of Algebra • Use Taylor's theorem for power series representation.
UNIT-III	Maximum modulus principle Schwarz lemma. Laurent's series. Isolated singularities, Meromorphic functions. The argument principle. Rouche's theorem inverse function theorem.	•State & apply Maximum modulus principle Schwarz lemma. •How to expand function using Laurent's theorem. •How to classify singularities and poles. •Explain the argument principle. •Rouche's theorem inverse function theorem.
UNIT-IV	Mobius Transformations. Fixed Points, Cross Ratio, Bilinear transformations, their properties and classifications. Definitions and Examples of Conformal mappings	•Students understand Mobius Transformations. Definition of Fixed Points, Cross Ratio, •What is Bilinear transformations, their properties and classifications. •Definition of and Examples of Conformal mappings. Use conformal mappings and know about meromorphic functions.
UNIT-V	Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, log z and z	• How to compute the residues and evaluate complex integrals using the residue theorem. • Understands Contour integration. • Definition of Branches of many valued functions.

Regular	Private
Theory Marks : 25 C.C.E. marks : 10 Practical Marks : 15	Theory Marks : 35 Practical Marks : 15

M. Sc. I Semester

Paper-V PROGRAMMING IN 'C'-I (OPTIONAL)

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	An overview of programming languages	Student must be able to • Understands programming languages and their purpose.
UNIT-II	Classification. C Essentials-Programs development, functions	•Understands C Essentials.
UNIT-III	Anatomy of Function. Variables and Constants Expressions. Assignment Statements. Formatting Source files. Continuation Character, the Pre-processor.	• How to differentiate between variables and constraints. •How to use them in functions.
UNIT-IV	Scalar Data types-Declarations, Different Types of integers. Different kinds of Integer Constants Floating-point type Initialization	• Students able to understands different data types used in C.
UNIT-V	Mixing types Explicit conversions-casts. Enumeration Types. the void data type, Typedefs. Pointers	• Able to understands data type other than basic data types. •How to types cost.

Paper-VI Comprehensive Viva- Voce 50 Marks.

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

M. Sc. II Semester

Paper-I ADVANCED ABSTRACT ALGEBRA – II

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Introduction to Modules, Examples, Sub-modules and direct sums, Examples of sub-modules, Quotient Modules, R-Homomorphism and Examples of R-Homomorphism	• Understands definition of Module, sub module and how prove their problems. •Definition of Quotient Modules. •Theorems based on the concept of homomorphism.
UNIT-II	Finitely generated modules. Cyclic modules, Simple modules, Schur's Lemma, Free modules	• Study different types of Modules and their relation between them. • State Schur's Lemma.
UNIT-III	Noetherian and Artinian modules and rings, Hilbert basis theorem.	• Understands definition of Noetherian and Artinian modules. • State Hilbert basis theorem and applications.
UNIT-IV	Uniform modules. Primary modules and Noether-Lasker theorem.	•Understands Uniform. Primary Modules. •Understands Noether-Lasker theorem and its uses.
UNIT-V	Algebra of linear transformations, Characteristic roots, Similarity of linear transformations, Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, Index of nilpotency, Invariants of a nilpotent transformation, The primary decomposition theorem.	• Understands Algebra of linear transformations, Characteristic roots, Similarity of linear transformations • Procedure of Reduction to triangular forms. • Definition of Nilpotent transformations, Index of nilpotency. • How to show that Invariants of a nilpotent transformation. •State The primary decomposition theorem.

M. Sc. II Semester

Paper-II **LEBESGUE MEASURE AND INTEGRATION**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Lebesgue outer measure. Measurable sets, Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets.	Students able to know about • Lebesgue outer measure. Measurable sets, Regularity. Measurable functions. • Results on Borel and Lebesgue measurability. • Define Non-measurable sets.
UNIT-II	Integration of Non-negative functions. The General integral. Integration of Series. Riemann and Lebesgue integrals.	•How to integrate Non-negative functions and understand Integration of Series. • Results based on Riemann and Lebesgue integrals.
UNIT-III	The Four derivatives. Functions of bounded variation. Lebesgue Differentiation Theorem. Differentiation and Integration.	•Understand the concept of functions of bounded variation. • Understands Lebesgue Differentiation Theorem. • Results of Differentiation and Integration.
UNIT-IV	The L^p spaces, Convex functions, Jensen's inequality, Hölder and Minkowski inequalities, Completeness of L^p.	• The L' spaces, Convex functions. • Understands Jensen's inequality, Hölder and Minkowski inequalities • How to apply Completeness of L
UNIT-V	Dual of space, Convergence in Measure, Uniform convergence and Almost uniform convergence.	•How to find Dual of space. •Convergence in Measure, Uniform convergence and Almost uniform convergence and their relation.

M. Sc. II Semester

Paper-III TOPOLOGY-II

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Separation axioms T_0, T_1, T_2, $T_3^{1/2}$, T_4, their characterization and basic properties. Urysohn's lemma. Tietze extension theorem.	Student must be able to • Sepration axioms and T_0, T_1, T_2,,$T_3^{1/2}$, T_4, their characterization • Understands Urysohn's lemma. • Understands Tietze extension theorem.
UNIT-II	Compactness. Continuous functions and compact sets. Basic properties of compactness, Compactness and finite intersection property. Sequentially and countably compact sets. Local Compactness and one point compactification. Stone-Cech compactification	•Students able to understands compactness, Sequentially and countably compact sets and their properties •Understands Local Compactness and one point compactification. •Stone-Cech compactification.
UNIT-III	Tychonoff product, Projection maps. Separation axioms and product spaces. Connectedness and product spaces Compactness and product spaces (Tychonoff Theorem). Embedding lemma and Tychonoff embedding	•Definition of Tychonoff product and product spaces. •Use Compactness and connectedness in product spaces. • Understands Embedding lemma and Tychonoff embedding.
UNIT-IV	First Nets and Filters. Topology and Convergence of nets. Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to Filters and vice versa. Ultrafilters and compactness	•Understands nets and filters and example •Understands Convergence of nets and filter. •Understands Ultrafilters and compactness.
UNIT-V	The fundamental group and covering spaces-Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra.	Students able to •Homotopy of paths. •The fundamental group. Covering spaces. • The fundamental theorem of algebra.

M. Sc. II Semester

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

Paper-IV COMPLEX ANALYSIS-II

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Weierstrass' factorisation theorem. Gamma function and its properties Riemann Zeta function. Riemann's functional equation.	Student must be able to • Understands Weierstrass' factorisation theorem. • Gamma function and its properties. •Definition of Riemann Zeta function. •How to apply Riemann's functional equation.
UNIT-II	Runge's theorem. Mittag-Leffler's theorem. Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation.	•Understands Runge's theorem. Mittag-Leffler's theorem. • Understand analytic continuation and uniqueness of direct analytic continuation. •How to check uniqueness of analytic continuation along a curve. and the method of power series of analytic continuation.
UNIT-III	Schwarz Reflection principle. Monodromy theorem and its consequences. Harmonic functions on a disk.	• Know about Schwarz Reflection principle. • Understands Monodromy theorem and its consequences. • Definition of Harmonic functions on a disk.
UNIT-IV	Harnack's inequality and theorem. Dirichlet problem. Green's function. Canonical products, Jensen's formula. Poisson - Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.	•Student able to understands Harnack's inequality and theorem. • Green's function. Canonical products. • Jensen's formula. Poisson - Jensen formula •Hadamard's three circles theorem. •Order of an entire function. Exponent of Convergence. •Borel's theorem. Hadamard's factorization theorem
UNIT-V	The range of an analytic function. Bloch's theorem. The little Picard theorem. Schottky's theorem. Montel Caratheodary and great Picard theorem. Univalent function. Bieberbach conjecture and the 1/4 theorem.	• The range of an analytic function. • Bloch's theorem. The little Picard theorem. Schottky's theorem. • Montel Caratheodary and great Picard theorem. Univalent function. Bieberbach conjecture and the 1/4 theorem.

M. Sc. II Semester

Regular	Private
Theory Marks : 25 C.C.E. marks : 10 Practical Marks : 15	Theory Marks : 35 Practical Marks : 15

Paper-V(iv) PROGRAMMING IN 'C'-II (OPTIONAL)

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Control Flow-Conditional Branching, the Switch Statement. looping, nested loops.	Student must be able to • Understands Control flow structure of programme using loops.
UNIT-II	The Break and Continue statement. the goto statement infinite loops.	•Students able to understands the use of Break and continue statement. • Understands the goto statement infinite loops.
UNIT-III	Operators and Expressions - Precedence and associatively. Unary plus and Minus operators. Binary Arithmetic operators, arithmetic assignment operators. Increment and decrement operators, Comma Operator, Relational operators, logical operators, bit-Manipulation operators, Bitwise assignment operators. Cast operators size of Operators, Conditional Operators, memory operator.	•Students able to understand all the types of Operators which can be used in C Programming.
UNIT-IV	Arrays and multidimensional Arrays. Storage Classes - fixed vs. Automatic Duration Scope, global variable	•Student must be able to understand different derived variables & storage classes.
UNIT-V	The Register Specificer Structures and Unions.	• Students Understands the Register Specificer Structures and Unions.

Paper-VI Comprehensive Viva- Voce 50 Marks.

M. Sc. III Semester

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

Paper-I INTEGRATION THEORY AND FUNCTIONAL ANALYSIS-I

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Signed measure. Hahn decomposition theorem, mutually singular measures, Radon Nikodim theorem. Lebesgue decomposition. Riesz representation theorem.	Students able to •Understands signed measure, mutually singular measure. • Understand Hahn decomposition theorem. • Understand Radon Nikodim theorem. •State Lebesgue decomposition. •Understand Riesz representation theorem.
UNIT-II	Outer measure, Extension theorem Caratheodory theorem, Lebesgue-Stieltjes integral, , Fubini's theorem.	• Understand Outer measure, product measures • Understands theorems related to them: Extension theorem, Caratheodory theorem & Fubini's theorem.
UNIT-III	Normed linear spaces. Banach spaces, Further properties of Normed Spaces, Finite dimensional Normed Spaces and Subspaces and Quotient Normed linear space.	•Understand Normed linear spaces, Completeness, Banach Space. • Understands Finite dimensional Normed Spaces and Subspaces. •Definition of Quotient Normed linear space.
UNIT-IV	Compactness and finite dimension, Linear Operators. Bounded and Continuous Linear Operators.	Students able to understands • Compactness and finite dimension • Linear Operators. • Bounded and Continuous Linear Operators.
UNIT-V	Linear Functionals, Linear Operators and functional on finite dimensional Spaces, Normed Spaces of Operators and Dual Space.	•Understands Linear Functionals, Linear Operators and functional on finite dimensional Spaces • Understands Normed Spaces of Operators and Dual Space.

M. Sc. III Semester

Paper-III (II(4)) **ADVANCED SPECIAL FUNCTION-I**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Gamma and Beta Functions: The Euler or Mascheroni Constant?, Gamma Function, A series For'(z) /Γ(z), Difference equation Γ (z+1)=z Γz.	Student must be able to • Understands Gamma and Beta Functions. • Mascheroni Constant?. •A series For'(z) /Γ(z), Difference equation Γ (z+1)=z Γz.
UNIT-II	Beta function, value of Γz. Γ(1-z), Factorial Function, Legendre's duplication formula, Gauss multiplication theorem	•How to find value of Beta function, value of Γz. Γ(1-z), Factorial Function •Legendre's duplication formula, •Gauss multiplication theorem
UNIT-III	Hypergoemetric and Generalized Hypergeometric functions: Function 2F1(a,b;c;z) A simple integral form evaluation of 2F1 (a, b;c;z)	•Understands Hypergoemetric and Generalized Hypergeometric functions, Function 2F1(a,b;c;z). •A simple integral form evaluation of 2F1 (a, b;c;z).
UNIT-IV	Contiguous function relations, Hyper geometrical differential equation and its solutions, F(a,b;c;z) as function of its parameters,	Students able to understands •Contiguous function relations. •Hyper geometrical differential equation and its solutions. •F(a,b;c;z) as function of its parameters.
UNIT-V	Elementary series manipulations, Simple transformation, Relations between functions of z and 1-z.	Students able to understands •Elementary series manipulations, Simple transformation, •Relations between functions of z and 1-z.

M. Sc. III Semester

Paper-IV(IV-1) **OPERATION RESEARCH-I**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Operations Research and its scope, Nature and Meaning of OR, Origin and Development of OR, Necessity of OR in Industry, Case studies of OR. Model in OR, Main Face of OR Uses and limitation of OR, Scope of OR, and role of OR in decision making.	After learning the contents of this unit the student must be able to • Origin & development of OR. •Necessity of OR in Industry, Case studies of OR. Model in OR, Main Face of OR. • Uses and limitation of OR, Scope of OR. •Role of OR in decision making. • It is used to find optimal or near optimal solutions to complex decision making problems. • It is used in finding maximum (of profit or yield) in real-world objective.
UNIT-II	Linear Programming Problem, Mathematical Formulation, Graphical Solution Method. Graphical Solution in some exceptional cases. Geometrical properties of L.P.P. General Formulation of L.P.P. Slack and Surplus Variables, Standard form of LPP. Assumptions in L.P.P. Limitation of L.P.P.	Student will be able to: • Understands the procedure to formulate LPP. • Graphical Solution Method. Graphical Solution in some exceptional cases. • Slack and Surplus Variables •Limitation of L.P.P.
UNIT-III	Linear Programming Problem -Simplex Method with exceptional cases, Computational procedure of simplex method, artificial variable techniques; Big M method, two phase Method, Problem of degeneracy.	Students able to Solve LPP •By simplex method artificial variable techniques; Big M method, two phase Method, Problem of degeneracy. • It is used in data envelopment. • It has strong ties to computer science and analytics.
UNIT-IV	Duality: Fundamental properties of Duality and Theorem of Duality.	• Understands fundamental properties of Duality. •Theorem of Duality.
UNIT-V	Transportation Problems, Initial Feasible Solution to T.P., North-West comer rule, Row minima, Colum Minima, Matrix Minima, VAM. Optimality test for the initial Feasible solution, Degeneracy in T.P., Assignment Problems Hungarian Method for assignment Problem and unbalanced assignment Problem.	• Solution of Transportation problem using North-West comer rule, Row minima, Colum Minima, Matrix Minima, and VAM. • How to apply optimality test for the initial Feasible solution, Degeneracy in T.P., • How to solve assignment Problems Hungarian Method for assignment Problem and unbalanced assignment Problem. OR is used in our daily life for example in decision making, in supermarket, in hospital management, Financial services, Govt policies, accounting, Construction, Finance, manufacturing, marketing, purchasing, R & D. etc.

M. Sc. III Semester

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

Paper-IV(4) INTEGRAL TRANSFORM-I (OPTIONAL)

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Application of Laplace Transforms	Student must be able to •Calculate the Laplace transform of standard functions both from the definition and by using tables. •Select and use the appropriate shift theorems in finding Laplace and inverse Laplace transforms. • Applications of Laplace transform, which are used in various branches of engineering.
UNIT-II	Laplace's equations,	Student must be able to •Laplace equations and its solution. •Learn the required conditions for transforming variable or variables in functions by the Laplace transform.
UNIT-III	Laplace's wave equation	Students able to understands • Laplace's wave equation and its solution under each cases. •Learn the application of Laplace transform in engineering analysis.
UNIT-IV	Application of Laplace Transforms	•How to use of available Laplace transform tables for transformation of functions and the inverse transformation. •Learn to use partial fraction and convolution methods in inverse Laplace transforms. •Application of Laplace transforms to solve ordinary and partial differential equations. •How to use of special functions in solving indeterminate beam bending problems using Laplace transform methods.
UNIT-V	Heat conduction equation.	•How to applied Laplace transforms to solve Heat conduction equation

M. Sc. III Semester

Paper-V(1) FUNDAMENTALS OF COMPUTER SCIENCE-I (OPTIONAL)

Regular	Private
Theory Marks : 25 C.C.E. Marks : 10 Practical Marks : 15	Theory Marks : 35 Practical Marks : 15

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Object Oriented Programming Paradigm, Basic Concepts, Benefits and Applications of Oriented Programming	After learning the contents of this unit the student must be able to •Object Oriented Programming Paradigm. •Basic Concepts, Benefits and Applications of Oriented Programming.
UNIT-II	C++ - Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Variables, Operators in C++, Expressions, Implicit Conversions.	Students able to understands • How to write a simple program in C++. •Tokens, Keywords, Identifiers and Constants •Basic Data Types, User-Defined Data Types, Derived Data Types •Variables, Operators in C++, Expressions, Implicit Conversions.
UNIT-III	Operator Overloading. Operator Precedence, Control Structure. The if Statement. The switch Statement, The do...while Statement, The while Statement, The for statement.	Student able to understands • Operator overloading, Operator Precedence, Control Structure • know about Statements and uses.
UNIT-IV	Functions in C++, The main Function, Function Prototyping, Call by Reference, Inline Function, Function Overloading, Friend and Virtual Functions.	Student able to understands • Functions in C++ and their purpose.
UNIT-V	Classes and Objects: Specifying a Class, Defining Member Function, Nesting of Member Function, Private Member Functions, Arrays within a Class, Static Data Members, State Member Functions, Pointers to Members	Student able to understands • Classes and Objects.

Paper-VI Comprehensive Viva- Voce 50 Marks.

M. Sc. IV Semester

Paper-I **FUNCTIONAL ANALYSIS- II**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Hahn-Banach theorem, Hahn-Banach theorem for complex vector space and Normed spaces, Reflexive spaces, Category Theorem and Uniform boundedness theorem.	Students able to understands • Hahn-Banach theorem, Hahn-Banach theorem for complex vector space. • Definition & problem based on Normed spaces, Reflexive spaces. • Category Theorem and Uniform boundedness theorem.
UNIT-II	Strong and Weak convergence Open Mapping Theorem, Closed Linear Operators and closed Graph Theorem., Closed Range Theorem.	• Learnt Strong and Weak convergence •Understands Open mapping Theorem. • Understands Closed Graph theorem. • Understands Closed range theorem.
UNIT-III	Inner product spaces, Hilbert spaces, further properties of inner product spaces, Orthogonal complements and Direct Sums (Projection Operator)	• What is Inner product spaces, Hilbert space • Properties of IPS. •Definition of Orthogonal sums and direct sums.
UNIT-IV	Complete Orthonormal sets and Bessel's Inequality, Convergence Theorems and fourier coeifficients,total Orthonormal sets and sequences Parseval's Relation Riesz representation theorem	Students able to understands •Complete Orthonormal sets and Bessel's Inequality. •Convergence Theorems • Fourier coefficients •Total Orthonormal sets and sequences Parseval's Relation •Understands Riesz representation theorem
UNIT-V	Representation of Functionals on Hilbert space (Riesz theorem, Riesz representation). Hilbert adjoint operator, Self-adjoint operators, Unitary operators and Normal operators	Students able to understands •Riesz theorem •Definition of Hilbert adjoint operator, self adjoint operators •Unitary operators and Normal operators.

M. Sc. IV Semester

Paper-II (II(4))ADVANCED SPECIAL FUNCTION-II

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Bessel function and Legendre polynomials: Definition of Jn (z), Bessel's differential equation Generating function, Bessel's integral with index half and an odd integer.	After learning the contents of this unit the student must be able to • Bessel' differential equation and Generating function of Jn(x). • Express poly as Legendre polynomials. • Bessel's integral with index half and an odd integer.
UNIT-II	Generating function for Legendre polynomials Rodrigues formula, Bateman's generating function, Additional generating functions, Hypergeometric forms of Pn(X), Special properties of Pn(X), Some more generating functions, Laplace's first integral form, Orthogonality	Understands •Generating function of Legendre's polynomials. • Rodrigues formula. • Hypergeometic forms of Pn(x). •Orthogonality.
UNIT-III	Special properties of Pn(X), Some more generating functions, Laplace's first integral form, Orthogonality.	Students must be able to understands • Some special Properties of Pn(x) •Laplace's first integral form •Orthogonality
UNIT-IV	Definition of Hermite polynomials Hn(x), Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions. Othogonality, Expansion of polynomials, more generating functions.	Understands the followings: •Hermite Polynomials Hn(x). •Recurrence relation. •Rodrigue's Formula. •Orthogonality.
UNIT-V	Laguerre Polynomials: The Laguerre Polynomials Ln(X), Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigue's formula, Orthogonal, Expansion of polynomials, Special properties, Other generating functions.	Understands the followings: •Laguerre Polynomials Ln(x). • Generating Functions. •Rodrigue's Formula. •Orthogonality. •Other generating function.

M. Sc. IV Semester

Paper-IV(IV-1) **OPERATION RESEARCH-II**

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Network analysis, constraints in Network, Construction of network, Critical Path Method(CPM) PERT, PERT Calculation, Resource Levelling by Network Techniques and advances of network (PERT/CPM).	After learning the contents of this unit the student must be able to • Network analysis, constraints of network • Critical Path method(CPM), PERT calculation • Resource Levelling by Network Techniques and advances of network
UNIT-II	Dynamic Programming - recursive equation approach, Characteristic of Dynamic Program ming, Computational procedure, Integer programming Gomory's all I.P.P.method, Branch and Bound Technique.	• Learnt about Dynamic Programming. • Understands Integer programming • How to apply Gomory's all I.P.P.method, Branch and Bound Technique.
UNIT-III	Game theory - Two person Zero-sum games, Maximix-Minimax principle, games without saddle points - Mixed strategies, Graphical solution of 2Xn and Mx2 Games. Solution by Linear Programming.	• Students learn about game theory, two person zero sum games. • Understands Maximix-Minimax principle •Games without saddle point •Graphical solution of 2Xn and MX2 games. • Solution of Linear Programming.
UNIT-IV	Non-linear programming: Mathematical Formulation, General Non-linear Programming Problems, Problems of Constrained Maxima and Minima (Kuhn-Tucker Condition). Non-negative Constraints.	•How to formulate non linear programming • Understands Kuhn- Tucker condition. • Understands Non-negative constraints.
UNIT-V	Quadratic programming: Wolfe's Modified Simplex method, Beale's Method, Separable programming, Convex programming, Separable programming algorithms.	Students able to understands • Wolfe's Modified, simplex method, Beale's Method for Quadratic programming. • Understands Scrabble programming. • Understands Convex programming.

M. Sc. IV Semester

Regular	Private
Theory Marks : 40 C.C.E. marks : 10	Theory Marks : 50

Paper-IV(V-4) INTEGRAL TRANSFORM-II (OPTIONAL)

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Application of Laplace Transform to Boundary Value Problems.	After learning the contents of this unit the student must be able to • various method to compute Laplace transform. • How to solve Boundary Value Problems by using Laplace transform.
UNIT-II	Electric Circuits. Application to Beams.	Students able to understands • Electric circuits • Application of beams.
UNIT-III	The complex Fourier Transform, Inversion Formula, fourier cosine and sine transform.	• What is definition of complex fourier transform? •How to apply Inversion formula. • How to compute fourier cosine and sine transform. •Application of Fourier transforms to solve differential and integral equation as well as many areas in science & Engineering.
UNIT-IV	Properties of Fourier Transforms, Convolution & Parseval's identity	Students able to Understands • Various properties of fourier transform. • Convolution theorem and its uses. • How to prove Parseval's identity.
UNIT-V	Fourier Transform of the derivatives, Finite Fourier Sine & Cosine Transform, Inversion Operational and combined properties Fourier Transform.	• How to compute fourier transform of derivative of function. • Finite fourier sine & cosine transform • Understands Inversion, Operational and combined properties.

M. Sc. IV Semester

Regular	Private
Theory Marks : 25 C.C.E. Marks : 10 Practical Marks : 15	Theory Marks : 35 Practical Marks : 15

Paper-V(VI-1) FUNDAMENTALS OF COMPUTER SCIENCE-II (OPTIONAL)

UNITS	PROGRAM CONTENTS	PROGRAM LEARNING OUTCOMES
UNIT-I	Inheritance, Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Templates including Class Templates.	After learning the contents of this unit the student must be able to • Inheritance, single. Multilevel, Multiple, Hierarchical, Hybrid Inheritance. • Templates.
UNIT-II	C++ Streams, C++ Stream Classes, put () and get() functions, getline() and write() Functions. Expressions, Implicit Conversions.	Learn how to use • C++ streams, write functions. • Expressions, Implicit conversions.
UNIT-III	Database Systems- Role of Database Systems, Database Systems Architecture.	Students understands: • Role of Database • Database systems architecture.
UNIT-IV	SQL- Basic Features including views, Integrity Constraints, Key, Functional dependency, Multivalued functional Dependency, Database Design- Normalization up to BCNF.	Students able to understands the concept of • SQL- Basic features. • Integrity key, functional dependency, multi -valued functional dependency. • Database design- normalization up to BCNF.
UNIT-V	Operating Systems-User Interface, Processor Management, memory management, Network and Distributed Systems.	After completion of this unit student must be able to: • Operating Systems-User interface • Memory management • Network and distributed Systems.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

FOR UNDERGRADUATE EDUCATION

OUTCOME
PROGRAM OBJECTIVES
INSTITUTIONAL GOALS

INTERNAL QUALITY ASSURANCE CELL
GOVT. MADHAV SCIENCE P.G.COLLEGE UJJAIN

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION

SECTION A

1.1 Introduction

Imparting quality Higher Education at the campus should be the high priority for any Higher Education Institution. Improvement of quality of higher education will enable effective participation of young students in knowledge production and participation in the knowledge economy, improving national competitiveness in a globalized world and for equipping young students with skills relevant for global and national standards and enhancing the opportunities or social mobility. Continuous initiatives are must for institutionalizing an outcome-oriented higher education system and enhancing employability of graduates through curriculum reform, based on a learning outcomes-based curriculum framework, improving/upgrading academic resources and learning environment, raising the quality of teaching and research across all higher education institutions; technology use and integration to improve teaching-learning processes and to reach a larger body of students through alternative learning modes such as open and distance learning modes and use of MOOCs.

Translation of academic research into innovations for practical use in society and economy, promoting efficient and transparent governance and management of higher education system, enhancing the capacity of the higher education system to govern itself through coordinated regulatory reform and increasing both public and private sector investment in higher education, with special emphasis on targeted and effective equity-related initiatives are other priority areas of action for imparting quality higher education.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution

We focus on Curriculum Enrichment and Execution rather than Curriculum planning and development as an affiliated college. The fundamental promise underlying the learning outcomes-based approach to curriculum Enrichment and Execution is that higher education qualifications such as a Bachelor's Degree programs and PG Programs are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values measurable through Internal Examination CCE modes and experiential activity modules) and academic standards expected from graduates of a program. Learning outcomes specify what graduates completing a particular program of study are expected to know, understand and be able to learn and understand do at the end of their program of study.

It may be noted that the learning outcomes-based curriculum framework in this college not only intend to promote designing of a syllabus for a program of study or learning contents of course,s within each program of study or to prescribe a set of approaches to teaching-learning process and assessment of student learning levels. Instead, they are intended to allow for flexibility and innovation in (i) Program design and syllabi development by higher education institution for self finance subjects (ii) Enrichment of Execution process of Syllabi (ii) Teaching learning process, (iii) Assessment of student learning levels, and (iv) Periodic program review within a broad framework of agreed expected graduate attributes, qualification descriptors, program learning outcomes and course learning outcomes.

The overall objectives of the learning outcomes-based curriculum framework are to:

- Help formulate graduate attributes, qualification descriptors, program learning outcomes and course learning outcomes that are expected to be demonstrated by the holder of a qualification;
- Enable prospective students, parents, employers and others to understand the nature and level of learning outcomes (knowledge, skills, attitudes and values or attributes), a graduate of a program should be capable of demonstrating on successful completion of the program of study;
- Maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility; and
- Provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programs and academic standards.

1.3 Key outcomes underpinning curriculum enrichment and execution

The learning outcomes-based curriculum framework for undergraduate education is a framework based on the expected learning outcomes and academic standards that are expected to be attained by graduates of a program of study and holder of a qualification. The key outcomes that underpin curriculum enrichment and execution at the undergraduate level include Graduate Attributes, Qualification Descriptors, Program Learning Outcomes, and Course Learning Outcomes:

1.3.1 Graduate attributes

The graduate attributes reflect the particular quality and feature or characteristics of an individual, including the knowledge, skills, attitudes and values that are expected to be acquired by a graduate through studies at the institution. The graduate attributes include capabilities that help strengthen one's abilities for widening current knowledge base and skills, gaining new knowledge and skills, undertaking future studies, performing well in a chosen career and playing a constructive role as a responsible citizen in the society. The graduate attributes define the characteristics of a student's university degree program and describe a set of characteristics/competencies that are transferable beyond study of a particular subject area and program contexts in which they have been developed. Graduate attributes are fostered through meaningful learning experiences made available through the curriculum, the total college experiences achievable through Flagship programs and a process of critical and reflective thinking developed there in.

The learning outcomes-based curriculum framework is based on the inherent principle that every student and graduate is unique. Each student or graduate has his/her own characteristics in terms of previous learning levels and experiences, life experiences, learning styles and approaches to future career-related actions. The quality, depth and breadth of the learning experiences made available to learn and understand the students while at institution help develop their characteristic attributes. The graduate attributes reflect disciplinary knowledge and understanding, generic skills, including global competencies that all students in different academic fields of study should acquire/attain and demonstrate. Some of the characteristic attributes that a graduate should demonstrate are as follows:

- ***Disciplinary knowledge:*** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate program of study.

- ***Communication Skills:*** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

- ***Critical thinking:*** Capability to apply analytic thought to a body of knowledge; Analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

- ***Problem solving:*** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply on's learning to real life situations.

- ***Analytical reasoning****:* Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

- ***Research-related skills:*** A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

- ***Cooperation/Team work****:* Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

- ***Scientific reasoning:*** Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

- ***Reflective thinking:*** Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.

- ***Information/digital literacy:*** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

- ***Self-directed learning:*** Ability to work independently, identifies appropriate resources required for a project, and manages a project through to completion.

- ***Multicultural competence:*** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

- ***Moral and ethical awareness/reasoning:*** Ability to embrace moral/ethical values in conducting one's life, formulates a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, Avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

- ***Leadership readiness/qualities:*** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

- ***Lifelong learning:*** Ability to acquire knowledge and skills, including, learning how to learn that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

1.3.2 Qualification descriptors

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification (for eg. a bachelor's degree or a Postgraduate degree). The qualification descriptors also describe the academic standard for a specific qualification in terms of the levels of knowledge and understanding, skills and competencies and attitudes and values that the holders of the qualification are expected to attain and demonstrate. These descriptors also indicate the common academic standards for the qualification and help the degree awarding bodies in designing, approving, assessing and reviewing academic programs. The learning experiences and assessment procedures are expected to be designed to provide every student with the opportunity to achieve the intended program learning outcomes. The qualification descriptors reflect both disciplinary knowledge and understanding as well as generic skills, including global competencies that all students in different academic fields of study should acquire/attain and demonstrate.

Qualification descriptors for a Bachelor's and Post Graduate Degree program : The students who complete three years of full-time study of a bachelor's program and complete two years of

full-time study of a Post Graduate Program will be awarded a Bachelor's Degree and Master's Degree respectively. Some of the expected learning outcomes that a student should be able to learn and understand demonstrate on completion of a degree-level program may include the following:

- Demonstrate (i) a fundamental/systematic or coherent understanding of an academic field of study, its different learning areas and applications, and its linkages with related disciplinary areas/subjects; (ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of study, including research and development, teaching and government and public service; (iii) skills in areas related to one's specialization and current developments in the academic field of study.
- Use knowledge, understanding and skills required for identifying problems and issues, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, and their application, analysis and evaluation using methodologies as appropriate to the subject(s) for formulating evidence-based solutions and arguments;
- Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the subject(s);
- Meet one's own learning needs, drawing on a range of current research and development work and professional materials;
- Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts, rather than replicate curriculum content knowledge, to identify and analyze problems and issues and solve complex problems with well-defined solutions.
- Demonstrate subject-related and transferable skills that are relevant to some of the job trades and employment opportunities.

1.3.3 Program learning outcomes

The outcomes and attributes described in qualification descriptors are attained by students through learning acquired on completion of a program of study. The term 'program' refers to the entire scheme of study followed by learners leading to a qualification. Individual programs of study will have defined learning outcomes which must be attain for the award of a specific degree. The program learning outcomes are aligned with the relevant qualification descriptors. Program learning outcomes will include subject-specific skills and generic skills, including transferable global skills and competencies, the achievement of which the students of a specific program of study should be able to learn and understand demonstrate for the award of the Degree qualification. The program learning outcomes would also focus on knowledge and skills that prepare students for further study, employment, and citizenship. They help ensure comparability of learning levels and academic standards across colleges/universities and provide a broad picture of the level of competence of graduates of a given program of study.

1.3.4 Course learning outcomes

The program learning outcomes are attained by learners through the essential learning acquired on completion of selected courses of study within a program. The term 'course' is used to mean the individual courses of study that makes up the scheme of study for a program. Course learning outcomes are specific to the learning for a given course of study related to a disciplinary or interdisciplinary/multi-disciplinary area. Some programs of study are highly structured, with a closely laid down progression of compulsory/core courses to be taken at particular phases/stages of learning. Some programs allow learners much more freedom to take a combination of courses

of study according to the preferences of individual student that may be very different from the courses of study pursued by another student of the same program. Course-level learning outcomes will be aligned to program learning outcomes. Course- level learning outcomes are specific to a course of study within a given program of study. The achievement by students of course,-level learning outcomes leads to the attainment of the program learning outcomes. At the course level, each course may well have links to some but not all graduate attributes as these are developed through the totality of student learning experiences across the years of their study. Teaching - learning process. The Learning Outcomes-Based Approach to curriculum planning, Enrichment, and transaction requires that the teaching-learning processes are oriented towards enabling students to attain the defined learning outcomes relating to the courses within a program. The outcome- based approach, particularly in the context of undergraduate studies, requires a significant shift from teacher-centric to learner centric pedagogies and from passive to active/participatory pedagogies. Planning for teaching therein becomes critical. Every program of study lends itself to well structured and sequenced acquisition of knowledge and skills. Practical skills, including an appreciation of the link between theory and experiment, will constitute an important aspect of the teaching-learning process. Teaching methods, guided by such a framework, may include: lectures supported by group tutorial work; practicum and field-based learning; the use of prescribed textbooks and e-learning resources and other self-study materials; open-ended project work, some of which may be team-based; activities designed to promote the development of generic/transferable and subject-specific skills; and internship and visits to field sites, and industrial or other research facilities etc.

1.4 Assessment methods

A variety of assessment methods that are appropriate to a given disciplinary/subject area and a program of study are used to assess progress towards the course/program learning outcomes. Priority will be accorded to formative assessment. Progress towards achievement of learning outcomes is assessed using the following: time-constrained examinations; closed-book and open-book tests; problem based assignments; practical assignment laboratory reports; observation of practical skills; individual project reports (case-study reports); team project reports; oral presentations, including seminar presentation; viva voce interviews; computerized adaptive testing; peer and self- assessment etc. and any other pedagogic approaches as per the context .

Course wise Learning Outcomes
Course/Learning outcomes

Class: B.Sc. First Year

Paper I: Diversity of Lower Plants

Units	Course content	Course/ Learning Outcomes: After completion of course, the students will be able to learn and understand-
Unit I	Viruses and Prokaryotes	Nature of viruses, characteristics & transmission of viruses especially TMV & bacteriophages. General account of Mycoplasma, Cyanobacteria & Bacteria, their nutrition, reproduction and economic importance.
Unit II	Algae	General characters, classification and economic importance of Algae. Important features and life history of important Algae from different groups of algae.
Unit III	Fungi	General characters, classification and economic importance of Fungi. Important features and life history of important fungi from different groups. General account of Lichens.
Unit IV	Bryophyta	General characters and classification. Study of morphology, anatomy and reproduction of different important bryophytes.
Unit V	Pteridophyta	Important characters and classification. Stelar organization. Study of morphology, anatomy and reproduction of different important pteridophytes.

Regular	Private
Theory marks: 40 CCE marks: 10	Theory marks: 40

Paper II : Diversity of Higher Plants

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course, the students will be able to learn and understand-
Unit I	Gymnosperms	General characters, classification of Gymnosperms. Heterospory and seed habit. Fossilization and fossil gymnosperms. Geological time scale.
Unit II	Gymnosperms	General account of Cycadofilicales, Bennettitales & Gnetales & Gingkoales. Morphology, anatomy, reproduction and life cycle of important gymnosperms.
Unit III	Tissue System	Types of vascular bundles, apical meristem, classification of meristem. Root apical meristem, anatomy and secondary growth in roots. Root modifications. Root microbe interactions.
Unit IV	The Shoot System	Shoot apical meristem. Anatomy of stem. Secondary growth in stem. Anatomy of C_3 & C_4 Plants. Anamolous secondary growth.
Unit V	The Leaf System	Origin and Development of leaf. Internal structure and diversity in size, shape and arrangement. Adaptation to photosynthesis and water stress.

Regular	Private
Theory marks: 40 CCE marks: 10	Theory marks: 40

Class: B.Sc. Second Year

Paper I: Taxonomy and Embryology of Angiosperms

Units	**Course content**	**Course/Learning Outcomes:** After completion of course, the students will be able to learn and understand-
Unit I	Taxonomy	Origin & Evolution of angiosperms. International Code of Botanical Nomenclature. Museum, Herbarium & Botanical gardens. Various systems of classification of angiosperms. Modern trends in taxonomy.
Unit II	Taxonomy	Terminology for plant description in semi technical language. Diagnostic characteristics & Economic importance of some important families.
Unit III	Taxonomy	Diagnostic characteristics & Economic importance of some important families.
Unit IV	Embryology	Concept of flower as a modified shoot. Structure of anther and pistil. Micro and megasporogenesis. Development of male and female gametophytes. Mechanism of pollination and pollinating agencies.
Unit V	Embryology	Fertilization and triple fusion. Development of different types of endosperms. Development of monocot and dicot embryo. Polyembryony and apomixes. Vegetative propagation.

Regular	Private
Theory marks: 40 CCE marks: 10	Theory marks: 40

Paper- II: Plant Ecology, Biodiversity and Phytogeography

Units	**Course content**	**Course/Learning Outcomes:** After completion of course, the students will be able to learn and understand-
Unit I	Ecosystems	Structure and types of Ecosystems. Trophic levels, food chain, food web. Ecological pyramids. Energy flow, concept of biogeochemical cycles.
Unit II	Ecological Adaptations	Morphological, anatomical and physiological responses against water, temperature and light. Photoperiodism. Causes, trends and processes of plant succession.
Unit III	Biodiversity & Population Ecology	Distribution patterns, density, mortality, natality, growth curves. Community ecology. Biodiversity. In situ & Ex situ conservation. Biosphere reserves. Sanctuaries and national parks, Endangered and threatened species, red data book.
Unit IV	Soil & Pollution	Soil formation, physical & chemical properties of soil. Development of soil profile, classification, composition. Types of Environmental pollution. Causes and control of global warming, acid rain, climate changeand ozone layer, ozone hole. Plant indicators. IPR.
Unit V	Phytogeography	Phytogeographical regions of India. Vegetation types of MP. Definition & classification of natural resources. Land resource management, Water & wet land management. Economic and ethnobotany.

Regular	Private
Theory marks: 40 CCE marks: 10	Theory marks: 40

Class: B.Sc. Third Year

Paper - I: Plant Physiology and Biochemistry

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course, the students will be able to learn and understand-
Unit I	Plant water relations	Properties & importance of water in plant life. Osmotic relations to plant cell. Water absorption by plant and ascent of sap. Mechanism of transpiration and factors affecting transpiration.
Unit II	Plant Nutrition, Biomolecules & Metabolism.	Role of essential micro and macro nutrients, Absorption of mineral nutrients. Hydroponics, translocation of organic solutes. Structure, classification & functions of bio-molecules. Nitrogen and lipid metabolism.
Unit III	Photosynthesis	Photosynthetic pigments, chloroplast. Concept of two photosystems. Light and dark reactions, red drop, Emersion's effect, Hatch & Slack cycle, CAM cycle. Photorespiration.
Unit IV	Respiration	Structure & function of mitochondria. Aerobic and an aerobic respiration, fermentation. Mechanism of respiration. Pentose phosphate pathway, ETC, Factors affecting respiration.
Unit V	Enzymology & Plant Hormones	Characteristics, classification and nomenclature of Enzymes. Mode and mechanism of enzyme action. Factors affecting enzyme activity. Discovery, structure, mode of action & role of auxins, gibberellins, cytokinin, abscissic acid and ethylene.

Regular	Private
Theory marks: 40 CCE marks: 10	Theory marks: 40

Paper- II: Cell Biology, Genetics & Biotechnology

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course, the students will be able to learn and understand-
Unit I	The cell envelopes and organelles	Techniques of cell biology, Prokaryotic & Eukaryotic cell structure, plasma membrane. Structure and function of cell wall, cell organelles, Cell signaling and cell receptors, signal transduction.
Unit II	Chromosome organization	Structure and functions of chromosome, centromere & telomere. Nucleosome model, specisl types of chromosomes, cell divisions. Variation in chromosome structure and number. Structure of DNA and its replication.
Unit III	Genetic Inheritance	Mendelism, linkage analysis, interaction of genes. Cytoplsmic inheritance, types of mutations, transposable elements, DNA damage & repair.
Unit IV	Gene	Development of genetics, structure of gene, genetic code, transfer of genetic information, protein synthesis, regulation of gene expression in prokaryotes & eukaryotes. Organic evolution.
Unit V	Plant Breeding, Biotechnology, Genetic Engineering & Biostatistics	Methods of plant breeding, selection and hybridization. Basic aspects of plant tissue culture, cellular totipotency. Differentiation & morphogenesis. Important achievements of biotechnology in agriculture. Introduction and application of bioststistics.

Regular	Private
Theory marks: 40 CCE marks: 10	Theory marks: 40

Course/Learning outcomes

Class: M.Sc. First Semester

Paper - I: Biology & Diversity of Viruses, Bacteria & Fungi (PG 101)

All papers of all Semesters MM: 40, CCE Marks: 10

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Viruses	Characteristics & ultrastructure of virions, Isolation & purification of Viruses. Chemical nature, replication & transmission of viruses, Economic importance.
Unit- II	Archaebacteria & Eubacteria	General account, ultrastructure, nutrition and reproduction. Biology and economic importance. Salient features and economic importance of cyanobacteria.
Unit-III	Bacteria & other Microorganisms	Classification of Bacteria, Actinomycetes, Mycoplasma, Rickettsiae, Chlamydiae and their significance
Unit- IV	Mycology	General characters and classification of fungi, substrate relationship. Cell structure, unicellular and multicellular organization. Cell wall composition, nutrition and reproduction, heterothallism and parasexuality.
Unit-V	Phylogeny of Fungi	General account of Mestigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina. Role of fungi in industry, medicine and as food. Fungal diseases in humans & plants. Fungi as biocontrol agents. Mycorrhiza.

Paper - II: Biology & Diversity of Algae, Bryophyta and Pteridophyta (PG 102)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Algae	Habitat, thallus organization, cell structure & reproduction in algae. Criteria for classification, pigments, flagella, reserve food.
Unit- II	Algae	Salient features of Protochlorophyta, Charophyta, Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta. Algal blooms, algal biofertilizers. Algae as food, feed and industrial uses.
Unit-III	Bryophyta	Morphology, structure, reproduction and life history of bryophytes. Distribution & classification. General account of important groups. Ecology and economic importance.
Unit- IV	Pteridophyta	Morphology, structure, reproduction and life history of pteridophyta. Distribution & classification. Evolution of stele, Heterospory & origin of seed habit.
Unit-V	Pteridophyta	Introduction to Psilopsida, sphenopsida & pteropsida.

Paper - III: Biology & Diversity of Gymnosperms (PG 103)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Gymnosperms	Introduction of vessel less and fruitless plants. Evolution of gymnosperms. Complexity of female gametophyte.
Unit- II	Gymnosperms	Classification and distribution of gymnosperms in India. Economic importance.
Unit-III	Gymnosperms	General account of pteridospermales, cycadeoidales and cordaitales.
Unit- IV	Gymnosperms	Structure, reproduction and interrelationships of cycadales, ginkgoales and coniferales.
Unit-V	Gymnosperms	Structure, reproduction and interrelationships of ephedrales, welwitschiales and gnetales.

Paper - IV: Plant Ecology (PG 104)

Unit	Course Content	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Population Ecology	Ecology &ecosystem. Density, distribution, natality, mortality, survivorship curves. Age structure and pyramids, fecundity schedules, life tables. Exponential and logistic curves of population growth. Intraspecific competition and self regulation, r- and k-strategies.
Unit- II	Community Organization	Concepts of community and continuum. Analysis of community analytical and synthetic characters, community coefficients & indices of diversity. Interspecific association negative and positive associations. Concept of ecological niche, biodiversity. Allopatric & sympatric speciation, Ecads & ecotypes.
Unit-III	Ecosystem development and Stability	Temporal changes cyclic and non cyclic, succession processes & types. Mechanism of succession facilitation. Tolerance and inhibition models. Concept of climax persistence resilience and resistance. Ecological perturbation. Ecological restoration.
Unit- IV	Fate of energy in Ecosystems	Tropical organization and structure, food chains & food webs, energy flow pathways, ecological efficiencies consumption, assimilation and production trophic. Primary production methods of measurement, global patterns, limiting factors.
Unit-V	Fate of matter in Ecosystems	Recycling pathways, relationship between energy flow and recycling pathways. Nutrient exchange and cycling, global geochemical cycles. Physical, chemical and biological characteristics of soil.

Class: M.Sc. Second Semester

Paper - I: Plant Development & Reproduction (PG 201)

Unit	Course Content	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Unique features of Plant Development	Difference between animal and plant development. Organization of shoot apical meristem. Control of tissue differentiation. Secretory ducts and laticifers. Wood development in relation to environmental factors.
Unit- II	Leaf growth & root apical meristem	Leaf growth and differentiation. Organization of root apical meristem. Cell fates and lineages, vascular tissue differentiation, Lateral roots, root hairs. Root – microbe interaction.
Unit-III	Vegetative options & Sexual reproduction	Flower development, genetics of floral organ differentiation. Homeotic mutants in *Arabidiopsis & Antirrhinum*. Sex determination. Structure of anthers, microsporogenesis, role of tapetum, pollen development and gene expression.
Unit- IV	Male Sterility	Pollen development, pollen tube greet & guidance. Pollen storage, pollen allergy and pollen embryos. Ovule development, megasporogenesis, organization of embryo sac, structure of embryo sac cells.
Unit-V	Floral Characteristics	Pollination mechanism & vectors, breeding systems. Structure of pistil, pollen stigma interaction. Sporophytic and gametophytic self incompatibility. Double fertilization. Endosperm development, embryogenesis, polyembryony, apomixis. Biochemistry and molecular biology of fruit maturation.

Paper - II: Morphology & Taxonomy of Angiosperms (PG 202)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Morphology of stamens and carpels	Morphology of stamens and carpels. Carpel evolution, morphology of inferior ovary, placentation types and their origin.
Unit- II	Taxonomic hierarchy	Species, genus, family and other categories. Principles used in assessing relationships, delimitation of taxa and attribution of rank. Salient features of International Code of Botanical nomenclature.
Unit-III	Taxonomic Evidences	Role of Morphology, anatomy, palynology, embryology, cytology, phytochemistry, genome analysis & nucleic acid hybridization in relation to taxonomy. Relevance of taxonomy to conservation.
Unit- IV	Taxonomic tools	Herbarium, floras, histological, cytological, phytochemical, serological and molecular techniques. Computers & GIS. Local plant diversity and its socio-economic importance.
Unit-V	Systems of classification of angiosperms	Phonetic versus phylogenetic systems. Cladistics in taxonomy, relative merits and demerits of major systems of classification. Endemism, hot spots, hottest hot spots. Plant explorations, invasions and introductions.

Paper - III: Utilization & Conservation of Plant Resources (PG 203)

Unit	**Course Content**	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Plant Biodiversity	Major biomes of the world, tropical rain and seasonal forests, temperate and seasonal forests, boreal forests, grasslands, deserts. Aquatic ecosystems, wetlands, lakes, pond streams & rivers. Marine & Estuarine habitats.
Unit- II	Sustainable Development	Status & utilization of biodiversity. Sustainable development and utilization of resources from forest, grassland and aquatic habitats. Food, forage, fodder, timber & non wood forest products. Threats to quality & quantity of resources due to over exploitation.
Unit-III	Strategies for conservation of resources	Principles of conservation, sanctuaries, national parks, biosphere reserves for wildlife conservation. Habitat conservation practices of conservation for forests, soil and water. Botanical gardens, field gene banks, seed banks. *In vitro* repositories, cryo-banks
Unit- IV	Pollution and climate change	Air, water and soil pollution, kind, sources, quality parameters, effects on structure & function of ecosystems, management of pollution, bioremediation. Climate changes resources, trends & role of green house gases. Effect of global warming on climate, ecosystem processes & biodiversity. Ozone layer & ozone hole.
Unit-V	Resource monitoring	Remote sensing concepts & tools, satellite remote sensing, basic sensors. Visual and digital interpretation, EMR bands and their application. Indian remote sensing program, application of remote sensing in ecology & forestry.

Paper - IV: Cell Biology of Plants (PG 204)

Unit	Course Content	**Course/Learning outcomes:** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Plant Cell Structure	Structural organization of plant cell, specialized plant cell types. Structure and function of cell wall, biogenesis, growth. Organization and role of microtubules and microfilaments. Motor movements.
Unit- II	Plasma Membrane	Structure, models and functions, sites for ATPases, ion carriers, channels and pumps, receptors. Structure of plasmodesmata, role in movement of molecules, comparison with gap junctions.
Unit-III	Cell organelles	Structure of Chloroplast, genome organization, gene expression, nucleo-chloroplastic interactions. Structure of Mitochondria, genome organization, biogenesis. Tonoplast membrane, ATPases, transporters, as storage organelle. Structure & functions of Golgi apparatus, lysosomes & endoplasmic reticulum.
Unit- IV	Nucleus	Structure, cell cycle, role of cyclins and cyclin dependent kinases. Mechanism of programmed cell death. Chromosome structure and packaging of DNA, euchromatin & heterochromatin. Karyotype analysis and evolution, banding pattern, special types of chromosome.
Unit-V	Chromosomal aberrations & Polyploidy	Origin, meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygotes. Origin, occurrence, production and meiosis of haploids, aneuploids and euploids. Origin and production of autopolyploids, allopolyploids, genome constitution and analysis.

Class: M.Sc. III Semester

Paper I: Plant Physiology (PG 301)

Unit	Course Content	Course/Learning outcomes : After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Plant water Relations	Structure & function of ATP, mechanism of water transport through xylem, root-microbe interactions in facilitating nutrient uptake. Membrane transport proteins.
Unit- II	Phloem transport	Phloem loading and unloading. Passive and active solute transport. Signal transduction, receptors and proteins, phospholipids signaling, role of cyclic nucleotides, calcium-calmodulin cascade. Specific signaling mechanisms. Two component sensor regulator system in bacteria and plants.
Unit-III	Plant Growth Regulators and Elicitors	Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene and abscisic acid, brassinosteroids, polyamines, jasmonic acid and salicyclic acid. Hormone receptors.
Unit- IV	Flowering Process	Photoperiodism and its significance, endogenous clock and its regulation. Floral induction and development. Phytochromes and chryptochromes, their photochemical and biochemical properties. Role of vernalization.
Unit-V	Stress Physiology	Plant responses to biotic and abiotic stress. Water deficit and drought resistance. Salinity stress and resistance. Concepts of freezing, heat and oxidative stresses.

Paper II: Plant Biochemistry & Metabolism (PG 302)

Unit	**Course Content**	**Course/Learning outcomes :** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Fundamentals of Enzymology	Allosteric mechanism, regulatory and active sites, isoenzymes, kinetics of enzymatic catalysis, Michaelis-Menten equation and its significance. Mechanism of enzyme action.
Unit- II	Photochemistry & Photosynthesis	Evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes. Photooxidation of water, mechanism of electron and proton transport, carbon assimilation; Calvin cycle, photorespiration and its significance, C4 cycle, CAM pathway, physiological and ecological considerations.
Unit-III	Respiration	Overview of respiration in plants, glycolysis, TCA cycle, electron transport and ATP synthesis. Pentose phosphate pathway, glyoxilate cycle, alternate oxidase system.
Unit- IV	Lipid & Sulphur Metabolism	Structure and function of lipids, fatty acid biosynthesis, structural and storage lipids and their catabolism, sulphate uptake and reduction, transport and assimilation
Unit-V	Nitrogen metabolism	Biological Nitrogen fixation, nodule formation. Mechanism of uptake and reduction, ammonium assimilation

Paper III: Genetics & Cytogenetics (PG 303)

Unit	**Course Content**	**Course/Learning outcomes :** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Genetics of Prokaryotes & Eukaryotes	Genetic recombination in prokaryotes: genetic transformation, conjugation and transduction in bacteria. Genetics of mitochondria and chloroplast: Cytoplasmic male sterility
Unit- II	Genetic recombination and genetic mapping in Eukaryotes	Recombination, independent assortment and crossing over, molecular mechanism of recombination. Chromosome mapping, linkage groups, genetic markers, construction of molecular maps, somatic cell genetics.
Unit-III	Mutation	Spontaneous and induced mutations, physical and chemical mutagens, molecular basis of gene mutations. Transposable elements in prokaryotes and eukaryotes. Mutations induced by transposons. DNA damage and repair mechanisms.
Unit- IV	Polyploidy	Cytogenetics of numerical and structural changes in chromosomes, Euploidy, Aneuploidy: origin, meiosis and effect. Cytogenetics of deficiencies, duplication, inversion and translocation.
Unit-V	Molecular Cytogenetics	Nuclear DNA content, c-value paradox, *cot* Curve and its significance. Concept and technique of restriction mapping, multigene families and their evolution. Transfer of whole genome in wheat, *Brassica* and *Arachis*

Paper IV: Molecular Biology (PG 304)

Unit	**Course Content**	**Course/Learning outcomes :** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Structure of DNA	A, B & Z forms of DNA, plant promoters and transcription factors, splicing, mRNA transport, rRNA biosynthesis
Unit- II	Gene structure & Expression	Genetic fine structure: cis-trans test, fine structure analysis of eukaryotes. Introns and their significance, RNA splicing, regulation of gene expression in prokaryotes and eukaryotes.
Unit-III	Ribosomes	Structure, mechanism of translation, initiation, elongation and termination. Structure & role of tRNA, protein sorting: targeting of proteins to organelles.
Unit- IV	Cell cycle & Apoptosis	Role of cyclins and cyclin dependent kinases, cytokinesis and cell plate formation. Mechanism of programmed cell death. DNA replication in prokaryotes and eukaryotes.
Unit-V	Immunotechniques	Concepts and techniques of *In situ* hybridization. Physical mapping of genes on chromosomes. *In situ* hybridization to locate transcript in cell types, FISH, Flow cytometry.

Class: M.Sc. IV Semester

Paper I: Plant Cell, Tissue & Organ Culture (PG 401)

Unit	Course Content	Course/Learning outcomes : After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Introduction of Plant cell & tissue culture	General introduction, history, scope, concept of cellular differentiation and totipotency.
Unit- II	Techniques of Tissue Culture	Organ culture: meristem, anther and embryo culture. *In vitro* fertilization.
Unit-III	Organogenesis & Adventive embryogenesis	Fundamental aspects of morphogenesis. Somatic embryogenesis and androgenesis. Mechanism techniques and utility.
Unit- IV	Somatic Hybridization	Protoplast isolation, fusion and culture, hybrid selection and regeneration. Possibilities, achievements and limitations of protoplast research.
Unit-V	Different aspects of Tissue Culture	Applications of tissue culture, Clonal propagation, artificial seeds. Production of hybrids, somaclones & somaclonal variation. Production of secondary metabolites and natural products. Cryopreservation and germplasm storage.

Paper II: Biotechnology & Genetic Engineering (PG 402)

Unit	**Course Content**	**Course/Learning outcomes :** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Basic concepts of Biotechnology	Principles and scope. IPR. Possible ecological risks and ethical concerns.
Unit- II	Recombinant DNA technology	Principle and techniques of Gene cloning. Construction of genomic/ cDNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction and DNA fingerprinting.
Unit-III	Genetic Engineering in plants	Aims and strategies for development of transgenics. *Agrobacterium*- the natural genetic engineer, T-DNA and transposons mediated gene tagging. Chloroplast transformation and its utility.
Unit- IV	Microbial genetic manipulation	Bacterial transformation: selection of recombinants and transformants, genetic improvements of industrial microbes & nitrogen fixers, fermentation technology.
Unit-V	Genomics and Proteomics	Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosomes, high throughput sequencing. Genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

Paper III: Environmental Science (PG 403)

Unit	**Course Content**	**Course/Learning outcomes :** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Ecology & Environment	History & scope of ecology, autecology, synecology, population, community, biome. Distinguishing characters of forests, grasslands, arid lands & wetlands. Concept of habitat, key stone species, dominant species. Species diversity and measurement of diversity. Biological communities and ecosystem, bio element cycling.
Unit- II	Natural Environmental resources & Conservation	Forest resources- forest types of India, deforestation and its effects. Indian water resources, hydrological cycles, surface water, ground water, world water resources, distribution. Food resources: conservation of natural resources and environmental management.
Unit-III	Current Environmental Issues	Climate change, global warming, green house effect & global ozone problems, acid rain, atmosphere turbidity and nuclear winter. Global carbon dioxide rise and impact on biosphere. Air, water and noise pollution. Radiation hazards and environmental degradation.
Unit- IV	Energy Production & Management	Energy production and consumption, sources of energy, non conventional and biological energy, use of waste and energy use pattern in India. Future energy scenario of the world. Nuclear energy and its risks.
Unit-V	Environmental Biotechnology	Nucleic acid hybridization and polymerase chain reaction as sensitive detection methods. Use of micro-organisms in waste management and [illegible]

		production, production of enzymes like cellulose, proteases & amylases. production of alcohol and acetic acid

Paper IV: Ethnobotany (PG 404)

Unit	**Course Content**	**Course/Learning outcomes :** After completion of course, the students will be able to learn and understand learn & understand
Unit-I	Definition and Scope of ethnobotany	Historical review and outline idea of Archaeoethnobotany, Ethnoecology, Ethnomedicines, Ethnonarcotics, Ethnopharmacology, Ethnotaxonomy, Ethnocosmetics, Ethnolinguistics, Ethnoorthopaedics.
Unit- II	Preservation of Genetic diversity	Plants used in different systems of medicines- Ayurvedic, Unani, Homeopathic and Allopathic systems. Plants used by villagers and tribal people, role of ethnobotany in the development of society.
Unit-III	Ethnobotanical Importance of some plants	Ethnobotanical importance of: *Aconitum napellus, Allium cepa, Mentha arvensis, Allium sativum, Nux-vomica, Aloe vera, Ocimum sanctum, Atropa belladonna, Azadirachta indica, Piper nigrum, Butea monosperma, Pterocarpus marsupium, Eugenea aromatica, Terminalia arjuna, Euginea jambolana, Terminalia bellerica, Hollarhena antidysentrica, Terminalia chebula, Withania somnifera, Lawsonia inermis*
Unit- IV	Plants in Mythology	Taboos and totems in relation to plants, folklore and folk tales, wild life protection in tribal, plant domestication by the tribal. Plants in similes and metaphors. Ethnobotanical importance of: *Cassia fistula, Cannabis sativa, Ricinus communis, Emblica officinalis, Santalum album*
Unit-V	Detailed study of some	Plants used in treatment of following diseases:

	ethno-medicinal plants	expulsion of worms, skin diseases, bronchial inflammation & asthma, tuberculosis, Urino-genital problems, Amoebic dysentery, malaria, rheumatism, leprosy, jaundice, heart diseases, piles and leukoderma.

Zoology Department

Learning Outcomes-Based Curriculum Framework for Undergraduate/Post-Graduate Education

Section A

1.1 Introduction

Zoology deals with the study of animal kingdom, especially the structural diversity, biology, embryology, evolution, habits and distribution of animals, both living and extinct. As it covers a fascinating range of topics, the modern zoologists need to have insight into many disciplines. The learning outcomes-based curriculum framework for a B.Sc. degree in Zoology is designed to cater to the needs of students in view of the evolving nature of animal science as a subject. The framework is expected to assist in the maintenance of the standard of Zoology degrees/programmes across the country by reviewing and revising a broad framework of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes. The framework, however, does not seek to bring about uniformity in syllabi for a programme of study in Zoology, or in teaching learning process and learning assessment procedures. Instead, the framework is intended to allow for flexibility and innovation in programme design and syllabi development, teaching learning process, assessment of student learning levels.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution:

The courses should be delivered in terms of concepts, mechanisms, biological designs & functions and evolutionary significance cutting across organisms at B.Sc. level. These courses should be studied by students of all branches of biology. Both chalk and board, and PowerPoint presentations can be used for teaching the course. The students should do the dissertation/ project work under practical or different courses, wherever possible. The students are expected to learn the courses with excitements of biology along with the universal molecular mechanisms of biological designs and their functions. They should be able to appreciate shifting their orientation of learning from a descriptive explanation of biology to a unique style of learning through graphic designs and quantitative parameters to realize how contributions from research and innovation

have made the subjects modern, interdisciplinary and applied and laid the foundations of Zoology, Animal Sciences, Life Sciences, Molecular Biology and Biotechnology. These courses and their practical exercises will help the students to apply their knowledge in future courses of their career development in higher education and research. In addition, they may get interested to look for engagements in industry and commercial activities employing Life Sciences, Molecular Biology and Biotechnology. They may also be interested in entrepreneurship and start some small business based on their interest and experience.

B.Sc. Zoology courses will help to understand the behaviour, structure and evolution of animals. Zoologists use a wide range of approaches to do this, from genetics to molecular and cellular biology, as well as physiological processes and anatomy, whole animals, populations, and their ecology. The scope of Zoology as a subject is very broad. The intention is to understand the subject of Zoology in the evolving biological paradigm in modern times; where, living beings need to be understood at the level of atomic interactions; and comparative systems of organisms need to be studied through the prism of integrated chemical, physical, mathematical and molecular entities to appreciate the inner working of different organisms at morphological, cellular, molecular, interactive and evolutionary levels. The key areas of study within the disciplinary/subject area of Zoology comprise: animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied zoology, behaviour, immunology, reproductive biology, and insect, vectors and diseases. B.Sc. degree programme in Zoology also deals with skill enhancement courses such as apiculture, aquarium fish keeping, medical diagnostics, sericulture etc. The depth and breadth of study of individual topics dealt with would vary with the nature of specific Zoology programmes. As a part of the efforts to enhance the interest and employability of graduates of Zoology programmes, the curricula for these programmes are expected to include learning experiences that offer opportunities for higher studies and research at reputed laboratories.

Zoology is the study of all animal life; from primitive microscopic malaria-causing protozoa to large advanced mammals, across all environmental spheres from red deer in mountain forests to dolphins in deep oceans, and from underground burrowing voles to golden eagles in the skies. Some of these animals are useful to us and we nurture them as pets or livestock; some are serious pests or disease-causing; and some are simply splendid and awe-inspiring. No matter what our relation with the animals is, we need to understand their behaviour, population dynamics, physiology and the way they interact with other species and their environments. It provides students with the knowledge and skill base that would enable them to undertake further studies.

in Zoology and related 12 areas or in multidisciplinary areas that involve advanced or modern biology and help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

The modern era requires a classical zoologist with a modern approach to master many subjects of Zoology. There is a need for the students to compete with the globe, therefore, the main focus of this curriculum is to enable the student to be professionally competent and successful in a career. Having Zoology as backbone of the curriculum, this course, with the department centric electives will enhance the skills required to perform research in laboratory and experimental research. The students can choose to focus on a "whole animal" or a "bits of animals" approach. The "whole animal" pathway makes the students proficient in the identification and study of animals while the latter approach provides the skills required to pursue laboratory and experimental work such as disease research, DNA technologies, wildlife forensics etc. The curriculum can be modified to such an extent that a student at B.Sc. level can be a specialist in immunology, ornithology, animal behaviour or entomology. For such specializations, the curriculum needs to focus on special skills to maximise the students' employment probability; for example, few skills needed by industry may include the species-specific monitoring for key species, handling of dangerous/ poisonous/ wild animals and the use of Geographic Information Systems (GIS) for data collection.

1.3 Key outcomes underpinning curriculum enrichment and execution:

The learning outcomes-based curriculum framework for undergraduate education is a framework based on the expected learning outcomes and academic standards that are expected to be attained by graduates of a programme of study and holder of a qualification. The key outcomes that underpin curriculum enrichment and execution at the undergraduate level include Graduate Attributes, Qualification Descriptors, Programme Learning Outcomes, and Course Learning Outcomes:

1.3.1 Graduate attributes

The graduate attributes define the characteristics of a student's university degree programme and describe a set of characteristics/competencies that are transferable beyond study of a particular subject area and programme contexts in which they have been developed. The graduate attributes reflect the particular quality and feature or characteristics of an individual, including the

knowledge, skills, attitudes and values that are expected to be acquired by a graduate through studies at the institution. Some of the characteristic attributes that a graduate should demonstrate are as follows:

- **Disciplinary knowledge:** Capable of demonstrating (i) comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases), and other related fields of study, including broader interdisciplinary subfields such as chemistry, physics and mathematics; (ii) ability to use modern instrumentation for advanced genomic and proteomic technology.
- **Communication Skills:** Ability to impart complex technical knowledge relating to Zoology in a clear and concise manner in writing and oral skills.
- **Critical thinking**: Able to understand and utilize the principles of scientific enquiry, think analytically, and make decisions during biological study.
- **Problem solving:** Ability to have problem solving skills in the basic areas of Zoology (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, insect, vectors and diseases etc.).
- **Analytical reasoning:** Ability to evaluate the reliability and relevance of evidence; analyze data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
- **Research-related skills:** Capability for asking relevant/appropriate questions relating to issues and problems in the field of Zoology, and planning, executing and reporting the results of an experiment or investigation.
- **Cooperation/Teamwork:** Capable of working effectively in diverse teams in both classroom, laboratory and in industry and field-based situations
- **Scientific reasoning:** Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

- **Reflective thinking:** Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
- **Information/digital literacy:** Capable of using computers in a variety of learning situations, demonstrating ability to access, and use a variety of relevant information sources for analysis of data.
- **Self-directed learning:** Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
- **Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
- **Moral and ethical awareness/reasoning:** Capable of conducting their work with honesty and precision thus avoiding unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, and appreciating environmental and sustainability issues. Research ethics committee expects them to declare any type of conflict of interest that may affect the research. Any plan to withhold information from researchers should be properly explained with justification in the application for ethical approval.
- **Avoid unethical behaviour**: Such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
- **Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.
- **Lifelong learning:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling.

1.3.2 Qualification descriptors:

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification (for eg. a bachelor's degree or a bachelor's degree with honors). The qualification descriptors also describe the academic standard for a specific qualification in

terms of the levels of knowledge and understanding, skills and competencies and attitudes and values that the holders of the qualification are expected to attain and demonstrate. These descriptors also indicate the common academic standards for the qualification and help the degree-awarding bodies in designing, approving, assessing and reviewing academic programmes. The learning experiences and assessment procedures are expected to be designed to provide every student with the opportunity to achieve the intended programme learning outcomes. The qualification descriptors reflect both disciplinary knowledge and understanding as well as generic skills, including global competencies, that all students in different academic fields of study should acquire/attain and demonstrate.

Qualification descriptors for a Bachelor's Degree programme in Zoology:

The qualification descriptors for a Bachelor's Degree programme in Zoology may include the following:

- Demonstrate (i) a fundamental/systematic or coherent understanding of the academic field of Zoology, its different learning areas and applications, and its linkages with related disciplinary areas/subjects; (ii) procedural knowledge that creates different types of professionals related to Zoology area of study, including research and development, teaching and government and public service; (iii) skills in areas related to specialization area relating the subfields and current developments in the academic field of Zoology.
- Use knowledge, understanding and skills required for identifying problems and issues relating to Zoology. A keen interest in research and the study of living organisms.
- Communicate the results of studies undertaken accurately in a range of different contexts using the main concepts, constructs and techniques of the subject(s);
- Meet one's own learning needs, drawing on a range of current research and development work and professional materials;
- Apply one's subject knowledge and transferable skills to new/unfamiliar contexts to identify and analyze problems and issues and solve complex problems with well-defined solutions.
- Demonstrate subject-related and transferable skills that are relevant to Zoology Related job trades and employment opportunities.
- Good observation skills
- Able to work precisely
- A logical approach to problem-solving
- Good oral and written communication abilities

- Able to work independently or with team members

1.3.3 Programme learning outcomes:

The outcomes and attributes described in qualification descriptors are attained by students through learning acquired on completion of a programme of study. The term 'programme' refers to the entire scheme of study followed by learners leading to a qualification. Individual programmes of study will have defined learning outcomes which must be attaind for the award of a specific certificate/diploma/degree. The programme learning outcomes are aligned with the relevant qualification descriptors. Programme learning outcomes will include subject-specific skills and generic skills, including transferable global skills and competencies, the achievement of which the students of a specific programme of study should be able to demonstrate for the award of the certificate/Diploma/Degree qualification. The programme learning outcomes would also focus on knowledge and skills that prepare students for further study, employment, and citizenship. They help ensure comparability of OUTCOME PROGRAMME OBJECTIVES INSTITUTIONAL GOALS 8 LOCF learning levels and academic standards across colleges/universities and provide a broad picture of the level of competence of graduates of a given programme of study.

1.3.4 Course learning outcomes:

The programme learning outcomes are attained by learners through the essential learnings acquired on completion of selected courses of study within a programme. The term 'course' is used to mean the individual courses of study that make up the scheme of study for a programme. Course learning outcomes are specific to the learning for a given course of study related to a disciplinary or interdisciplinary/multidisciplinary area. Some programmes of study are highly structured, with a closely laid down progression of compulsory/core courses to be taken at particular phases/stages of learning. Some programmes allow learners much more freedom to take a combination of courses of study according to the preferences of individual students that may be very different from the courses of study pursued by another student of the same programme.

Course-level learning outcomes will be aligned to programme learning outcomes. Course- level learning outcomes are specific to a course of study within a given programme of study. The achievement by students of course-level learning outcomes leads to the attainment of the programme learning outcomes. At the course level, each course may well have links to some but

not all graduate attributes as these are developed through the totality of student learning experiences across the years of their study.

1.4 Teaching - learning process:

The Learning Outcomes-Based Approach to curriculum planning and transaction requires that the teaching-learning processes are oriented towards enabling students to attain the defined learning outcomes relating to the courses within a programme. The outcomes-based approach, particularly in the context of undergraduate studies, requires a significant shift from teacher-centred to learner-centric pedagogies, and from passive to active/participatory pedagogies. Planning for teaching therein becomes critical. Every programme of study lends itself to well-structured and sequenced acquisition of knowledge and skills. Practical skills, including an appreciation of the link between theory and experiment, will constitute an important aspect of the teaching-learning process. Teaching methods, guided by such a framework, may include: lectures supported by group tutorial work; practicum and field-based learning; the use of prescribed textbooks and e-learning resources and other self-study materials; open-ended project work, some of which may be team-based; activities designed to promote the development of generic/transferable and subject-specific skills; and internship and visits to field sites, and industrial or other research facilities etc.

1.5 Assessment methods:

A variety of assessment methods that are appropriate to a given disciplinary/subject area and a programme of study will be used to assess progress towards the course/programme learning outcomes. Priority will be accorded to formative assessment. Progress towards achievement of learning outcomes will be assessed using the following: time-constrained examinations; closed-book and open-book tests; problem based assignments; practical assignment laboratory reports; observation of practical skills; individual project reports (case-study reports); team project reports; oral presentations, including seminar presentation; viva voce interviews; computerised adaptive testing; peer and self-assessment etc. and any other pedagogic approaches as per the context .

Department of Zoology, Govt. Madhav Science College, Ujjain (M.P.)

Learning Outcomes Based Curriculum Framework (LOCF) for Zoology and Section B

Course/Learning outcomes Zoology

Class: B.Sc. 1st Year

Paper: 1st Invertebrates

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	1 Outline classification (upto orders) Lower and higher Non-chordate Phyla	• Understand the importance of classification of animals and classify them effectively using the six levels of classification. • Identify the invertebrate animals.
2	Representative animals of phylum Protozoa-, Porifera and Coelenterata	• Gain knowledge of representative animals of lower Invertebrates on the basis of their morphological characteristics/ structure and understand their life cycle. • They will be able to know different types of Malaria, its breeding and cure.
3	Fasciola, Nematodes and diseases, Metamerism in Annelida, Trochophore larva	• Learn about morphological characteristics/ structure and understand life cycle of Fasciola • Diagnose the diseases caused by nematodes and their treatment.
4	Arthropoda Palaemon- Larval forms in crustacea Insect as a vector of human diseases, Mollusca Pila, Larval forms in Mollusca	• Gain knowledge of representative animals of higher invertebrates (Arthropoda and Mollusca) and their larval forms. • Diagnose the diseases caused by vector insects, • and treatment for important diseases • How to control these harmful insects, prevent and cure diseases.

5	Echinodermata -Asterias Larval forms in Echinodermata Minor phyla, Hemichordata Balanoglossus,	• Learn about phylum Echinodermata and their larval forms • By studying similarities and dissimilarities of Balanoglossus with other groups. Students will learn its right taxonomic position.

Course/Learning outcomes Zoology B.Sc. 1st Year

Paper: 2nd Cell biology and developmental biology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	History of cell biology, Prokaryotic and Eukaryotic cells, Cell organelles	• Understand the importance of the cell as a structural and functional unit of life. • Able to Explain the principles of the cell theory • Able to differentiate between prokaryotes and eukaryotes. • Able to Understand how the endoplasmic reticulum and Golgi apparatus interact with one another and know with which other organelles they are associated • They will be able to know the ultrastructure and functional significance of these cell organelles.
2	Nucleus and Nucleolus. Typical chromosomes, Nucleo-cytoplasmic interaction, Cell cycle, Cell division	• Understand the ultrastructure and functioning of nucleus and extra nuclear organelles • Understand the different stages of cell division • They can understand about chromosome and their types • Importance of Cell cycle in cell division
3	Spermatogenesis, Oogenesis Fertilization, Parthenogenesis Regeneration	• Students will know how sperm and ovum formed and how fertilization and parthenogenesis take place • They will learn about significance of regeneration
4	Frog embryology: Development of frog, Tadpole larva	• Develop critical understanding how a single-celled fertilized

		• The egg becomes an embryo and then a fully formed adult by going through cell differentiation and morphogenesis. • Learn how three germ layers form different organs • Will learn about the development of frog
5	Chick Embryology, Development of Chick, Development of chick embryo up to formation of primitive streak, Extra embryonic membranes in Chicks	• Identify the developmental stages and understand the process of development of the chick. • Know different types of fetal membranes and their significance in chick.

Course/Learning outcomes Zoology Class: B.Sc.2nd Year

Paper: 1st Vertebrates and evolution

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Origin of Chordata and classification of phylum chordata upto orders Herdmania, Amphioxus, Comparison between Petromyzon and Myxine	• Develop an understanding of the evolution of Vertebrates • Gain knowledge of Protochordate animals. • They will learn how to identify and classify chordate animals • They will be able to differentiate Cyclostomata (Petromyzon and Myxine).
2	Comparative account of : Integument, Limb bones and girdles Digestive system, Respiratory system (in various vertebrate groups)	• Gain knowledge of morphological peculiarities and comparative account of integument, digestive and respiratory system of different Vertebrate groups • They will find out difference between digestive and respiratory organ of different groups
3	Comparative account of : Heart and aortic arches, Brain, Urino genital system, Placentation in Mammals	• Gain knowledge of morphological peculiarities and comparative account of heart, aortic arches, brain and urinogenital system in different vertebrate groups. • Students will learn how the evolution of heart and brain from lower to higher vertebrates takes place. • Gain knowledge of different types of placenta.
4	Origin of life, Lamarckism, Darwinism, Modern synthetic theory; Variation, Mutation, Isolation, Speciation, Adaptation and Mimicry,	• Understand the origin of life and various theories of evolution. • Understand the various adaptations necessary to help the animals to survive in all sorts of habitats.

	Micro, Micro and Mega evolution	• Find out evidences in favor of organic evolution
5	Fossils methods of fossilization, determination of age of fossils Dinosaurs and archaeopteryx Zoo Geographical distribution Evolution of man, Geological Time Scale	• Understand the concepts of radioactive dating to determine the approximate age of fossils and rocks • Understand the evolutionary history of birds • Compare and among different types of dinosaurs and cause of their extinction. • What kind environmental conditions, fauna and flora are present in different ages. • How the appearance of man changed in different eras and ages of history.

Course/Learning outcomes Zoology Class: B.Sc. 2nd Year

Paper: 2nd Animal physiology and biochemistry

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Nutrition and metabolism	• Understand the physiology of digestion in different organs and the importance of a balanced diet. • They will learn how the energy is generated needed for the activities of the body. • Significance of carbohydrates, proteins and fats.
2	Respiration excretion and immune system	• Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient. • Understand the process of excretion. Understand kidney structure and mechanism of urine formation, composition and disorders related to the urine. • Gain knowledge of Innate and acquired immunity.
3	Regulatory mechanism of enzymes and role of Vitamins	• Gain knowledge of enzymes, mechanism of enzyme action and factors affecting the enzyme activity. • Understood the types and importance of vitamins and coenzymes. • Explain why vitamins are essential to the healthy functioning of the human body. • Know how the enzymes are metabolic keys to life. • How the deficiency and excessive use of vitamins causes different diseases / disorders.
4	Neuromuscular coordination	• Understand the organization of the nervous system and process of nerve impulse conduction. • Understand neurohormones and neurosecretions and their importance.

		• Understand the process of muscle contraction and its significance in life.
5	Endocrine system	• Understand about different endocrine glands and disorders due to hypo and hypersecretion of their hormones. • Develop basic understanding of the endocrine system and its interactions with other systems. • Understand the reproductive cycles with hormonal control. • They will learn how the pituitary gland is master of all endocrine glands. • By the study of menstrual cycles in females, they can know how birth control can be done without the use of contraceptives.

Course/Learning outcomes Zoology Class: B.Sc.3rd Year

Paper: 1st Genetics

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Heredity and genetic material	• Gain knowledge of DNA structure and mechanism of replication and its importance as genetic material.
2	Gene expression	• Understand the process of transcription and translation of protein synthesis • Understand the mechanism of gene expression and regulation.
3	Linkage and chromosomal aberration	• Gain knowledge of genetic variation through linkage and crossing over and its role in organic evolution.
4	Human Genetics	• Explain the chromosome structure of the human and structural mutation of the chromosome • Categorize human chromosomes. • Relate chromosome mutations and genetic diseases. • Compare the genetic structure of human gonosomes. • Understand the theories of classical genetics and blood group inheritance in man • Understand the chromosomal syndromes in human beings
5	Genetic engineering	• Gain knowledge of recombinant DNA technology and gene cloning. • Gain knowledge of gene therapy. • They will be able to know how the genetic engineering techniques can help and improve various aspects of human life.

Course/Learning outcomes Zoology Class: B.Sc.3rd Year Paper: 2nd Ecology and applied zoology

Units	Course content	Course/ Learning Outcomes: After completion of course, the students will be able to
1	Concept of ecology	• The learner will be able to link food chains, food webs, biotic and abiotic components of ecosystem • How does the food chain maintain the dynamic balance of the ecosystem?
2	Habitat ecology, Biodiversity, natural resources	• Describe the relation between abiotic and biotic factors and habitat ecology. • Describe various biological interactions. • Understand about the major threats to biological diversity. • Characterize natural resources and be able to quantify at least one of these resources. • Know about the physico-chemical condition, flora and fauna of different habitat • How can the conservation of natural resources be done?
3	Wildlife and environment	• Understand and be able to gain knowledge of wildlife protection and conservation • They will know about the National Park and National sanctuaries of India and Madhya Pradesh.
4	Aquaculture	• Learn about freshwater and marine water fish species • They will know how self-employment can be generated by the culture of prawn and fishes. • They can understand how to maintain an aquarium.
5	Economic entomology	• Students will be able to understands the methods of sericulture, apiculture lac culture and biology of economic insects. • Students will be able to understands crop pest management techniques • How sericulture and apiculture may be used in Employment.

Course/Learning outcomes Zoology Class: MSc 1st sem

Paper: 1st Biosystematic, Taxonomy and evolution

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Definition and basic concepts of biosystematics, taxonomy	● Thorough understanding in the principles and practice of biosystematics. ● Know about the steps required for biosystematics. ● Understand the uses and limitations of phylogenetic trees.
2	Taxonomic characters Taxonomic procedures Taxonomic keys International code of Zoological nomenclature	● Gain a basics for the rules for the international code of Zoological nomenclature, Taxonomic procedures ● and taxonomic keys. ● How the animals can be collected, identify and classify through the procedure of Taxonomic keys ● How the naming of newly diverse animals can be done.
3	Species concept Shannon wiener index, Dominance index: Similarity and Dissimilarity index	● Appreciate the complexities and difficulties of various species concepts ● Gain knowledge on the diversity and relationships in the animal world. ● With the help of biodiversity indices students can calculate species richness. ● Know about the importance of biological species concept and evolutionary species concept.
4	Concept of evolution and theories of organic evolution, population genetics: Hardy weinberg law of genetic equilibrium, Destabilizing forces Genetic polymorphism	● Enable the students to understand the concept and theories of evolution ● This study module will help to understand about the genetic polymorphism and their importance. ● Understand Destabilizing forces of evolution ● They will learn about the destabilizing forces like mutation, variation and organic evolution.
5	Concept and mechanism of	● Enable the students to understand the micro and macro evolution. ● Correlate the theories with the evidence.

	Speciation, Theories of evolution	• Explain the genetic basis of evolution. • How the new species originated in the process of evolution.

Course/Learning outcomes. Zoology Class: MSc 1st sem

Paper: 2nd Str. and functions of Invertebrates

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Origin of Metazoa, Organisation of coelom, Locomotion:	• How do multicellular organisms originate? • They will be able to know different means of locomotion in Invertebrate groups.
2	Nutrition and digestion, Respiration	• Able to compare feeding mechanism and digestion in different Invertebrate phyla • Gain knowledge of organs of respiration in Invertebrate phyla • Know about the aquatic respiration (trachea in Pila and pulmonary respiration) in Invertebrates.
3	Excretion in Lower and Higher Invertebrates	• Compare excretory organs and mechanism of excretion in lower and higher Invertebrates. • Learn how the water and salt of the body are maintained in the body fluid (osmoregulation) of Invertebrate.
4	A Primitive nervous system: B Advanced nervous system:	• Gain knowledge of primitive) and advanced nervous systems in Invertebrates. • How the simple nervous system evolved and converted into a complex and advanced nervous system in higher Invertebrates.
5	Structure affinities and life history of Minor phyla	• Gain knowledge of larval forms in Higher Invertebrates. • Role of larval forms in evolution • Able to understand structure, affinities and life history of Minor Phyla. • By studying different similarities and dissimilarities found in Minor phyla students can establish relationships between different group.

Course/Learning outcomes Zoology Class: MSc 1st sem

Paper: 3rd Quantitative biology, Biodiversity and wildlife

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Quantitative biology	• Gain knowledge of Basic mathematics for biologists • Learn applications of mathematics in the field of Biology • How to make mathematical models for biological research.
2	Biostatistics	• Gain knowledge of descriptive biostatistics • Explain correlation and regression • Fundamental concept of Hypothesis testing. • Analysis of variances (ANOVA) • Application in various fields of research in biology.
3	Biodiversity	• Gain knowledge on the diversity and relationships in the animal world. • Understand the importance of biodiversity and the consequences of biodiversity loss and conservation. • Understand about medicinal use of forest plants. • How the endangered species can be conserved.
4	Wildlife of India types of wildlife Wildlife Protection Act	• Understand and be able to gain knowledge of protection and conservation of animals in the wild. • Awareness about wildlife Protection acts.
5	Wildlife and conservation	• Develop an understanding of how animals interact with each other and their natural environment. • Able to differentiate between natural park and sanctuaries • Learn how tigers, lions can be protected in Wildlife.

Course/Learning outcomes M. Sc. Zoology Class: MSc 1st sem

Paper: 4th Biomolecules and structure biology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Chemical foundation of biology	• Able to explain the structure and functions of various biomolecules. • About the nanoparticle and biomolecules and their significance in modern life.
2	Protein structure protein folding and denaturation, DNA and RNA structure	• Understand how DNA encodes genetic information. • Learn about the primary, secondary, tertiary and quaternary structure of Proteins. • Functional significance of lipids.
3	Basic concept of metabolism	• Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids and their metabolism.
4	Protein synthesis	• Understand the process of DNA replication, transcription and translation (Protein synthesis). • Biosynthesis of nucleotides, • Synthesis of peptides and their physiological significance.
5	Enzymes, Thermodynamics	• Understand the concept of enzyme, its mechanism of action and regulation. • Application of thermodynamic laws in biology. • How the energy rich compounds synthesized.

Course/Learning outcomes M. Sc. Zoology Class: MSc 2nd sem

Paper: 1st General and comparative animal physiology and endocrinology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Respiratory and nervous system	● Understand about the physiology of respiration at cellular and system levels, Respiratory pigments, ● Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient. ● Understand the organization of the nervous system and process of nerve conduction and describe the nervous pathways by which information is transmitted to the central nervous system.
2	Physiology of Nitrogen excretion, digestion, Physiology of pregnancy	● Understand the process of digestion and excretion in different animal groups ● They will know about classification of animals on the basis of the pattern of nitrogen excretes. ● Demonstrate an understanding of the hormonal control of pregnancy and how this is regulated ● Learn how temperature of the body regulated in cold blooded and warm-blooded animals.
3	Comparative study of sensory receptors	● Explain the structure of the special sense organs in relation to their function and describe the nervous pathways by which information is transmitted to the central nervous system. ● Understand the physiology of the vision, the mechanical senses (i.e., touch, and balance), the chemical senses (i.e., Taste and smell) and the electric sense in different vertebrate groups. .
4	Bioluminescence as means of communication among animals, and pheromones, mechanism of hormone action	● Understand different types of bioluminescent reactions ● Gain knowledge of Pheromones and other semiochemicals as means of communication ● Able to understand the chemical nature and mechanism of hormone action.

		• They will know how pheromones; bioluminescence make communication easy among animals.
5	Phylogeny of endocrine glands, ontogeny of endocrine glands, Neuroendocrine system	• Understand evolution of different endocrine glands in different vertebrate groups. • Develop basic understanding of the endocrine system. • Role of hormones in reproduction and breeding.

Course/Learning outcomes M. Sc. Zoology Class: MSc 2nd sem

Paper: 2nd Population ecology and environmental physiology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Population and their characters	● Understand the basics of population ecology and demography and its characteristics. ● Understand the demographic variables, and how these variables influence population growth, composition, and structure
2	Ecophysiological adaptation to: freshwater, Marine and Terrestrial environment	● Imparts conceptual knowledge of adaptations in relation to their environment. ● Get the knowledge on the basic principles of physiology and its connection with the environment. .
3	Environmental limiting factor inter and intra specific relationship	● Students will be able to: Describe the roles of predators and prey in an ecosystem's food chain. Generate examples of predators and their prey.
4	Environmental pollution and human health	● Gain knowledge of environmental pollution ● Analyze the different methods of air, water, and soil quality monitoring process. ● How the noise pollution affects the people in modern life. ● Importance of sustainable development.
5	Concept of homeostasis Meditation yoga and their effects	● Gain knowledge of chemical and physical changes in the external environment and elicit responses to maintain the internal medium homeostasis. ● Role of meditation, yoga and exercise in the maintenance of health.

Course/Learning outcomes M. Sc. Zoology Class: MSc 2nd sem

Paper: 3rd Tools and techniques for biology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Principles and applications Microscope, ultracentrifuge	● They will know the uses and applications of the microscopes, ultracentrifuge specially for research purposes.
2	Cryopreservation Agarose gel electrophoresis	● Students will be able to Explain the principle, working, materials used and applications of electrophoresis. ● They will learn application of these techniques in research and higher studies.
3	Radioisotopes, Autoradiography Immunodiffusion Immunoelectrophoresis Microtomes	● To understand the uses and applications of radioactive isotopes, Immunoelectrophoresis. ● Learn the procedure of preparing permanent histological slides using microtome. ● Learn about Immunodiffusion tests. ● Cytological, histological and pathological studies can be done by microtomy.
4	Culture media tissue fixation and complete procedure for staining, sterilization, inoculation and microbial identification	● Knowledge of basic terms in histology. ● The student will be able to understand all types of tissues. ● The student will be able to understand different staining procedures. ● Know the techniques for preparation of culture media ● Learn about different sterilization inoculation and microbial identification processes. ● These will help in research purposes.

5	Banding techniques in situ hybridization radio label and non-radiolabeled methods Southern blotting Northern blotting PCR	• Able to understand Chromosomal banding techniques • Students will be able to compare the various separation techniques • Understood the principles and types of PCR demonstration. • Will know about the applications of techniques.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 2nd sem Paper: 4th Molecular cell biology and genetics

Units	Course content	Course/ Learning Outcomes: After completion of course, the students will be able to
1	biomembranes: molecular composition	● Gain the knowledge of molecular structure and function of cell membrane, transport across cell membrane, microfilament and microtubules. ● How the transportation of materials takes place through cell membrane and role of kinesis, dyenine etc.
2	Cell cell signalling	● Acquire the detailed knowledge of different pathways related to cell signalling. ● Will understand functional significance of gap junctions and connexius.
3	Cell-cell adhesion and communication	● Gain the knowledge of Chromosomal organisation of genes non coding DNA. ● Non coding DNA and its role in gene expression and production of new proteins.
4	Sex determination, Human Genome Project	● Gain the knowledge of Human Genome Project ● They will know how the sex determination can be done in mammals. ● Able to make karyotypes of human beings and understand the meaning of dosage compensation.
5	Genetic diseases and genomics, transgenic animals and their applications	● Gain the knowledge of human gene therapy. ● Able to: understand some of the types of disease that might be treatable by gene therapy. ● Will understand the applications of transgenic animals and the methods used for obtaining transgenic animals.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 3rd sem

Paper: 1st Comparative anatomy of vertebrates

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Origin of chordates, concept of protochordates development structure and functions of integument comparative account of Respiratory system in vertebrates comparative account of digestive system in vertebrates	● Develop an understanding of the origin and evolution of vertebrates ● Learn the comparative structure, function and development of integument ● Learn the comparative account of digestive system in vertebrates ● Learn the process of different types of respiration (aquatic respiration, cutaneous respiration, pulmonary respiration and tracheal respiration) in different vertebrate groups.
2	Evolution of heart, aortic arches and portal system, blood circulation in vertebrates Comparative account of jaw suspensorium and vertebral column	● Gain knowledge of morphological peculiarities, evolution and comparative account of heart, aortic arches, portal system, blood circulation and brain in different vertebrate groups
3	Evolution of urinogenital system, Organs of olfaction and taste, Nervous system in vertebrates	● Gain knowledge of the urinogenital system in different vertebrate groups. ● The structure of brain cells and their circuit. Evolution and adaptation of brain and cranial nerves in vertebrates. ● Know about Organs of olfaction and taste in vertebrates.
4	Comparative account of: lateral line system, Electroreception Flight adaptation in vertebrates	● Know about the comparative account of lateral line systems and their significance in aquatic environments. ● Know how birds and mammals adapted to their environment

	Aquatic adaptations in Birds and Mammals	• How the electroreceptors will help animals in capturing their prey.
5	Origin and evolution organisation and affinities of Ostracoderm Elasmobranchii Holocephali, Dipnoi and Crossoptergii	• Origin, evolution and general organisation structure affinities of fishes. • General organisation and evolution of jawed vertebrate

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 3rd sem

Paper: 2nd Limnology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Limnology: Development and scope types of freshwater habitat and their ecosystem: A Pond river and stream b Lake origin and classification Morphometry	• Gain knowledge of distribution and dynamics of freshwater bodies • They can understand classification and general characteristics of water bodies • Morphometric study will help students for the limnological research for the lake and pond.
2	Physico-chemical characters: in freshwater	• Understand physical and chemical properties of water. • Studies of physico-chemical parameters will help in hydrobiological research of any river / lake / pond.
3	Study of biota : A phytoplankton, zooplanktons and their interrelationship B aquatic insects Bird and their environmental significance	• Understand all biotic factors that are related to individual, population, community and ecosystem and relationships between them. • Prepare the identification key of plankton (zoo and phyto), large aquatic plants and macro benthic organisms. • Help in biological study of any river / lake / pond.
4	Methods of water quality testing BOD and COD, sewage: definition composition and treatment, bioindicators	• Develop employable skills in freshwater biological water quality analysis. • Scientific methodologies such as experimentation and data analysis in the area of aquatic biology • Study of these parameters will be helpful in pollution of aquatic water bodies.

5	Causes of pollution of aquatic resources: their management and conservation	• Explain in detail the types of pollution. • Describe the pollution monitoring strategies. • Methods to study the impact of pollutants on organisms and human beings.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 3rd sem

Paper: 3rd ecotoxicology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	General principles of environmental biology	• The learner will be able to link the food chains, food webs, energy flow, biotic and abiotic components. • They will know the application of thermodynamic laws in the energy flow in the ecosystem.
2	1 productivity production and analysis, environmental conservation techniques recycling and reuse technology for solid and liquid waste and their role in environmental conservation, environmental indicator and their role in in Environmental balance	• Understand various recycling technologies for solid and liquid waste and their role in environmental conservation • Gain knowledge about waste management • Understand about environmental indicator and their role in in environmental balance • Will help to improve environmental conditions.
3	Kinds of environmental pollution and their control method	• Understand different causes of environmental pollution and their remedies. • Know what radioactivity is and how it pollutes the environment. • Learn the various sources of radioactive pollution • Gain knowledge about waste management. • Vehicular pollution effluents and its control mechanisms.
4	Toxicology basic concepts and toxicological Agents 2 toxicity testing principles, hazards, risks and their control methods, food toxicants and their control methods Public Health	• Understand the basic principles and applications of toxicology, • Understand the Toxic effects and control methods of food toxicants. • Understand toxicological research and effects of toxicants on organisms.

	hazards due to environmental disasters	
5	Pesticides type nature and their effect on environment	• Understand the definition of a pesticide. • Learn about the different types of pesticides. • Acquire information about the risks associated with the use of pesticides. • Familiarity with pesticide safe handling. • Their study will help in enhancement of agricultural production.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 3rd sem

Paper: 4th Aquaculture

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Aquaculture history definition scope and importance	● Understand the aquaculture systems ● Understand the environmental impacts of aquaculture. ● They will know the importance and significance of aqua farming (culture in water) ● Role of aquaculture in providing nutritional and proteinaceous food to the population.
2	Fish culture, prawn culture, mussels, calms, oysters, Pearl culture, Sewage fed fish culture, paddy cum fish culture, frog culture	● Understand the different culture techniques ● They will know how to earn money from oysters, pearl, fish, prawn and frog culture.
3	Fish breeding, transport of live fish and seed, craft used for fish catching, planktons, common weed of fishpond	● Understood the type of hatchery, brood stock, larval production, feed management water quality and disease management in cultivable species, live feed production. ● Students will be able to learn how to collect fish and earn money.
4	setting and management of setting at freshwater aquarium, preservation and processing of fish by product of fish industry and their utility	● To learn the scientific method of setting an aquarium. ● To learn the culture breeding and marketing techniques of common indigenous ornamental fishes. ● To learn the preservation and processing of fish ● by product of the fish industry and their utility.
5	Water pollution, common fish diseases and their control, nutritional value of fish, fisheries economics and marketing,	● Learn the cause for the water pollution. ● To learn about common fish diseases and their control ● Understand the nutritional value of fishes

	fisheries management and extension	• Understand economics constraints in fisheries development.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 4th sem

Paper: 1st Animal behaviour and neurophysiology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Introduction: ethology is a branch of biology	● Understand and evaluate information about animal behaviour and ecology encountered in our daily lives. ● They will learn how to make an ethogram catalogue of animal behaviour of different animals.
2	Neural and hormonal control on behaviour, genetic and environmental components in the development of behavior, Motivation: Drive, timing and interaction of drives, communication: chemical, visual light and audio Evolution of language (primates)	● Understand the neural control of animal behavior. ● Develop skills, concepts and experience to understand all aspects of animal behaviour. ● How is the behaviour controlled by hormones and genes? ● Students will understand the infrastructure of oral communication in monkeys and human beings and other means of communication in animals.
3	Ecological aspects of the area biological rhythms learning and memory	● Learn a wide range of theoretical and practical techniques used to study animal behaviour
4	reproductive behaviour social behaviour, aggregation schooling in fishes floating in word herding in mammals group selection kin selection altruism. Social Organisation in insects	● Students acquire knowledge of key concepts and principles in reproductive and social behavior in animals. ● Will learn how social organizations help in animals like honey bees, termites, ants, monkeys and human beings.

5	Comparative study of receptor physiology	• Students can understand the physiology of different classes of sensory receptors • Learn temperature regulation (thermoregulation) helps in homeostasis. • Learn different sensory organs function in different animal groups.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 4th sem

Paper: 2nd Gamete biology, development and differentiation

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Comparative account of differentiation of gonads In Mammals and invertebrates	• Gain knowledge of early events in animal development (fertilization, cleavage, gastrulation, and organogenesis). • They will be able to understand analysis of semen and determination of fertility in male human beings.
2	Ovarian follicular growth and differentiation biology of sex determination and sex differentiation multiple ovulation and embryo transfer techniques	• They will acquire the knowledge about different types of follicles (ovarian). • Students will be able to compare and contrast levels of sex determination. • Learn about applications of embryo transfer techniques • Will learn how multiple ovulation and embryo transfer techniques will help in increasing the healthy population of cattles.
3	Hormonal regulation of reproductive biology	• Demonstrate an understanding of the hormonal control of reproduction. • They will learn how the mother's milk is complete food for newly born young ones. • Learn how eggs, sperm and embryos be preserved for many years by cryopreservation techniques.
4	Cell commitment and differentiation, development of gonads melanogenesis	• Understand the basic concepts in cell biology, cell differentiation.

5	Creating new cell types, basic evolutionary mystery cell diversification in early amphibian embryo, totipotency and pluripotency Embryonic stem cell connective tissue self family Haemopoietic stem cell	• An understanding of stem cell properties. • An understanding of stem cell applicability and ethical constraints. • Importance of stem cells and their disorders.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 4th sem

Paper: 3rd (c) Entomology

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Insect head type and their modification, hypothetical wing venation	● Acquired the knowledge to understand the various modifications and adaptations such as head, legs, wings, antennae, mouthparts, abdomen, sense organs. ● Identification of insects can be done by this study.
2	Structure of cuticle and pigment sclerotization and tanning of cuticle Structure of alimentary canal and physiology of digestion Malphighian tubules	● Developed a sound knowledge on Structure of cuticle and pigment, sclerotization and tanning of cuticle ● Basic aspects of anatomy of different systems, elementary physiology, nutritional physiology ● Gained the knowledge of digestive system,
3	Structure of circulatory system cell-mediated and humoral Immunity structure of compound eye and physiology of vision	● Gained the knowledge of circulatory systems and their physiology ● Understand the structure of compound eye ● Chemical composition of haemolymph. ● How compound eyes make acute vision in insects?
4	Sound production in insects structure and functions of endocrine gland Pheromones	. ● Understand the structure and functioning of endocrine gland. ● Gain knowledge of development in insects, ● Importance of pheromones in communication among insects.
5	Metamorphosis insecticide effects on CNS important pest of soybean	● Understand how the insecticide effects on CNS ● Understand the effective way of insect pest management strategy.

	modern concept of pest management	• Learn how soybean crop be protected from pests by controlling them.

Course/Learning outcomes M. Sc. Zoology Class: M.Sc. 4th sem

Paper: 4th (I) Sericulture

Units	Course content	**Course/ Learning Outcomes:** After completion of course, the students will be able to
1	Introduction and moriculture	• Knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing and silk reeling. • Gain knowledge on various aspects of growth and development of mulberry.
2	Plant pathology and biology of Bombyx mori	• Gain knowledge on various aspects of growth and development of mulberry. • Methods of silk production and how the silkworm culture is done.
3	Rearing facilities and operation	• Understand silkworms rearing and their products. • Generation of skilled man power in the field of sericulture, to impart training in post cocoon technology and to provide field exposure.
4	Moulting, mounting and silkworm diseases	• Gain scientific procedure involved in production of disease free layings.
5	Cocoon marketing Silk reeling and non-Mulberry silkworm	• Learn about the various skills that are necessary for self-employment in the mulberry and seed production. • Mulberry garden establishment.

LOCF
Learning Outcome Based Curriculum frame work
Adopted by UGC

Department of Pharmaceutical Chemistry
Govt. Madhav Science College Ujjain, Madhya Pradesh

Learning Outcomes-Based Curriculum Framework for Undergraduate Education/ Postgraduate Education

1.1 Introduction

The learning outcome-based curriculum framework for Bachelor of Science in pharmaceutical chemistry is proposed to provide a comprehensive exposure to the theory, programmes, practical aspects, processes of pharmaceutical chemistry. Pharmaceutical chemistry leads to careers in drug development, biotechnology, pharmaceutical companies, research facilities, and more. Studying pharmaceutical chemistry allows students to contribute to life-saving remedies, enhance the speed of delivery of new medications, and help others.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution

Some of the representative qualities of a degree holder in pharmaceutical chemistry may include the following:

- **Disciplinary knowledge:** Proficient in representing comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in pharmaceutical chemistry and its different subfields (medicinal chemistry, inorganic chemistry, organic chemistry, analytical chemistry and physical chemistry). Capable in attributing knowledge and practical skills in related fields of study interdisciplinary subfields. Able to use modern instrumentation for pharmaceutical analysis and separation.
- **Communication Skills:** Capable in transforming complex technical information relating to pharmaceutical chemistry in a clear and concise way in both writing and verbal manner.
- **Critical thinking:** Ability to solve critical problems in an efficient manner in the all areas of pharmaceutical chemistry (medicinal, analytical, inorganic, organic, and physical chemistry).
- **Problem solving:** Capacity to apply their abilities to solve different kinds of non-familiar problems and apply pharmaceutical learnings to real life situations.

- **Analytical reasoning:** Capability to evaluate, analyse and synthesise pharmaceutical and other data from a variety of sources and draw valid conclusions. Able to support the analysed data with evidence and examples.
- **Research-related skills:** Capability to define pharmaceutical and related problems, formulate hypotheses, test hypotheses, perform experimental work, analyse, interpret and draw conclusions from data. Establish hypotheses and report the results of an experiment or investigation.
- **Cooperation/Team work:** Able to work effectively in diverse teams in both classroom, laboratory and in industry and field-based situations.
- **Scientific reasoning:** Ability to apply theoretical and experimental knowledge to analyse, interpret and draw conclusions from quantitative/qualitative data. Evaluate ideas, experimental evidence and experiences from an open-minded perspective.
- **Reflective thinking:** Problem-solving responsiveness to live experiences, with self-awareness and responsibility to society.
- **Information/digital literacy:** Capable of using IT tools and networking for pharmaceutical chemical simulation, drug designing/docking, computation and appropriate software for analysis of data, and employing modern e-library like N-list, e-contents, to study and evaluate pharmaceutical chemistry-related information.
- **Self-directed learning:** Capability for independent learning, problem solving approach and to identify appropriate resources required for pharmaceutical chemistry.
- **Multicultural competence:** Ability to understand multi cultures and global perspective to live and work in a diverse world.
- **Moral and ethical awareness/reasoning:** Avoiding unethical behaviour such as fabricated data, falsification or manipulation of data or committing plagiarism. Appreciate environmental & sustainability issues and adopt impartial and truthful actions in all aspects of work.
- **Leadership readiness/qualities:** Ability to develop vision, courage, integrity, strategic planning, focus and motivating team members using management skills to guide people in the right direction.
- **Lifelong learning:** Capable of self-initiated learning and focus on personal development throughout life.

1.3.2 Qualification descriptors

Qualification descriptors for a Bachelor's Degree programme:

The qualification descriptors for a Bachelor's Degree programme in Pharmaceutical Chemistry includes the following:

- To train pharmaceutical chemistry graduates with strong fundamental concepts in medicine and high technical skills. These qualities will be used in the pharmaceutical sector for success.
- To develop a teamwork ability and awareness in the students towards the importance of interdisciplinary approach for developing capability to solve critical problems in the area of pharmaceutical chemistry.
- Use of knowledge and skills to understand & identify problems related to the pharmaceutical chemistry. Collection of relevant quantitative and/or qualitative data from various sources and their application, analysis and evaluation using appropriated methodologies for formulating evidence-based solutions.

1.3.3 Programme learning outcomes:-

- Students who have a deep interest in the field of Pharmaceuticals Chemistry opt for this course as it provides a great horizon of knowledge through which they can create new inventions in the field of pharmaceutical chemistry.
- Students study principles and applications of natural and synthetic chemistry.
- It provides advanced knowledge in modern synthetic chemistry with related areas of significance in the drug design, discovery, and development process for manufacturing therapeutic drugs for prevention and cure of life-threatening diseases.
- This course studies various substances, organic chemistry, pharmaceutical chemistry, medicinal chemistry, pharmaceutical quality control, quality assurance, enzyme technology, biochemistry, drug analytics.
- This course will never go out of trend.
- MSc Pharmaceutical Chemistry graduates are always in demand and will always be in demand.
- The jobs of this field never exhaust.

- MSc pharmaceutical provides various job opportunities for graduates in the field of drug industry.
- It includes developing and formulating drugs to treat patients with diseases and researching how different chemicals affect various biological systems.
- Graduates from MSc Pharmaceuticals Chemistry can work to create new drugs and products in the most cost-effective way that produces the least amount of negative side-effects.
- They can design and apply methods of chemical analysis to a product to ensure that the drug is refined.
- If one wants to improve their career trajectory then they can pursue a PhD in Pharmaceutical Chemistry. This can help an aspirant to hold a better grip over the subject and explore the fields of pharmaceutical chemistry.
- One may even make a career in teaching under various top pharmaceutical colleges with this degree.
- One can find a job like: Scientist, Research, Officer, Research Executive, Professor, Quality Control & Quality Assurance Analyst, Scientific Data Entry Specialist, Patent Analyst, Pharmaceutical Patent Analyst, Assistant Manager, etc.
- Some sectors that are constantly recruiting MSc Pharmaceutical Chemistry graduates are: Pharmaceutical industry, colleges & universities, biotechnological companies, chemical or biomedical industries, scientific industries, govt./ pvt. hospitals, defense services, etc.
- Some of the top recruiters are: Value Edge Research, Dr. Reddy's Laboratories, eValueserve, IMS Health, Jubilant, Biocon, Parexel, NCBS, TIFR, Indian Institute of Technology, Gratiot labs limited, Hydro Chemicals Pvt. Ltd., Novartis Healthcare Pvt. Ltd., Syngene International Limited, Hemmo Pharmaceuticals Private limited, etc.

1.3.4 Course learning outcomes:-

Pharmaceutical chemistry is the study of drugs, and it involves drug development. This includes Drug discovery, delivery, absorption, metabolism, and more. There are elements of biomedical analysis, pharmacology, pharmacokinetics, and pharmacodynamics. Pharmaceutical chemistry work is usually done in a lab setting.

Pharmaceutical chemistry involves cures and remedies for disease, analytical techniques, pharmacology, metabolism, quality assurance, and drug chemistry. Many pharmaceutical chemistry students will later work in a lab. Pharmaceutical chemistry leads to careers in drug development, biotechnology, pharmaceutical companies, research facilities, and more. Studying pharmaceutical chemistry allows students to contribute to life-saving remedies, enhance the speed of delivery of new medications, and help others. Pharmaceutical chemistry also includes other branches of study such as pharmacokinetics, pharmacodynamics, and drug metabolism. These are important for learning the effects that drugs have on the body.

Pharmacognosy course is the most advanced introductions in Herbal Medicines that is offered. You will learn about Herbs, and their Science. Classification of Medicinal Plants, Phytochemistry, Carbohydrates, Lipids, Terpenes, Polyphones, Alkaloids, Pharmacology, Toxicity, Formulations and Preparations of Herbal Medicines. How herbs influence our physiology and can be helpful against several disorders. Relations between Phyto-therapy and the Elderly, Phytotherapy Drug discovery and development course will explore the process of drug development, from target identification to final drug registration. It will present drug development as a process involving target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening. Safety evaluation, bioavailability, clinical trials, and the essentials of patent law will also be discussed. Along the way you will learn about molecular recognition, computer aided drug design, and toxicology as applied to the development of new medicines For each therapeutic class described in Medicinal Chemistry, the student will have knowledge of: General structural features of agents belonging to the therapeutic class, Relevant physicochemical properties, Relevant chemical reactions/synthetic pathways for selected drugs, Structural influences o

1.4 Assessment methods

- Evaluation is executed by
    1) Chalk-Board presentation
    2) Power-point presentation
    3) Poster presentation
    4) Various assignments
    5) MCQ
    6) Surprise test

7) Unit test after completion of each unit
8) Final examination

SECTION –B

Detailed Syllabus based Course Learning outcome

B.Sc. I year (Pharmaceutical Chemistry)

Paper I Pharmaceutical organic Chemistry

Learning outcome:-

1. Write the structure, name of the organic compound.
2. Knowledge about types of isomerism.
3. Write the reaction, name the reaction and orientation of reaction.
4. Account for reactivity/ stability of compounds.
5. Identify / confirm the unknown organic compound.

S.No.	Unit	Learning outcome
1.	Historical development of pharmaceutical chemistry, Atomic and molecular orbital , covalent bond, hybrid orbitals , intermolecular forces , bond dissociation energy , (hemolysis and heterolysis), polarity of bonds and molecules , structure and physical property (melting point , boiling point , solubility), resonance, inductive effect, field effect, hyper conjugation , hydrogen bonding. Acid and bases: Arrhenius concept, Bronsted lowery concept, strength of acids and bases, Lewis concept, pH, Pka , pKb values , buffers , buffers in pharmaceutical and biological systems , buffered isotonic solutions.	1. Know the formulate of common acid and bases. 2. State that an alkali is a soluble base that releases OH- ions in aqueous solution. 3. Outline the basic knowledge of the atomic and molecular orbitals
2	Physicochemical properties and molecular constitution : surface and interfacial tension, refractive index , optical rotation ,dielectric constant, dipole moment, density, viscosity , molar refraction and parachor. Stereo isomerism: Optical isomerism – optical activity, enantiomerism, diastereomerism, meso compounds, Elements of symmetry, chiral and achiral molecules. DL system of nomenclature of optical isomers. Reaction of chiral molecules. Racemic modification and resolution of racemic mixture.	1. Differentiate chiral and achiral molecules. 2. Recognize and draw structural isomers., stereoisomers including enantiomers and diastereomers, racemic mixture and meso compound. 3. Understand and identify geometrical isomerism. 4. Understand the chemical significance of cis and trans isomerism.

	Geometrical isomerism: Nomenclature of geometrical isomers, methods of determination of configuration of geometrical isomers.	
3.	Types of organic reaction , Mechanism of organic reactions: curved arrow rotation , drawing electron movement with arrows, half headed and double headed arrow , Electrophiles and nucleophiles , reaction intermediates: formation , Nucleophilic aliphatic substitutions (SN1 and SN2 reactions): Mechanism kinetics , order of reactivity and stereochemistry . Elimination reactions (E1 and E2 reactions) : mechanism , kinetics, order of reactivity and stereochemistry .	1. Predict the product of SN1 and SN2 reaction including stereochemistry. 2. Predict the product of E 1 and E2 reaction.
4	Classification of the drug on the basis of sources (Biological , Geographical, Marine , minerals) Theories of drug action: Biological defenses, chemical defenses, surface active agent, metabolic antagonism, Enzyme neutralizers. Drug receptor interaction and receptor theories.	1. To understand the classification of drug on the basis of different sources. 2. To understand the drug receptor. 3. Student will understand drug receptor interaction.
5	Introduction to dosage form classification and definition, routes of drug administration, Aromatic waters, syrup, Tinctures and infusions. Introduction to medicinal system: Ayurvedic, Unani, Siddha, Homeopathic, Allopathic. Weights and measures: Imperial and metric system, Calculation involving percentage solutions, allegation, proof spirit and isotonic solutions based on freezing point and molecular weight.	1. Student will get the knowledge about the different types of medicinal system. 2. To understand the routes of drug administration 3. Student will understand about the knowledge of weight and measures.

B.Sc. I year (Pharmaceutical Chemistry)

Paper II Inorganic and Pharmaceutical Analysis

Learning Outcome:-

1. Well acquainted with the principle of limit tests.
2. Familiar with different classes of inorganic pharmaceuticals and their analysis.
3. Identification of different anions, cations and different inorganic Pharmaceuticals.
4. Knowledge about the sources of impurities and methods to determine impurities inorganic drugs.

S.No.	Unit	Learning outcome
1.	Impurities in pharmaceutical substances: History of Pharmacopoeia. Sources and types of impurities, effect of impurities. Permissible impurities in pharmaceutical substances, methods used to purify inorganic substance5, Test of purity, Limit test principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals.	1. Student will understand about the impurities and different sources of impurities. 2. Student will understand about the limit test.
2	Pharmaceutical analysis: Different techniques of analysis, Methods of expressing concentration, Primary and secondary standards, Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide. hydrochloric acid, sodium thiosulphate. sulphuric acid, potassium permanganate and ceric ammonium sulphate. Errors: Sources of errors, types of errors. methods of minimizing errors, accuracy.	1. Student will understand about the calculation of pharmaceutical substances. 2. Understanding the primary and secondary standard.
3.	Acid base titration: Theories of acid base indicators, classification of acid base titration and theory involved in titrations of strong,	1. Defines oxidation reduction titration indicators.

	weak, and very weak acids und bases, neutralization curves Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine Hel Redox titrations: Concepts of oxidation and reduction and types of redox titration - (Principles. And applications: Cerimetry, Iodimetry, Iodimetry Titration with potassium iodate)	2. Interprets redox titration. 3. Define end points.
4	Precipitation titrations: Mohr's method, Yolhard's, Modified, Yolhard's. Fajans method. estimation of sodium chloride. Complexometric titration: Classification, metal ion indicators, masking and damasking reagents, estimation of Magnesium sulphate and calcium gluconate. Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium Sulphate, Basic Principle, method and applications of diazotization Titration.	1. Define titration curve for precipitation and complex formation titration. 2. Define end points.

B.Sc. II year (Pharmaceutical Chemistry)

Paper I Medicinal Chemistry I

Learning objective:-

1. Helps in Correlating between pharmacology of a disease and its mitigation or cure.
2. To Understand the drug metabolic pathway , adverse effect and therapeutic value of drugs.
3. To know the structure activity relationship of different class of drugs
4. Well acquainted with the synthesis of some important class of drug.
5. Knowledge about the mechanism pathway of different class of medicinal compounds.
6. To Understand the chemistry of drug with respect to their pharmacological activity.

S.No.	Unit	Learning outcome
1.	1 Physicochemical properties in relation to biological action (Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, isomerism, Optical and Geometrical isomerism.)	1. Student will understand physicochemical properties of drugs. 2. Understand the correlation between physicochemical properties and biological activity of drug.
2.	General anesthetics: Classification, mechanism of action, synthesis of nitrous oxide. halothane, thiopental sodium and chloroform Local anesthetics: Classification, mechanism of action, SAR, synthesis of procaine hydrochloride, benzocaine, lignocaine hydrochloride.	1. Student will understand the General and local anesthetic. 2. Student will understand the SAR of different drugs.
3.	Hypnotic and sedative: Classification, mechanism of action, SAR of barbituric acid derivatives and synthesis of barbital, allobarbital , hexobarbital , SAR of benzodiazepines and synthesis of diazepam, alprazolam: zolpidem.	1. Student will understand the hypnotic and sedative drugs. 2. Student will understand the anticonvulsant drug.

	Anticonvulsants: Classification, mechanism of action And synthesis of Phenobarbital and phenytoin sodium.	
4	Analgesics and antipyretics: Classification, mechanism of action and SAR of morphine analogue, mechanism of action, mechanism of action and SAR ofsalicylic acid. aryl alkanoic acid derivatives, synthesis of aspirin and paracetamol. Anti-histaminics: Classification, mechanism of action and SAR ethanolamine derivatives, synthesis of diphenhydramine hydrochloride, promethazine hydrochloride.	2.1. Student will understand the analgesic and antipyretic drugs. 3. Student will understand different types of drug used in the form of analgesic and antipyretics.
	Diuretics: Classi1ication, mechanism of action and SAR. Synthesis and uses of Hydrochlorothiazide, acetazolamide. Hydroflumethiazide, ethacrynic acid. furosemide. Antihypertensives: Classification, mechanism of action, SAR. Synthesis of Captopril, propranolol hydrochloride.	1. Student will understand the diuretic drugs. 2. To understand the classification of diuretic drugs. 3. Student will understand the antihypertensive drugs.

B.Sc. II year (Pharmaceutical Chemistry)

Paper II Natural Product

Learning Outcome:-

1. To understand the importance of metabolism of substrates.
2. To understand the basic principles of protein and polysaccharide structure.
3. Student will learn and get experience about classification, phytochemistry of carbohydrate, lipids.
4. Student will learn and get experience about terpenes, alkaloids, glycoside, steroids, and pharmacology. formulation and isolation of herbal medicines.
5. How herbs influences our physiology and can be helpful against several disorders.

S.No.	Unit	Learning outcome
1.	Heterocyclic Compound:- Nomenclature, Structure, Synthesis, chemical reaction of Imidazole, oxazole, pyrazoles, pyran pyrimidine, purine ,indole, isoquinoline.	1. Student will understand the term of heterocyclic compound. 2. Student will understand the different types of heterocyclic compound.
2.	Carbohydrate:- Classification, nomenclature, , monosaccharide: Glucose and fructose and their reaction, Cyclic Structure of D-Glucose, Disaccharide: Maltose, Sucrose and lactose , Polysaccharide: Starch, cellulose, dextran, glycogen, insulin. Fats:- fats, oils, waxes . Fatty acid, physiochemical property, phospholipid, lecithenes, Cephalins, plasmogens glycolipid.	1. Understand the different classes of carbohydrates. 2. Learn about the function of carbohydrate in the diet and how they relate to health issue.
3.	Amino Acids: Classification, Structure and stereochemistry of amino acids, properties of amino acid. Protein: Classification, properties of proteins, primary, secondary and tertiary structure of protein. Nucleic Acid:- Introduction, Structure of DNA and RNA.	1. Be able to draw the basic structure of amino acid. 2. Understanding the biological activity of amino acids. 3. Explain the reaction of amino acid. 4. Understanding the classification of protein.
4.	Alkaloid:- Classification, General introduction, Composition, Chemistry and chemical classes , therapeutic uses and commercial application of quinine , morphine, reserpine.	1. Student will understand about the alkaloids.

	Glycoside:- Classification, General introduction, Composition, Chemistry and chemical classes , therapeutic uses and commercial application of Senna, Aloes, Bitter almond.	2. Understanding application of morphine, quinine and reserpine 3. Student will understand about the classification of glycosides.
5.	Terpenes:- Classification, General introduction, Composition, Chemistry and chemical classes , therapeutic uses and commercial application of Citral, Carvone , menthol , Thymol, Camphor Steroids: Isolation, nomenclature, Chemistry of cholesterol, ergosterol, stigmasterol, cartosone.	1. Understanding the classification of terpenes. 2. Understanding isolation of steroids and terpenes.

B.Sc. III year (Pharmaceutical Chemistry)

Paper I Medicinal Chemistry II

Learning outcome:-

1. To understand the chemistry of drug with respect to their biological activity.
2. To know the metabolism, adverse effect and therapeutic activity of drugs.
3. To understand the different modern techniques of drug design
4. To appreciate the SAR of some important classes.
5. To acquire knowledge in the chemotherapy for cancer and microbial diseases and different antiviral drugs.
6. To have been introduce to a variety of drug classes and some pharmacogical properties.

S.No.	Unit	Learning outcome
1.	Adrenergic: Classification, mechanism of action and SAR of ethylamine analogue, synthesis of adrenalin, epinephrine, norepinephrine, ephedrine, dopamine Anticoagulants: Classification, mechanism of action, synthesis and uses of heparin, dicoumarol. Expectorants and Antitussive: Classification, mechanism of action, synthesis of acetylcysteine, guaifenesin and noscapine.	1. Understanding the classification of adrenergic drug. 2. Understand the term of Expectorant and antitussive. 3. Understanding the synthesis of heparin.
2.	Antibiotics: Historical background, structure activity relationship, chemical classification of beta lactam antibiotics: penicillin, Cephalosporins. Aminoglycosides: Streptomycin and neomycin, Tetracyclines: Tetracycline. Macrolide: Azithromycin, constitution and synthesis and uses of chloramphenicol. Sulphonamide: classification and mechanism of action, synthesis and uses of sulphacetamide, sulphaguianidine, dapsone.	1. Understanding the antibiotics drug. 2. Understanding different types of antibiotic drugs. 3. Understanding classification and synthesis of sulphonamides drug.
3.	Antimalarial: Classification, mechanism of action, SAR of 4 amino quinolones, synthesis of chloroquine phosphate, amidiaquine hydrochloride phosphate. Antitubercular drugs: Classification, mechanism, synthesis and uses of para amino salicylic acid, isoniazid, rifampicin. Anti-amoebic: Classification, Mechanism, synthesis and uses of metronidazole.	1. Understanding the classification of antimalarial drugs. 2. Understand about the antitubercular drug. 3. Understanding synthesis and mechanism of different amoebic drugs.
4.	Anti-diabetic: Classification, Mechanism, synthesis and uses of metformin, sit gliptin, glimperide.	1. Understanding about antidiabetic drugs.

	Anti-neoplastic: Types of cancer , Classification, mechanism, synthesis and uses of 5- fluoro uracil , 6-mercaptopurine, thiotepa, busulphan.	2. Understanding about anticancer drugs.
5.	Drug Design: various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient , Hammets electronic parameter, Trafts Steric parameter and hansch analysis , Free Wilson analysis . Introduction to 3D QSAR approaches.	1. Student will understand various approaches of drug design. 2. Student will understand about QSAR.

B.Sc. III year (Pharmaceutical Chemistry)

Paper II Instrumental Analysis

Learning outcome:-

The student will learn to

1.The basic theoretical knowledge of the instrument techniques available.

2. Theoretically understand the aspects of separation for multi components.

3.Practical skills for the analysis of drug and excipients using various instrumentation techniques.

4.To make accurate analysis and report the result in defined format.

5. To learn documentation and express the observation with clarity.

S.No.	Unit	Learning outcome
1.	Conductometry: Introduction, conductivity cell, conductometric titration, applications. Potentiometry: Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrodes), methods to determine end point of potentiometric titration and applications. Polarography: principle, Ilkovic equation, construction and working of doping mercury electrode and rotating platinum electrode, application	1. Student will understand the basic phenomena of conductometry. 2. Understanding about reference and indicator electrode. 3. Student will describe about polarography.
2.	UV: Principle, Instrumentation, and application of UV spectroscopy. IR: Principle, Instrumentation, and application of IR spectroscopy.	1. Understanding about UV and IR spectroscopy. 2. Understand the basic knowledge of instrumentation of UV and IR.
3.	NMR: Principle, the spinning nucleus, magnetic and nonmagnetic nuclei , rules to find nuclear spin , effect of external magnetic field ,processional motion and frequency , chemical shift , measurement shielding and deshielding , factors affecting spin-spin coupling , coupling constant , instrumentation , interpretation of NMR spectra.	1. Understanding about NMR spectroscopy. 2. Understanding about Mass spectrometry. 3. Understand the basic knowledge of instrumentation of NMR and Mass.

	Mass Spectrometry: Principle, Instrumentation, Types of ions and uses of mass spectroscopy in the determination of molecular weight.	
4.	Chromatography: Introduction to Chromatography, Adsorption and partition column Chromatography: Methodology, advantages and disadvantages and application. Thin layer Chromatography: Introduction, principle, methodology, Rf value, advantages, disadvantages and application.	1. Student will understand the separation techniques. 2. Student will understand about the adsorption and partition chromatography. 3. Student will understand about TLC.
5.	Gas Chromatography: Introduction, theory, derivatization, temperature, programming, advantages and disadvantages and application. High performance liquid Chromatography: Introduction theory, Instrumentation advantages and application.	1. Understanding about Gas Chromatography. 2. Understanding about the HPLC.

M.Sc. Pharmaceutical Chemistry

Paper I

PC-101 Introduction to Pharmacy Drug Regulatory Act, Intellectual Property Rights

Learning outcome:-

1. The students understand the importance of quality in pharmaceutical products.
2. The student is explored into importance of Good practices such as GMP, GLP etc.
3. The factors affecting the quality of pharmaceutical is explored
4. He understand the regulatory aspects of pharmaceutical taught to the student.
5. The process involved in manufacturing of pharmaceuticals different section / department and activity is learnt.
6. The various documentation process is highlighted to the students.

S.No.	Unit	Learning outcome
1	Introduction to Pharmacy, Careers in Pharmacy, Codes of pharmaceutical ethics, Importance of Pharmaceutical Chemistry, Pharmacopeia & its history (IP,BP, USP, NF)	1. Understanding the careers in pharmacy. 2. Understanding the pharmacopeia and its history.
2	Routes of drug administration. Introduction to tablets, capsule, suspension, emulsion, ointments etc, Introduction to NDDS.	1. Student will understand about the routes of drug administration.
3	Drug and Cosmetics Act with special reference to schedule M, GMP, GLP, GCP. USFDA, NDA, ANDA, Clinical Trials	1. The student is explored into importance of Good practices such as GMP, GLP etc.
4	Concept of Quality & total Quality Management, Quality Assurance & Quality Control, IPQ A, IPQC	1. Understanding the concept of Quality control and quality assurance.
5	Documentation and Maintenance of records, Intellectual property rights patents, Trademarks, Copyrights, Patents Act.	1. The various documentation process is highlighted to the students.

Pharmaceutical Chemistry paper II
PC-102 PHARMACEUTICAL CHEMISTRY & BI OCHEMISTRY

Learning Outcome:-

1. To understand the importance of metabolism of substrates.
2. Will acquire chemistry and biological importance of biological macromolecules.
3. To acquire knowledge in the qualitative and quantitative estimation of the biological macromolecules
4. To understand the basic principle of protein and polysaccharide structure.

S.No.	Unit	Learning outcome
1	Chemical structure and biological activity, Study of relationship between physics-chemical properties and biological potencies of drugs. Metabolic changes of drugs & related organic compounds or the body	1. Student will understand the correlation of chemical structure and biological activity.
2	Classification of drugs on the basis of (i) Chemical Structure (ii) Therapeutic action (at least one example of each class). D 8 Receptors: (i) Nature of drug receptors (ii) Isolation of drug receptors (iii) Receptor theories (iv) Types of drug receptors	1. Student will understand the classification of drug. 2. Student will learn about the concept of receptor and receptor theories.
3	Heterocycles: - Synthesis reactivity reactions applications and biological significance of the following: - (A) Mono Hetero Atom Systems: - Indole, Quinoline, Isoquinoline. (B) Multi Hetero Atom Systems: - Diazole, Pyrazole, Oxazole	1. Student will learn about the concept of heterocyclic compound. 2. Understanding the significance of various heterocyclic compound.
4	Biochemical organization of the cell and transport processes across cell membrane, bioenergetics, production of ATP and its biological significance. Enzymes: Nomenclature, Kinetics and its Mechanism of action, Mechanism of Inhibition, Isoenzymes, enzymes in technical diagnosis.	1. Student will understand the structure of cell. 2. Student will learn about the concept of ATP and its production.
5	Disorders of Carbohydrate, Lipid and Protein Metabolism, Biomedical importance and Implications in Clinical Biochemistry, Diagnostic tests for detection of metabolic disorders, Urea cycle, metabolic disorders of urea cycle.	1. Student will understand carbohydrate and disorder of carbohydrate.

Pharmaceutical Chemistry paper III
PC 103 Principles of Organic Pharmaceutical Chemistry

Learning Outcome:-

1. To carry out an organic reaction, including isolating, purifying and characterizing the product.
2. Student will understand about various name reaction.
3. Understanding about the Stereo- chemistry.
4. Student will understand the aromaticity.

S.No.	Unit	Learning Outcome
1	Stereo Chemistry and Conformational Analysis: Optical isomerism- Concept of Chirality, recognition of symmetry elements and chiral structures, R-S nomenclature, Diasterisomerism in acyclic and cyclic systems, Optical activity without asymmetric carbon atom (allenes, spiranes and biphenyls)	1. Student will understand the concept of stereochemistry. 2. Student will able to determine the structure of various organic compound.
2	Geometrical Isomerism: Geometrical isomerism of olefins and oximes, E-Z nomenclature. Conformational Analysis: conformational analysis of ethane, butane, cyclohexane and decalins. Effect of conformation on reactivity in acyclic compounds and cyclohexenes, Interconversion of Fischer, Newman and Sawhorse projections. Stereo selective Synthesis: Asymmetric Synthesis	1. Student will understand the E –Z nomenclature. 2. Student will understand the conformation of cyclohexane.
3	Reaction Intermediates: Structure, formation and examples of participation in chemical reaction of the following: - Carbocation, Carbanion, Nitrenes, Carbenes, Arynes, Free radicals. (B) Mechanism of Organic Reactions: - Types of reactions, thermodynamic and kinetic requirements. Potential energy diagram, methods of determining reaction mechanisms, (C) Aliphatic Nucleophilic Substitute on: SN1 ,, SN2, SNi;, factors affecting mechanism, hydrolysis of ester,	1. Student will understand the carbocation, carbanion, and free radical. 2. Student will understand the mechanism of organic reaction.
4	Elimination Reactions: E1 E2 and E1cb mechanism, Hoffman and Saytzeff elimination. Addition Reactions: General mechanism, hydroboration, epoxidation, Wittig reaction. Aromaticity concept: Huckle's rule and its limitations, Benzenoid and non- benzenoid compounds,	1. Student will understand the E1 and E2 reaction. 2. Understanding Huckel's rule for aromaticity.

	cyclopentadienyl anion, tropylium cation, azulenes, fullerenes. Synthetic applications, mechanisms and stereochemistry (wherever applicable) of the following organic reactions and molecular rearrangements', - Pinacol - pinacolone rearrangements, Benzylic acid rearrangement, Beckmann rearrangement, Hoffmann- Curtius, Lossen and schmidt rearrangement, Claisen rearrangement	3. Student will understand various name reaction.
5	Study of reactions of synthetic importance: mechanisms and stereochemistry (whenever applicable) Birch reduction, Mannich reaction, Meerwein-Pondorf-Verley reduction and Oppenauer oxidation, Ozonolysis and hydrogenation, Diels-Alder reaction, Reformatsky reaction. Grignard reaction.	1. Student will understand the various name reaction.

Pharmaceutical Chemistry Paper IV
PC-104 PRINCIPLES OF PHYSICAL PHARMACY —I

Learning Outcome:-

1. Upon successful completion of the course , student will be able to-
   1 State the physicochemical properties of drug molecule, pH and solubility.
   2 Explain the role surfactants, interfacial phenomenon and thermodynamics.
   3 Describe the flow behaviour of fluids and concept of complexation.
   4 Analyse the chemical stability tests of various drug product.
   5 Understand the physical properties of solutions, buffers, isotonicity, disperse system and rheology.

S.No.	Unit	Learning Outcome
1	Basic Principles of Physical Pharmacy	1. Student will understand the first law of thermodynamics. 2. Understanding the free energy and Gibbs Helmholtz equation.
2	Determination of the physical properties of molecules.	1. Student will understand the concept of types of solution. 2. Understanding the concentration expression.
3	Buffers in pharmaceutical and biological system:	1. Student will learn about the concept of buffer solution. 2. Understanding in-vivo biological buffer system.
4	(A) Interfacial Phenomena, (B) Micromeritics	1. Student will understand the interfacial phenomena. 2. Understanding the particle size and size distribution.
5	Rheology	1. Student will understand Newtonian and non-Newtonian system. 2. Understanding viscoelasticity.

Pharmaceutical Chemistry paper V
PC —105 (a) MATHEMATICS AND STATISTICS FOR CHEMISTS
(For biology background)

S.No.	Unit	Learning Outcome
1	Matrix Algebra	1. Student will learn about the calculation of matrix algebra. 2. Understanding inverse, adjoint and transpose of matrices.
2	Differential Calculus	1. Student will understand rules for differentiations. 2. Understanding application of differential calculus.
3	Integral Calculus	1. Student will understand the basic rule for integration. 2. Understanding application of integral calculus.
4	Elementary Statistics	1. Understanding variable, univariate data , bivariate data. 2. Student will learn about the calculation of mean, mode, median.
5	Permutations and combinations	1. Student will learn about the correlation coefficient. 2. Student will understand the rules for probability.

Pharmaceutical Chemistry paper V
PC -105 (b) BIOLOGY FOR CHEMISTS (for mathematics background students)

S.No.	Unit	Learning Outcome
1.	Cell Structure and Functions	1. Student will understand the structure of cell. 2. Understanding the metabolic processes.
	Carbohydrate	1. Student will understand the conformation of monosaccharide. 2. Understanding the role of sugar in biological system.
	Lipid	1. Understanding the lipid and fatty acids. 2. Student will understand the lipid metabolism.
	Amino- Acid	1. Student will understand the primary and secondary structure of protein. 2. Understanding the chemistry of oxyticin.
	Nucleic Acid	1. Student will understand the structure of DNA and RNA. 2. Understanding translation and genetic code.

PC 201 PRINCIPLES OF INORGANIC PHARMACEUTICAL CHEMISTRY —I

Learning Outcome:-

Well acquainted with the principle of limit tests.

Familiar with different classes of inorganic pharmaceuticals and their analysis.

Identification of different anions, cations and different inorganic Pharmaceuticals.

Knowledge about the sources of impurities and methods to determine impurities inorganic compound.

S.No.	Unit	Learning outcome
1	Impurities in Pharmaceutical Substances and their tests. Synthesis, properties and uses of inorganic compounds of pharmaceutical importance	1. Well acquainted with the principle of limit tests. 2. Familiar with different classes of inorganic pharmaceuticals and their analysis. 3. Identification of different anions, cations and different inorganic Pharmaceuticals. 4. Knowledge about the sources of impurities and methods to determine impurities.
2	Structure and Bonding I A) Chemical periodicity, structure and bonding in homo and heteronuclear molecules including shapes of molecules (VSEPR theory) B) Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.	1. Student will understand the concept of acid and bass. 2. Understanding the VSEPR theory 3. Determine the structure of water.
3	Transition elements and Coordination compounds: . Inner transition elements:	1. Student will understand the concept of transition elements and inner transition metals. 2. Understanding industrial application of transition metal.
4	A) Complexing and chelating agents used in therapy, B) Dental product: Dentifrices, anti - caries agents. C) Bioinorganic Chemistry: photosystems, porphyrin, metalloenzymes. Oxygen transport, electron- transfer actions: nitrogen fixation	1. Student will understand the dental products. 2. Understanding the complexing and chelating agent used in therapy.
5	Structure and Bonding II	1. Understanding the boron hydrate. 2. Student will understand the carboranes and metallo-carboranes.

PC- 202 PHARMACEUTICAL ANALYSIS —I

Learning Outcome:-

1. Student will learn the various hyphenated analytical instrumental techniques.
2. Student will deals with different analytical data from different principle instrument .
3. The fellow student will gain the interpretation skills .
4. Fellow student will able to handle different analytical data to predict the unknown structure.

S.No.	Unit	Learning Outcome
1	UV-Visible Spectroscopy	1. Understanding the instrumentation of UV spectroscopy. 2. Understanding basic principle of UV spectroscopy.
2	Infrared Spectroscopy	3. Understanding the instrumentation of IR spectroscopy. 4. Understanding basic principle of IR spectroscopy.
3	Nuclear magnetic resonance spectroscopy	5. Understanding the instrumentation of NMR spectroscopy. 6. Understanding basic principle of NMR spectroscopy.
4	Mass spectrometry	7. Understanding the instrumentation of mass spectroscopy. 8. Understanding basic principle of mass spectroscopy.
5	Electron spin resonance spectroscopy.	9. Understanding the instrumentation of ESR spectroscopy. 10. Understanding basic principle of ESR spectroscopy.

Pharmaceutical Chemistry Paper Ill
PC —203 PHARMACEUTICAL ANALYSIS – II

Learning Outcome:-

The student will learn to

1. The basic theoretical knowledge of the instrumentation techniques available.
2. Theoretically understand the aspects of separation for multi components.
3. Practical Skills for analysis of drugs and excipients using various chromatography techniques.

S.No.	Unit	Learning outcome
1	Chromatography: General principles, classification of chromatographic techniques, normal and reversed phase, bonded phage, separation mechanisms	1. Student will understand the separation techniques. 2. Understanding the classification of Chromatographic techniques.
2	Principles Instrumentation and applications of - Thin layer chromatography, column chromatography, gas —liquid chromatography and Flash chromatography	1. Student will understand the instrumentation of TLC 2. Understanding the application of Column Chromatography.
3	High performance liquid chromatography, ion exchange chromatography, size exclusion gel chromatography, Chiral Chromatography	3. Student will understand the instrumentation of HPLC. 4. Student will learn about Chiral Chromatography.
4	Principle of liquid-liquid extraction and solid liquid extraction, distribution law, factors favoring solvent extraction, Sequences of the ex-traction process, Extraction techniques, Soxhlet extraction, Important applications of liquid-liquid extraction	1. Student will understand the liquid – liquid extraction. 2. Understanding the importance of liquid – liquid extraction.
5	A) General Titrimetric and Gravimetric analysis, determination of dissolved oxygen (DO) Biological oxygen demand (BOD), Chemical oxygen Demand (COD), B) I.P. methods for water analysis, zeta sizer, C, H, N analyzer.	1. Student will understand the titrimetric and gravimetric analysis. 2. Student will understand DO, BOD and COD.

Pharmaceutical Chemistry Paper IV
PC —204 PRINCIPLES OF PHYSICAL PHARMACY —II

Learning Outcome:-

1. Student will understand about the knowledge of activation energy.
2. Understanding the knowledge of pharmacokinetics and ADME phenomena.
3. Student will able to understanding the concept of electrochemistry.
4. Student will learn about the concept of polymer science.
5.

S.No.	Unit	Learning outcome
1	Pharmacokinetics	1. Student will understand the concept of ADME. 2. Student will understand the pharmacokinetic and pharmacodynamics parameter.
2	Chemical Kinetics I	1. Understanding the rates of chemical reaction. 2. Understanding the concept of activation energy.
3	Electro Chemistry:	1. Understanding the electrical transport. 2. Understanding the Arrhenius concept.
4	Polymer Science	1. Understanding the concept of polymer Science 2. Understanding the application of polymers.
5	Statistical thermodynamics	1. Understanding Boltzmann distribution. 2. Student will understand Kinetic theory of gases.

Pharmaceutical Chemistry Paper V

PC 205 COMPUTERS FOR CHEMISTS

S.No.	Unit	Learning Outcome
1.	Introduction to Chemistry	1. Student will understand generation of computers. 2. Understanding input and output devices.
2.	Basic Structure and Functioning of computers	1. Understanding computer languages. 2. Student will understand operating System.
3.	Computer application in pharmaceuticals and clinical Studies	1. Understanding various application of computers in pharma chemistry. 2. Student will learn about docking programs.
4.	Use of Computer Programmes	1. Student will understand MS word. 2. Student will learn about MS excel.
5.	Application of internet of Chemistry	1. Understanding various search engine. 2. Student will understand web camera.

Pharmaceutical Chemistry Paper.1

PC —301 PRINCIPLES OF PHYSICAL PHARMACY-III

1. Student will understand the concept of colloidal system.
2. Student will learn about the concept of catalysis which is used in the pharmaceutical analysis.
3. Understanding about the basics of solubility.

S.No.	Unit	Learning outcome
1	Colloids Introduction: Types of Colloidal system, Optical Progenies of Colloids, Kinetic Properties of Colloids, Electric Properties of Colloids, Solubilization, thermodynamics of Micellization.	1. Understanding the colloidal system. 2. Student will understand properties of colloids.
2	Diffusion and Dissolution Steady- State Diffusion, Procedure and Apparatus, Dissolution, Drug Release, Drug in polymer matrix, release from granular matrices, multiplayer diffusion membrane control and diffusion layer control, Thermodynamic of diffusion, Fick's Second Law.	1. Understanding the steady state diffusion. 2. Understanding the Fick's second law
3	Catalysis- Characteristics of catalyzed reactions classification of catalysts acid — base catalysis, kinetics of enzyme catalyzed reactions, Decomposition and Stabilization of Medicinal Agents, Photo degradation, Accelerated Stability Analysis	1. Student will understand the catalysis phenomena. 2. Understanding kinetics of enzyme catalyzed reaction.
4	Chemical bonding in Diatomic: elementary concepts of MO and VB theories: Huckel theory for conjugated electron system	1. Student will understand the Huckel theory. 2. Understanding VB and MO theories.
5	Basic of solubility in different states of matter, partition coefficient, phase rule, determination of degree of dissociation of acid and base	1. Understanding the basic solubility in different state of matter. 2. Student will understand the phase rule.

Pharmaceutical Chemistry Paper II
PC —302 PRINCIPLES OF PHARMACOGNOSY

Learning Outcome:-

This course is one of the most advanced introductions in herbal medicines that is offered. will learn and get experience about :

1. Herbs and their science
2. Classification of medicinal plant, phytochemistry, carbohydrate, lipid.
3. Terpenes, alkaloids, pharmacology, toxicity, formulation and preparation of Herbal medicine.
4. How herbs influences our physiology and can be helpful against several disorders.
5. The recognition of medicinal plant, identification of adulteration and contamination.
6.

S.No.	Unit	Learning outcome
1	A) introduction to pharmacognosy, Contribution of pharmacognosy in modern medicine. Present status and future trends in pharmacognosy (B) Natural Sources of drugs: - Higher plants, microbes, animals, and marine organisms. Classification of drugs from natural origin: Morphological, taxonomical, pharmacological (therapeutically), chemical classification.	1. Understanding the classification of drugs. 2. Student will understand natural Sources of drugs.
2	Primary & secondary metabolites, basic metabolic pathways, Shikmik acid pathway, Acetate pathway, Mevalonic acid pathway	1. Understanding the shikmik acid pathway. 2. Student will learn about acetate pathway.
3	Carbohydrate Classification Isolation of a carbohydrate drug, Identification Characterization & Pharmacognostic study of lsapgol, Acacia, Dextran, Glycoside drug- Classification Isolation of a Glycoside drug Biological Significant of Glycoside drug, O- Glycoside, medicinally Important Glycoside Anthraquinon Glycoside (Seena Leaf and Fruit), Flavonoid Glycosides, Cardiac Glycoside, (Ditoxin Digitalis)	1. Understanding the classification of carbohydrates. 2. Understanding isolation and classification of Glycoside drugs.
4	Alkaloid d rugs- Classification Isolation of Alkaloid drug Identification Characterization & Pharmacognostic study of Rauwolfia, Opium, Beladonna Herb, Cinchona	1. Understanding the different alkaloids drug. 2. Understanding classification and isolation of alkaloids drug.
5	Terpenes- Classification and Isolation of Terpenes drug Identification Characterization & Pharmacognostic study of Eucalyptus oil, Turpentine oil, Peppermint oil,	1. Understanding the different terpene drugs. 2. Understanding classification and isolation of terpenes drugs.

Pharmaceutical Chemistry paper UI
PC —303 PHARMACEUTICAL MEDICINAL CHEMISTRY—I

Learning Outcome:-

1. Helps in correlation between pharmacology of a disease and its mitigation or cure.
2. To write the chemical synthesis of some drugs.
3. To know the structure activity relationship of different class of drugs.
4. Knowledge about the mechanism pathway of different class of medicinal compound.
5. To understand the chemistry of drugs with respect to their pharmacological activity.

S.No.	Unit	Learning outcome
1	Unit I Central Nervous System depressants: (A) General anesthetics (B) Loch anesthetics	1. Student will understand the synthesis of different local and general anesthetic drugs. 2. Understanding the mechanism of action of local anesthetic drugs.
2	A) Anxiolytic, Sedatives, hypnotics- (B) Anticonvulsant	1. Student will learn about the sedative and hypnotic drugs. 2. Student will understand the synthesis and classification of anticonvulsant drugs.
3	Adrenergic and Antiadrenergic system and drugs	1. Student will understand the classification of adrenergic drugs. 2. Student will understand the synthesis of naphazoline drugs.
4	Cholinergic and Anticholinergics system and drugs	1. Student will understand the SAR of cholinergic drugs. 2. Understanding the classification of Anticholinergics drugs.
5	A) Analgesics, Antipyretics and Anti-inflammatory agents	1. Student will learn about the concept of analgesic drugs. 2. Student will understand the SAR of morphine.

Pharmaceutical Chemistry paper IV
PC 304 PRINCIPLES OF INORGANIC PHARMACEUTICAL, CHEMISTRY- II

1. Student will understand the concept of calcium and iron compounds.
2. Understanding the various major intra and extra cellular electrolytes.
3. Student will understand about the coordination chemistry.
4. Student will understand about the radiopharmaceuticals.

S.No.	Unit	Learning outcome
1	Calcium and iron compounds as Pharmaceutical agents:- .	1. Student will understand the concept of calcium and iron compounds. 2. Student will understand the application of iron compounds.
2	A) Diagnostic drugs, Antithyroid drugs, Disinfectants. (B) Major intra and extra cellular electrolytes, physiological acid base balance, electrolytic combination therapy	1. Understanding the various major intra and extra cellular electrolytes. 2. Understanding Antithyroid drugs.
3	Coordination Chemistry 1 Stability of complexes; thermodynamic aspects of complex formation; factors affecting stability, Determination of stability constants by spectrophotometric, polarographic and potentiometric methods.	1. Student will understand about the coordination chemistry 2. Student will understand the polarographic methods.
4	Coordination Chemistry II and Macrocyclic Ligands Macrocyclic ligands; types; porphyrins; corrins, Schiff bases; crown ethers; crypts. Crystal field theory and its limitations, d-orbital splitting, LFSE, spectrochemical Series	1. Student will understand about the coordination chemistry 2. Understanding Crystal field theory.
5	Radiopharmaceuticals Basic properties, production, quality control, stability, clinical and medicinal applications of radioisotopes used in pharmacy and medicine preparations of diagnostic and therapeutic agents	1. Student will understand about radiopharmaceuticals. 2. Understanding medicinal application of radioisotopes.

Pharmaceutical Chemistry paper V
PC —305 INSTRUMENTAL ME THODS OF ANALYSIS

Learning outcome:-

1. Student will understand about the various analytical method.
2. Student will understand about the polarography instrument.
3. Student will understand about the concept of potentiometry techniques.
4. Student will understand the various titration which is used in conductometry, potentiometric.

S.No.	Unit	Learning outcome
1	Nephelometry and Turbidimetry:-	1. Understanding nephelometry and turbidimetry techniques. 2. Understanding the instrument single and double beam.
2	Fundamentals of Potentiometry Polarography-	1. Understanding Fundamentals of Potentiometry, Potentiometric Titrations. 2. Understanding Karl fisher titrations.
3	Amperometry- Fluorimetry-	1. Understanding Fluorimetry-Introduction, theory, instrumentation and applications. 2. Understanding application of Fluorimetry.
4	Basic principle, instrumentation and applications of Atomic absorption spectroscopy arid Flame Photometry. Basic principle, instrumentation and applications of X-Ray diffraction	1. Understanding instrumentation and applications of Atomic absorption spectroscopy. 2. Understanding instrumentation of X-Ray diffractions.
5	Basic principle, instrumental ion and applications of Differential scarring calorimetry (DSC), Thermo-Gravimetric analysis (TGA), Differential thermal analysis (DTA).	1. Understanding instrumental ion and applications of Differential scarring calorimetry (DSC), 2. Student will understand DTA.

Pharmaceutical Cbemislry Paper I

PC —401- PHARMACEUTICAL MEDICINAL CHEMISTRY-II

Learning Outcome:-

1. To understand the chemistry of drug with respect to their biological activity.
2. To know the metabolism, adverse effect and therapeutic activity of drugs.
3. To understand the different modern techniques of drug design
4. To appreciate the SAR of some important classes.
5. To acquire knowledge in the chemotherapy for cancer and microbial diseases and different antiviral drugs.
6. To have been introduce to a variety of drug classes and some pharmacogical properties.

S.No.	Unit	Learning outcome
1	A) Antihypertensive drugs (B) Diuretics	1. Student will understand the classification of antihypertensive drugs. 2. Student will understand the synthesis of diuretics drugs.
2	Central Nervous System Stimulants	1. Understanding CNS stimulant drugs. 2. Student will understand the classification of CNS Stimulants drugs.
3	Chemotherapy	1. Understanding cancer and chemotherapeutic agent. 2. Student will understand the classification of chemotherapeutic drugs.
4	Sulphonamides	1. Understanding classification and SAR of sulphonamides.
5	A) Antitubercular drugs: (B) Gastrointestinal drugs,	1. Understanding the structure of different antitubercular drugs. 2. Student will understand gastrointestinal drugs.

Pharmaceutical Chemistry Paper II

PC — 402 DRUG DESIGN AND MEDICINAL CHEMISTRY

Learning Outcome:-

1. To develop an understanding of the physiochemical properties of drug.
2. To understand how current drugs were developed by using Pharmacophore modelling and docking techniques.
3. To acquire knowledge in the chemotherapy for cancer and microbial disease and different Antiviral agents.
4. To acquire knowledge about the mechanism pathway of different class of medicinal compound.

S.No.	Unit	Learning outcome
1	Structure and activity:	1. Understanding Relationship between chemical structure and biological activity (SAR) 2. Understanding Free Wilson analysis.
2	Pharmacodynamics:	1. Understanding biotransformation. 2. Student will understand membrane active drugs.
3	Antibiotics and antibacterial:	1. Understanding different types of antibiotic drugs. 2. Understanding anticancer drugs.
4	Antifungal Antimalarial	1. Understanding different types of Antifungal drugs. 2. Understanding different types of antiviral drugs.
5	Nonsteroidal Anti-inflammatory drugs: Antihistaminic and Antiasthmatic agents:	1. Understanding different types of antihistaminic drugs. 2. Understanding anti-inflammatory drugs.

PC4 03'ADVANCE CHEMISTY '*

Learning Outcome:-

S.No.	Unit	Learning outcome
1	Pericyclic reactions-.	1. Understanding Pericyclic reactions
2	Chemical Kinetics and Elements of group Theory Acid - Base catalysis - .	1. Understanding Acid - Base catalysis
3	Applications of Group Theory	1. Understanding application of Group Theory
4	Organometallic compounds:	1. Understanding Organometallic compounds
5	Organic Transformations and reagents:	1. Understanding Organic Transformations and reagents

Pharmaceuticnl Chemistry Paper IV

ÊC — 404 FOOD SUPPLEMENTS, AODITTVES AND TOXICOLOGY

Learning Outcome:-

1. Student will understand about the concept of vitamins
2. Student will able to learn about artificial sweetners.
3. Student know the concept of E number.
4. Student will understand the concept of drug addiction.

S.No.	Unit	Learning outcome
1	(AJ Historical and dietary importance of vitamins A, B complex , C, D, E, K and minerals, Biological role of vitamins and minerals. (B) Artificial sweeteners, their availability, regulation of use and potential toxicity.	1. Student will understand about the concept of vitamins 2. Student will able to learn about artificial sweeteners.
2	A) E- numbers and their use in classifying food additives. (B) Fluoride in toothpaste and water supplies and tire implications in supplementation of diet. (C) Salt and monosodium glutamate in processed foods, and the implications for health.	1. Student know the concept of E number. 2. Student will understand presence of Fluoride in toothpaste.
3	A) Definition and types of toxicology, Basic principles of toxicology. Drugs and pregnancy. (B) Drugs addiction and drug dependence, drug abuse, (C) Toxicology and treatment of Drugs such as salicylates, paracetamol. Opium, quinine, ethyl alcohol, nicotine, digitalis, barbiturates etc. (D) Toxicology and treatment of metals Such as lead. Aluminium, mercury, arsenic, antimony etc	1. Student will understand the concept of drug addiction. 2. Student will understand the toxicology and treatment of drugs.
4	A) The role of herbal supplements in the diet (B) Marketed preparations that are used as a supplement in various diseases like diabetes, arthritis, hypertension etc.	1. Understanding The role of herbal supplements in the diet. 2. Student will understand the hypertension.
5	General treatment of different types of pollution such as Air pollution, water pollution and noise pollution	1. Understanding different types of pollution.

Pharmaceutical Chemistry Paper V
PC-405- DRUG PHARMACOKINETICS AND DRUG DEVELOPMENT

Learning Outcome:-

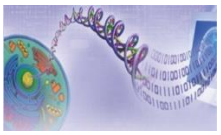
After successful completion of the course student will able to-

1. Understand the concept of ADME of drug in human body.
2. Determine the various Pharmacokinetics parameters from either plasma concentration or urinary excretion data for drug.
3. Ability to design and perform in-vitro dissolution studies for various drugs as per the standard of official monograph.
4. Basic understanding about the concepts of in-vitro –in-vivo correlation.

S.No.	Unit	Learning outcome
1	Drug Targets — Nature and mechanism of functioning of drug targets: - Enzymes, receptors, proteins, nucleic acids	1. Understanding the nature and mechanism of drug target. 2. Understanding enzyme as drug target.
2	Pharmacokinetics: - Introduction (A) Drug absorption: - Introduction, cell membrane, drug solubility. (B) Drug distribution: - Introduction, distribution around Ibe blood supply, distribution to tissues, Distribution to cells. other distribution factors, blood brain barrier, placental barrier	1. Understand the concept of ADME of drug in human body. 2. Understanding placental barrier.
3	Pharmacokinetics (a) Drug excretion: - Definition, lungs, the bile duct, other routes and the kidneys. (b) Drug Administration: Definition, oral administration, mucous membranes, Rectal, inhalation topical, injection, subcutaneous implants. (c) Drug dosing: - Dosing, drug-half life, steady-state concentration, drug tolerance	1. Determine the various Pharmacokinetics parameters from either plasma concentration or urinary excretion data for drug. 2. Understanding Drug dosing.
4	Biological testing and bioassays - drug testing, drug testing in vitro. drug testing in vivo. Drug Dissolution & disintegration, apparatus and uses.	1. Ability to design and perform in-vitro dissolution studies for various drugs as per the standard of official monograph. 2. Understanding dissolution apparatus.

5	Structure activity relationships: - Definition & importance (A) Binding Interaction (Drug target) with one example of each type- ionic bonding, hydrogen bonding, Vender walls interaction, Dipole-dipole interactions and covalent bonds. (B) Functional groups as binding groups:- Alcohol s and phenols, amines, aldehydes rind ketones and Carboxylic acids	1. Understanding Binding interaction. 2. Understanding functional group as binding group.

Bioinformatics Department, Govt. Madhav Science College Ujjain



Learning Outcomes based Curriculum Framework (LOCF) For Bioinformatics

1.1 Introduction:

Bioinformatics sometimes use as a synonymous to computational biology , but mainly deals with the analysis of biological data such as DNA, RNA and protein. Bioinformatics as a subfield of biology was growing since last three decade but driven largely when used in human genome project and rapid advances in DNA sequencing technology. Mining of biological data mainly involve collection the meaningful information and use this information for further research, identification of information require writing and running of the software programs that use algorithms from graph theory, artificial intelligence, soft computing, data mining, image processing, and computer simulation.

1.2Learning outcomes-based approach to curriculum Enrichment and Execution

Graduation course should be designed in term of providing all basic study for all those who are not aware to this, means in term of basic information of field and subfield, Information related to various biological and chemical databases and all basic concept which helps to build a strong base of students. The students should have a minor project as a part of curriculum at the last year of graduation which help student to asses and use of knowledge they got in previous year.The students areexpecting to learn various biological databases of protein, dna and rna, and apart from this different bioinformatics concept use for analysis of biological information: such as sequence alignment relevant to DNA, RNA and protein. Having bioinformatics as part of the graduation curriculum, enhance the skills required to perform research in field of biological science which provide job at last

and efficient way to process the large amount of raw data to filter out useful information.

Disciplinary knowledge:
Student should able to understand and demonstrate major concept and mechanism of sequence alignment process and evaluation of result and use these result to solve problem and also able to understand the concept of molecular modeling for designing a best for unknown protein sequence.
Student should understand the concept to phylogenetic analysis which helps to identify the relationship between the species by the analysis of their genome. Student should grow with the ability to apply this knowledge to solve the modern problem related to genomics, proteomics, metabolomics and cheminformatics.

Communication Skills:
Communication skill development helps students to understand the problem, it is essential for the student to read research paper, publications and deliver seminar, listen and follow scientific viewpoint and engage with them. Due to lack of communication skill students hang behind and for the use of advancement in subject.

Critical thinking:
Critical thinking represent ability and efficiency to problem solving skill related to bioinformatics area. As bioinformatics software and algorithm do all work in automated way but sometime it is necessary to do manual manipulation and minor changes in data set for getting the much better results, like as refinement of alignment results, validation and cross checking of computed build 3D model of biomolecules.

Problem solving:
Problem solving approach shows that how students sees a problem and apply their skill and knowledge for solving them apart from this it also represent the ability to close observe the situation and apply lateral skill and computational skills. Use knowledge, understanding and skill required for identifying the problem and issue related to bioinformatics. Its engage students in laboratory work.

Analytical reasoning:
It mainly helps to evaluate the strong point and weakness in text and flows in their text. Main challenge of bioinformatics is to move from descriptive to predictive explanation of actual biomolecule function and how its function modulate when it come contact with other biomolecules. Protein-protein interaction diagram for

information flow, mapping of gene and calculation of distance between the gene on genome and prediction of all possible interaction between the biomolecules are the some example of this

Research-related skills:
Research skill involve investigating, interpreting, organizing information, reviewing and paraphrasing information, collecting data, searching and managing information sources, observing and interpreting, which can be done by the minor project (Graduation level), dissertation(Master level). It helps student to generate new knowledge through research so they can broad their point of view toward research. Bioinformatics researchers develop systems to gather data. Examples include constructing a survey methodology, designing a clinical trial for a new medication, and programming a statistical model for population growth.

Cooperation/Team work:
Collaboration, cooperation and realizing the power of groups and community and ability to work in group not even in local group but also at the global level helps to achieve the aim because the planning and management is the main factor to achieve objectives. High level research requires intensive interaction among the different candidate who is involve in research. Its also help to understand the idea and to turn idea into the required action related to required method, mechanism or process.This also help to develop social skill to interact others and make them to work in challenging environment.

Scientific reasoning:
It provides ability to analyze texts, evaluating ideas and scientific strategies, formulate logical and convincing arguments. The main advantages of using logic to represent scientific knowledge provide an better understanding for creating a new paradigm for solutions. But using of scientific knowledge has ever been represented using logic is very little or only using in limited filed.We can easily understand the importance of reasoning as the part of research on the basis of some important point: what this experiment is for? what is the general output of this experiment? how is this experiment related to your study or how could it benefit you?This skill is important because it is found that students, beginners of research make mistakes in case of selection the right technique and methodology or experiments for getting desired result.

Reflective thinking:

It is Ability to locate oneself and see the influence of location—regional, national, global— on critical thinking. It helps to understand broader concept or can say is the simple thinking can be define consciously thinking about and analyzing:
what you are currently doing, what you have previously done, what you have experienced, what and how you have learned.It is a notion of awareness of one's knowledge, assumption and previous experience they got.Previous learning and experience provide the context to thoughts, and are therefore unique for students, but reflective thinking is a dynamic process that continues to develop and evolve in learning and respond to new experiences, situations, events or information

Information/digital literacy:
Ability to use digital sources, and apply various platforms to convey and explain concepts of bioinformatics, digital literacy enables using computers and computation approaches and appropriate software for analysis of genomics and proteomics data, and employing modern techniques of bioscience and searching tools to locate, retrieve, and evaluate location and biological annotation genes of different species genomes. As research going on at world wide a lot of biological data is accumulated and now it is necessary to proper management and its processing so new information can be discover. Using of computational biology for development of new and robust algorithm for the identification and processing of new data for getting desirable results.

Self-directed learning:
Self-directed learning show the awareness in the form of work independently, identify appropriate resources required for a project and manage a project through to completion. It is found that many of students are more dependent than self-directed. Generally self-directed learning comes with a good set of learning skills. They are essential but all are not necessary. Students should think and believe that they can get these skills and using them to make a difference.

Multicultural competence:
Ability to engage with and understand cultures of various nations and respect and transcend differences.It Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. It can also be define that to develop sensitivity among students through the discipline of Psychology so that they can perceive and sensitize themselves to the enrichment present among various cultures and ethnic groups in the place of work, home, neighborhoods and the world at large.

Moral and ethical awareness/reasoning:
Graduation is an inter-junction between formal school and the place of work, hence it is important to foster moral and ethical outlook in their academic as well as real life. It's define ability to embrace moral/ethical values in conducting one's life, formulates a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work

Avoid unethical behavior:
Unethical behavior simply the opposite of doing right things. In the workplace or school unethical behavior certainly includes any deeds that violate the law, such as theft or violence of the college rules. But unethical behavior can involve much broader areas as well, such as ragging of juniors, fighting or misbehave with faculties, Allowing another person to do one's work and submitting it under one's own name, Using unauthorized notes, or study aids, or information from another student or student's paper on an examination.

Leadership readiness/qualities:
Develop leadership skills as a result of extensive practical and research related work undertaken at the graduate level. Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. It also involves lead group discussion, to formulate questions related to scientific and social issue.

Lifelong learning:

Ability to retain and build on critical thinking skills, and use them to update scientific knowledge and apply them in day to day business and also to acquire knowledge and skills, including learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and

cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development.

1.3.2 Qualification descriptors:

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification (for eg. a bachelor's degree or a bachelor's degree with honors). The qualification descriptors also describe the academic standard for a specific qualification in terms of the levels of knowledge and understanding, skills and competencies and attitudes and values that the holders of the qualification are expected to attain and demonstrate.These descriptors also indicate the common academic standards for the qualification andhelp the degree-awarding bodies in designing, approving, assessing and reviewing academic programmers. The learning experiences and assessment procedures are expected to be designed to provide every student with the opportunity to achieve the intended program learning outcomes. The qualification descriptors reflect both disciplinary knowledge and understanding as well as generic skills, including global competencies that all students in different academic fields of study should acquire/attain and demonstrate.

Following points may serve as the important qualification descriptors:

- Knowledge of diverse method and concept use in bioinformatics
- Understand of bioinformatics database and concept
- Advance concept which can help to solve the research related problems
- Generate the new data by the processing the previous data for getting better results.
- Ability to use the previous knowledge and concept though minor projects.
- Improve the ability of biostatistics and biomathematics concept for making new desired concept.

1.3.3 Programme learning outcomes

The course start form explaining the basic concept related to sequence is sequence alignment of from the simple multiple sequence to multiple complex form. The course not only limited to sequence base study but latter ahead describes by a

result of the sequence alignment can be use as a input form in different concept like phylogenetic analysis. Further information related to various databases during the course also provided, various database like genome database, protein database, rna database and protein 3D structure databases. Latter in curriculum different proteomics and genomics techniques also kept in which various computational approaches are mentioned which helps to solve the problem like molecular interaction study and molecular modeling.

1.3.4 Course learning outcomes:

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

- Understand what is bioinformatics and where it can be used and the type of biological problem can be solve by the applying of bioinformatics knowledge.
- Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
- Existing software effectively to extract information from large databases and to use this information in computer modeling.
- Problem-solving skills, including the ability to develop new algorithms and analysis methods
- An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries
- Discuss the technologies for modern high-throughput DNA sequencing and their applications so use and describe some central bioinformatics data and information resources.
- Describe principles and algorithms of pairwise and multiple alignments and sequence database searching perform pattern matching of biomolecular sequences and basic principles of hidden Markov models and their application in sequence analysis.
- Describe how evolutionary relationships can be inferred from sequences (phylogenetics) and describe the most important principles in gene prediction methods.

1.4 Assessment methods

The assessment of students' achievement in Bioinformatics will be aligned with the course/programme learning outcomes and the academic and professional skills that the programme is designed to develop. A variety of assessment methods that are appropriate within the core area of bioinformatics will be used. The assessment strategy adopted within the BSc Bioinformatics aims to test subject knowledge, independent thought and skills acquisition and to provide information about candidates that will be useful to employers.Formative assessment is provided during practical classes where students can apply knowledge from lectures as well as seek guidance on practical skills. Students are also encouraged to ask questions during lectures to clarify issues, or even develop ideas derived from lecture material. Lecturers will also set aside time for workshops and seminars focused on key subjects.

- Demonstrating knowledge and understanding by written examination, oral examination, essay and report.
- Computation, taking readings, using equipment, following laboratory procedures, following protocols, carrying out instructions.
- Communicating (One and two-way communication; communication within a group, presenting; using specific written forms) by written presentation (essay, report, reflective paper etc.), oral presentation, group work).

SECTION B

Detailed Syllabus based course learning outcome

B.Sc. Ist Year

Paper I: BI **101: INTRODUCTION TO BIOINFORMATICS**

Unit	Unit Description	Learning outcome
I	Definition, History, Branches of Bioinformatics, Aims, Scope & research Areas, Human genome project, Role of computer in Bioinformatics, Bioinformatics in India, BlO-IT-The Flourishing future. Application of bioinformatics.	• This allied paper introduces the students to concepts in bioinformatics and student will be able to apply basic principles of biology, computer science and mathematics to address complex biological problems.
II	Introduction to genomics & proteomic data, Post genomics era, Data acquisition — functions and purposes, Biological databases-relational and object orient concepts. Information retrieval, concepts of digital libraries, information retrieval from biological databases EN3"REZ-SRS, Methods for presenting large quantities of data, sequence viewer, structure viewer, RASMOL, ligand explorer.	• Students will able to discuss how biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells. • Students will able to understand working mechanism of different biological database, and which type of system works for retrieving information from databases.
III	Primary & Secondary Data Base, gene banks, ENBC nucleotide, sequence data bank- DDBJ-RNA sequence data bases: 165 & 23 rRNA, Mutation data bases, HIV sequence data base, NON CODE sequence submission tools, sequin, webin, sqkura, bank etc,	• Demonstrate an understanding of biological and computer science concepts and develop an insight into scientific methodology, advances in bioinformatics research and related ethical issues. • Demonstrate the ability to work effectively and interactively in teams in order to accomplish a common goal. • Understanding of current technology trends as well as future directions and recognizes the need and develops the necessary skills for continued professional development.
IV	Protein sequence data bases — PIR, SWISSPROT, UNIPROT-TrEMBL,	• After successfully completing this unit, student will able to understand:

	EXPASY,NCBI,Protein, Databases— PRF, UNIPROT-MIPS-O/P-protein sequence motif database, E blocks- eblocks-PROSITE, PROTEIN DOMAIN, databases, ADDA, INTERPRO, Pfame-protein	• Practical and theoretical knowledge in protein databases. • Knowledge about common workflows for the large-scale analysis of proteins. • Student will be able to describe the development of Omics technologies, with emphasis on genomics and proteomics.
V	PDB-PDBSum SCOP-CATH-MMDB-EMSD-SWISS MODEL repository-ModBase-Protein MODE1 portal, Eurocarb DB-DIP-BNND, STRNG	• Student will able to understand synthesize information to discuss the key technological developments that enabled modern genomic and proteomic studies, to describe advanced genomics and proteomics technologies and the ways in which their data are stored, describe the different types of genome variation and their relationship to human diseases. • Student will learn about different software which are using for protein designing to protein-protein interaction network.

Paper II: BI 102: CONCEPTS IN BIOINFORMATICS

Unit	Unit Description	Learning outcome
I	Introduction, sequence alignment, Scoring matrix , PAM BLOSUM, Gaps and Gap penalties, Different Gap weights, Biological significance of Gaps.	• Student will be able to understand describe an algorithm for exact global multiple alignment under a sum of pairs score, prove that a heuristic star alignment is a good approximation for global multiple alignment. • To understand different principal of software and process use for solving biological problems.
II	Pairwise sequence alignment, DotPlot analysis, Dynamic programming, Needleman-Wunch algorithm, Smith-Waterman algorithm, Edit distance dynamic programming, Database similarity search, BLAST, FASTA. Multiple sequence alignment, sum of pairs, Divide and Conquer, Progressive and Iterative alignment, ClustalW, TCPFFEE, Profile methods, Gribskov profile, PSI BLAST.	• Student will be able to understand and perform several possible heuristic progressive multiple alignment solutions, several approaches for aligning a sequence to a multiple alignment. • Student will learn how sequence aligns with more than two to alignments with each other. • The difference between local and global multiple alignment. • Several approaches for solving the local multiple alignment problem
III	Phylogenetic relationships, Clustering and Phylogeny, Phylogenic analysis, Concept of Phylogenetic Tree, Methods of Phylogeny analysis, Distance and character based methods, Motif detection, Protein family databases.	• Student will be able to understand what true phylogeny is and how can perform phylogenetic analysis among various species if their genome is available. • Student will be able to understand the actual mechanism of phylogenetic analysis. • Student will be able to perform different software for phylogenetic analysis. • They will be also understand the difference between the rooted and unrooted tree.
IV	Data mining, Introduction, Definition, Data mining problems, Cluster analysis, Data mining techniques, Tools and Methods. Management of Databases. DBMS, Difference	• Student will be able to understand Data Warehouse fundamentals, Data Mining Principles, Identify appropriate data mining

	between DBMS and file system.	algorithms to solve realworld problems, Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule of mining. • Understand the fundamentals of a database systems, Design and draw ER and EER diagram for the real life problem, Understand the concept of transaction, concurrency and recovery.
V	Metabolic pathway database (KEGG pathway database), Concept of Metabolome and Metabolomics, Drug discovery and Design, Target identification , Target validation, Lead identitication, Lead Optimization, Preclinical Pharmacology and Taxology, Chemoinformatics tools for Drug discovery, Chemical structure representation(SMILE & SMART), Chemical databases : CSD, ACD, WDI, Chembank, PUBCHEM.	• Student will be able to understand basic concept of metabolomics and what is the basic difference between metabolites, metabolome and metabolomics. • They will also understand the basic difference between primary and secondary metabolites. • Student will be able to understand the basic concept of drug design and the entire process of drug designing and how bioinformatics.

B.Sc. II[nd] Year

Paper I:BI 201: INTRODUCTION TO COMPUTERS AND PROGRAMMING

Unit	Unit Description	Learning outcome
I	Overview and function of computers, Characteristics of computers, History of Computers, Evolution. Generation of Modem Computers, Classification of Computers, Micro-computers, Mini computers, Main Frame, Super computers, Special purpose computer (Comparison in their memory, power, cost and Size), PC types, Tower, Desktop, Notebook, Laptops, Handheld, Palmtop, PDA, Types of Modern Computers, Workstations, Servers	• This is a skill based paper that introduces the students to the basics of computer operations, • Students will have knowledge of both hardware and software. • Students will understand the use of computers for various applications
II	Components of a computer, Input devices, Output device, CPU, Memories (RAM and ROM), Secondary storage devices, Hard Disk, Magnetic tapes, Zip drives, Digital tapes, CU- llOM, DVD, BluRay, Number system , introduction, Decimal , Binary, Octal, Hexadecimal number systems and their inter conversion.	• Students will understand the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming, Apply standard statistical inference procedures to draw conclusions from data. • Student will be able to understand different storage devices and how these devices play role in the functioning of computer.
III	Hardware and Software definitions, Inlroduction to O/S, Functions, Classification real time, slngle user single task, single user multi task, Basic description about DOS, WINDOWS, Windows server NT/2000, UNIX/LINUX, MVS, Overview of Software development. Software development phases, problem definition, analysis, algorithm design and representation, coding and debugging (simple description about each phase).	• Student will be able understand the fundamental hardware components that make up a computer's hardware and the role of each of these components, and understand the difference between an operating system and an application program, and what each is used for in a computer. • Students will understand how a operating system will provide a communication gateway between machine and human, and helps human to understand which types of function can be performed by machine.

IV	Basic flowchart symbols and their meaning, Pseudo codes, definition and importance, Syntax and Semantics, Programming approaches, Procedural, Object oriented programming languages, Definition, categories, low level languages, Machine language, Assembly language, Advantages and disadvantages, High level languages, Advantages and disadvantages, Interpreters, Compilers and Translators, Overview of compilation process, Types of High level languages. Introduction to Pearl.	• Student will be able to understand and describe some examples of computers and state the effect that the use of computer technology has had on some common products, and Using computers at user level, including operative systems and programming environments. • Student will know different types of language which uses for designing the software according to requirement.
V	Multimedia, Introduction, Characteristics, Elements and Applications, The internet and its resources, World Wide Web(WWW), Associated tools, services, resources and various terminologies, An overview of Computer viruses, virus definitions, symptoms, transmission, danger and general precautions	• Student will be able to design basic business web pages using current HTML/CSS coding standards. • How to install, configure, and remove software and hardware. • How to Analyze, compression techniques and file formats to determine effective ways of securing, managing, and transferring data

Paper II: BI 202: STRUCTURAL BIOINFORMATICS

Unit	Unit Description	Learning outcome
I	Nucleic acids — DNA and RNA, Protein-Primary, secondary, tertiary and quaternary structures, Amino acids, Ramchandran plot.	• Demonstrate a proficiency in developing relevant biochemical questions, carrying out laboratory investigations to answer those questions, and critically analyzing, interpreting, and presenting in oral and written form the results of their experiments. • What is critically analyze, interpret and discuss data, hypotheses, results, theories, and explanations found in the primary literature, applying knowledge from Chemistry and Biology.
II	Protein-Protein, Protein- Nucleic acid, Protein- Carbohydrates, Structure of Ribosome.	• Through this course the students are exposed to importance of biological macromolecules interaction and how this information can be apply to solve different biological challenges. • This study influence and play role in structure identification and reactivity of biomolecules.
III	Overview of experimental techniques to study macro molecular structure, Methods to study 3D structure — X-ray, NMR, Cryo electron microscopy, Microarray., MALDI-TOFF	• Explain the theoretical aspects of key analytical techniques and instruments used in geochemistry, including but not limited to electron microscopy, X-ray diffraction, mass spectrometry and spectroscopy (including synchrotron techniques). • Design an analytical work-flow to acquire data and achieve the research objectives of their project.
IV	Proteomics, Homology modelling, Protein tertiary structure, Prediction, Methodology	• Process data from the chosen instruments and demonstrate understanding of the limitations and quality of the data. • Justify the approach taken to data processing. • Write a clear and concise justification and description of the molecular modeling employed, suitable for publication in a scientific journal.
V	Introduction, Genome mapping, assembly annotative and comparison, Comparative Genomics, Free of life and some completed Genomics, Drug research in the era of Genome sequencing.	• The student will gain a basic understanding on human genetics and hereditary. • This course aims to provide the knowledge and practical skills of functional genomics.

		• At the end students will have the necessary learning to radically advance our understanding of life and transform medicine.

B.Sc. III[rd] Year

Paper I: BI 301: BIOSTATISTICS

Unit	Unit Description	Learning outcome
I	Biostatistics: Definition, standard terms, population sample, unit, variable, parameters, limitations and uses of statistics.	• Demonstrate familiarity with intermediate statistical theory and methods. • Students will understand Statistical Inference, Linear Regression, Categorical Data Analysis. • Learn to use Modern Causal Methods, Epidemiology, Longitudinal Data Analysis, and Survival Analysis.
II	Data and its collection, classification of data, purpose of classification, advantages, types of classification, Tabulation of data, Objectives of tabulation, rules of tabulation, Difference between classification and Tabulation, Diagrammatic presentation of data, Line diagram, Bar diagram, Percentage bar diagram, Pie diagram, C raphical representation of data, Histogram, Frequency curve, frequency polygon, Olives.	• Students will know formulation and perform a descriptive and inferential analysis of a public health or other health sciences study. • By the using statistical software. Reshape data for analysis using a programming or statistical language.Interpret the findings from a moderately complex analysis. • Will able to Demonstrate familiarity with core content of at least one area in health sciences: for example- genetics.
III	Mean, Mode, Median and their merits, Mean deviation, measures of dispersion, Range, Standard deviation and its relative measures, Probability, Distribution, Basics of Binomial, Poisson and Normal distribution and their applications to Biology.	• Understand and be able to address ethical, regulatory and practicalaspects of human subjects research including human subjects protections and IRB requirements. • Student will understand and Demonstrate competence in collaborative research in at least one area of public health or health sciences.
IV	Concepts of correlation, coefficient of coi relation, Types of correlation, Scatter diagram Of Dot diagram method, Kar Pearson's coefficient of correlation, Spearman's rank correlation coefficient, Probable error in correlation, Regression: meaning, linear regression, regression coefficient and its properties, Regression equations, Fitting, Prediction, Difference between correlation and regression.	• Student will capable of self directed learning of unfamiliar statistical methods and written and oral presentation of results/findings. • Recognize when and why statistical tests are needed. Specify null and alternative parameters based on a question of interest, defining relevant parameters. • Demonstrate an understanding of the concept of statistical significance. Recognize that the strength of evidence

		against the null hypothesis depends on how unlikely it would be to get a statistic as extreme just by random chance, if the null hypothesis were true.
V	Test o1" significance, Null hypothesis, alternative hypothesis, simple hypothesis and composite hypothesis, two types of errors, single tail and two tailed test, Large sample test, Test of significance of a single mean and difference between two means, Student's "t" test, test of significance of a single mean and difference between means when n=nt and n / n2, Chi square test for goodness of fitness, Analysis of variance, meaning, assumptions, one way classification and two way classification (simple problems)	• Student will able to Recognize a significance level as the tolerable chance of getting a false positive (making a Type I error). • They will able to explain the problem of multiple testing and publication bias. • Recognize that statistical significance is not always the same as practical significance,Make a less formal statement about the strength of evidence in a p-value.Use the normal or t-distribution, the standard error formulas, and the formula (statistic - null value)/SE to calculate a p-value for tests for means, difference in means, proportions, difference in proportions, correlation, and slope.

Paper II: BI 302: MATHEMATICS FOR BIOLOGICAL SCIENCES

Unit	Unit Description	Learning outcome
I	Basic series and series AP, standard AP, Sum of first n terms of AP,GP, standard GP, sum of n terms in GP, geometric mean, HP, Basic logarithmic and exponential series.	• Student will gain knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. • Student will know existing software effectively to extract information from large databases and to use this information in computer modeling. • This will help to enhance problem-solving skills, including the ability to develop new algorithms and analysis methods
II	Sets, inverse of a matrix, matrix method, Cramer's rule, vectors, addition and subtraction, dot product, cross product, gradient, divergence, curl.	• An understanding of the intersection of life and information sciences, the core of shared concepts. • Help to students in language and sharp their skills which make them able to speak the language of structure-function relationships, information theory, gene expression, and database queries.
III	Differentiation and Integration, concept of limit, continuity, differentiation, maxima and minima, introduction to partial differentiation, integral calculus, definite integral.	• Calculus II for Biologists, within the context of biological questions a student will be able, using hand computation and/or technology as appropriate. • Analyze first-order difference equations and first-order differential equations and small systems of such equations using analytic, graphical, and numeric techniques, as appropriate.
IV	Errors in computer arithmetic, normalization, polynomial interpolation, solution of non-linear equations, Errors, convergence of solutions, Iterative methods for system of linear equations, Numerical differentiation and integration.	• Analyze basic population models, including both exponential and logistic growth models. • Solve integration problems using basic techniques of integration, including integration by parts and partial fraction.
V	Trigonometric ratios, De Molvre's theorem, the general equation of a straight line, slope of a line, intercept of a line, angle between	• Solve basic problems in probability theory, including problems involving the binomial, geometric, exponential,

	two lines, intersection of two lines, The general equation of a circle.	Poisson, and normal distributions. • Student will able to Estimate basic population parameters, and perform basic hypothesis test.

Department of Biotechnology

Class: B.Sc. First Year
Paper: Cell Structure & Biology

Unit	**Course Content**	**Course/Learning Outcomes: -** After completion the course the students will be able to-
Unit I	Cell Structure & Theory	Structure of Prokaryotic cell, Eubacteria and Archaebacteria, Gram's negative & Gram's positive cell, Difference between Plant & Animal Cell
Unit II	Prokaryotic & Eukaryotic Cell	Structure & Function of bacterial cell- Different Cell Organelles Structure & Function of Eukaryotic Cell – Different Cell Organelles
Unit III	Cell Cycle & Cell Division	Mitosis, Meiosis, Anomalies in cell division and associated diseases, Cell synchrony, Cell-Cell interaction, Cell locomotion, Cell differentiation
Unit IV	Transport Process	Cell Membrane, Models of membrane structure, membrane proteins & their Properties, Membrane carbohydrates & their Properties, Transport Across membrane
Unit V	Necrosis & Apoptosis	Senescence, Apoptosis, Mechanism of Apoptosis, Apoptosis in relation to Cancer, Oncogenes- Types of Cancer

Class: B.Sc. First Year
Paper: Microbiology

Unit	Course Content	Course/Learning Outcomes: - After completion the course the students will be able to-
Unit I	Introduction to Microbiology	History, Application & Status of Microbiology in India, Classification of Microorganisms, Systems of Classification, Microbial Taxonomy, Classification & Identification of Bacteria, Bergey's Manual
Unit II	Bacteriology	Structure & Diversity of Bacteria, Virus, Microbes in Extreme environment, Nutritional requirement of microbes, Morphology and ultra structure of bacteriomorphological types, Archaebacteria
Unit III	Structure & Diversity of Microbes	Structure & Diversity of Algae, Fungi, Protozoans, Mycoplasmas and Extremophiles, different staining techniques
Unit IV	Microbial Growth & Control	Mathematical expression of growth, Growth Curve, factors affecting growth, batch, continuous, synchronous & diauxic growth, quantification of microbial growth, physical & chemical control of microorganisms, evaluation of chemical disinfectants
Unit V	Microbial Nutrition & Metabolism Fermentation Process	Concept of Anabolism & Catabolism processes, nitrogen fixation, Microbial disease in plants and animals Fermenter & its microbes of industrial importance

Class: B.Sc. Second Year
Paper: Biophysics & Biochemistry

Unit	Course Content	Course/Learning Outcomes: - After completion the course the students will be able to-
Unit I	Thermodynamics	Thermodynamic system, equilibrium, thermodynamic laws and their applications, different types of processes, thermodynamic variables and entropy, thermodynamic potential and relation, Maxwell's Equation, Fundamental equation of heat flow.
Unit II	General Biophysical Methods	Measures of pH, radioactive labelling & counting, Autoradiography, diffusion, sedimentation, osmosis, viscosity, factors influencing them & their application in biology
Unit III	Fundamentals of Biochemistry	Axioms of living matter, major organic compounds of animate objects a general view, chemical elements, structure of atoms, molecules and chemical bonds, ionic, covalent, coordinate & hydrogen bonds, water as universal solvent, acids, bases and salts
Unit IV	Biomolecules	Introduction & Occurrence, classification, properties, importance of carbohydrates, lipids, proteins & Nucleic acids
Unit V	Enzymes	Structure, Classification and function of enzymes, mechanisms of enzyme action, Allosteric enzymes, holoenzymes

Class: B.Sc. Second Year
Paper: Bioinstrumentation, Biostatistics & Bioinformatics

Unit	Course Content	Course/Learning Outcomes: - After completion the course the students will be able to-
Unit I	Microscopy & Centrifugation	Light, phase contrast, fluorescence and Electron microscopy Centrifugation techniques, principle, types & separation of biomolecules
Unit II	Chromatography & Electrophoresis	Principle & application of electrophoresis and chromatography, Immuno electrophoresis, different blotting techniques
Unit III	Spectroscopy & Colorimeter	Principle & application of Spectroscopy and colorimeter, Radio and Non radio labeling
Unit IV	Biostatistics	Collection and Classification of data summarization and presentation of data, Arithmetic mean, median, Standard deviation, probability, binomial probability distribution
Unit V	Computers & Bioinformatics	Organization of hardware, software, languages, internet application Search Engines, Biological database, cluster database, database technologies, structural database

Class: B.Sc. Third Year
Paper: Molecular Biology & Genetic Engineering

Unit	Course Content	Course/Learning Outcomes: - After completion the course the students will be able to-
Unit I	Structure of DNA & RNA	Chemical structure of DNA & RNA, Types & Properties, Genome, DNA Replication, Replicons
Unit II	Eukaryotic chromosomal Organization	Euchromatin, heterochromatin, chromatin structure, nucleosomes, histone & non histone proteins, epigenetics
Unit III	Origin of Life & Mendelian Genetics	Classical experiments & current concepts, evolution of biological macromolecules, mendelian genetics, chromosomal analysis, allelic variation, linkage and crossing over
Unit IV	Recombinant DNA Technology	rDNA technology, scope & importance, gene cloning, PCR, Restriction endonucleases, Vectors for DNA transfer, plasmids, Phagemids, cosmids, BAC, Gene amplification
Unit V	Mutation & Gene Expression	Types of mutation, transcription, translation and gene expression in eukaryotes, alternate splicing

Class: B.Sc. Third Year
Paper: Applied Biotechnology

Unit	**Course Content**	**Course/Learning Outcomes: -** After completion the course the students will be able to-
Unit I	Microbial Biotechnology	Food Microbiology, food preservation, Industrial production of Ethyl alcohol, Penicillin, Cyanocobalamin, Glutamic acid, Citric Acid, Amylase, Protease
Unit II	Plant Biotechnology	Plant Tissue culture, Nutritional Requirement, In vitro culture, Single cell culture, another culture, ovule culture, somatic embryogenesis, organogenesis, protoplast culture, somatic hybridization
Unit III	Immunology & Animal Biotechnology	Infection, Organ & Cells of immune system, Vaccines, Antigens, Immunoglobulins, ag-ab reactions Animal cell culture, Physical requirements, growth curve, differentiations of cell, organ culture, animal biotechnology, Selectable markers, HAT selection, transgenic animals, bioreactor for large scale production
Unit IV	Fermentation Technology	Primary & secondary screening, Strain improvement, inoculum development, sterilization process, scale-up and harvesting and recovery Different types of culture processes, submerged and solid-state fermentation, fermentor design, Types of fermentor
Unit V	Environment Biotechnology	Basic concept of environment, significance, public awareness, environmental pollution and its treatment, Biopesticides, biofuels, biofertilizers, bioremediation and biodeterioration

LOCF
Learning Outcome Based Curriculum frame work
Adopted by UGC

Department of Computer Science & Application

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION/ POSTGRADUATE EDUCATION BASED ON BLOOM'S TAXONOMY AND REVERSE BLOOM'S TAXONOMY.

SECTION A

1.1 Introduction

A high priority task in the context of future education development agenda in India is fostering quality higher education. Further improvement of quality of higher education is considered critical for enabling effective participation of young people in knowledge production and participation in the knowledge economy, improving national competitiveness in a globalized world and for equipping young people with skills relevant for global and national standards and enhancing the opportunities or social mobility. Sustained initiatives are required for institutionalizing an outcome-oriented higher education system and enhancing employability of graduates through curriculum reform based on a learning outcomes-based curriculum framework, improving/upgrading academic resources and learning environment, raising the quality of teaching and research across all higher education institutions; technology use and integration to improve teaching-learning processes and reach a larger body of students through alternative learning modes such as open and distance learning modes and use of MOOCs.

Other priority areas of action for fostering quality higher education include translation of academic research into innovations for practical use in society and economy, promoting efficient and transparent governance and management of higher education system, enhancing the capacity of the higher education system to govern itself through coordinated regulatory reform and increasing both public and private sector investment in higher education, with special emphasis on targeted and effective equity- related initiatives.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution

The learning outcomes-based curriculum framework for undergraduate education is a framework based on the expected learning outcomes and academic standards that are expected to be attained by graduates of a program of study and holder of a qualification. The key outcomes that underpin curriculum planning and development at the undergraduate level include Graduate Attributes, Qualification Descriptors, Program Learning Outcomes, and Course Learning Outcomes. The overall objectives of the learning outcomes-based curriculum framework are to:

- Help formulate graduate attributes, qualification descriptors, program learning outcomes and course learning outcomes that are expected to be demonstrated by the holder of a qualification;

- enable prospective students, parents, employers and others to understand the nature and level of learning outcomes (knowledge, skills, attitudes and values) or attributes a graduate of a program should be capable of demonstrating on successful completion of the program of study;
- maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility; and
- provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programs and academic standards.

- **Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate program of study.
- **Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
- **Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
- **Problem solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
- **Analytical reasoning:** Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesis data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
- **Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.
- **Cooperation/Team work**: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
- **Scientific reasoning:** Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
- **Reflective thinking:** Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
- **Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources;

and use appropriate software for analysis of data.

- **Self-directed learning:** Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
- **Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
- **Moral and ethical awareness/reasoning:** Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
- **avoid unethical behavior:** While studying, one hardly has to think of ways to prevent unethical behavior in the workplace. But from the students' point of view, it is very important to have a cordial atmosphere between a teacher and a student, but very important in the basic purpose of education. It happens
- **Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.
- **Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

1.3.1 Qualification descriptors

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification (for eg. a bachelor's degree). The qualification descriptors also describe the academic standard for a specific qualification in terms of the levels of knowledge and understanding, skills and competencies and attitudes and values that the holders of the qualification are expected to attain and demonstrate. These descriptors also indicate the common academic standards for the qualification and help the degree-awarding bodies in designing, approving, assessing and reviewing academic programs. The learning experiences and assessment procedures are expected to be designed to provide every student with the opportunity to achieve the intended program learning outcomes. The qualification descriptors reflect both disciplinary knowledge and understanding as well as generic skills, including global competencies, that all students in different academic fields of study should acquire/attain and demonstrate.

Qualification descriptors for a Bachelor's Degree program:

Qualification descriptors for a Bachelor's Degree program: The students who complete three years of full-time study of an undergraduate program of study will be awarded a Bachelor's Degree. Some of the expected learning outcomes that a student should be able to demonstrate on completion of a degree-level program may include the following:

- ✓ Demonstrate (i) a fundamental/systematic or coherent understanding of an academic field of study, its different learning areas and applications, and its linkages with related disciplinary areas/subjects; (ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of study, including research and development, teaching and government and public service; (iii) skills in areas related to one's specialization and current developments in the academic field ofstudy.
- ✓ Use knowledge, understanding and skills required for identifying problems and issues, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, and their application, analysis and evaluation using methodologies as appropriate to the subject(s) for formulating evidence-based solutions and arguments;
- ✓ Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the subject(s);
- ✓ Meet one's own learning needs, drawing on a range of current research and development work and professional materials;
- ✓ Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts, rather than replicate curriculum content knowledge, to identify and analyze problems and issues and solve complex problems with well-defined solutions.
- ✓ Demonstrate subject-related and transferable skills that are relevant to some of the job trades and employment opportunities.

1.3.2 Program learning outcomes

The outcomes and attributes described in qualification descriptors are attained by students through learning acquired on completion of a program of study. The term program refers to the entire scheme of study followed by learners leading to a qualification. Individual programs of study will have defined learning outcomes which must be attained for the award of a specific certificate/diploma/degree. The program learning outcomes are aligned with the relevant qualification descriptors.

Program learning outcomes will include subject-specific skills and generic skills, including transferable global skills and competencies, the achievement of which the students of a specific program of study should be able to demonstrate for the award of the certificate/Diploma/Degree qualification. The program learning outcomes would also focus on knowledge and skills that prepare students for further study, employment, and citizenship. They help ensure comparability of learning levels and academic standards across colleges/universities and provide a broad picture of the level of competence ofgraduates of a given program of study. A program of study may be monodisciplinary, multi- disciplinary or inter-disciplinary.

1.3.3 Course learning outcomes:

The program learning outcomes are attained by learners through the essential learnings acquired on completion of selected courses of study within a program. The term 'course' is used to mean the individual courses of study that make up the scheme

of study for a program. Course learning outcomes are specific to the learning for a given course of study related to a disciplinary or interdisciplinary/multi-disciplinary area. Some programs of study are highly structured, with a closely laid down progression of compulsory/core courses to be taken at particular phases/stages of learning. Some programs allow learners much more freedom to take a combination of courses of study according to the preferences of individual student that may be very different from the courses of study pursued by another student of the same program. Course-level learning outcomes will be aligned to program learning outcomes. Course- level learning outcomes are specific to a course of study within a given program of study. The achievement by students of course-level learning outcomes lead to the attainment of the program learning outcomes. At the course level, each course may well have links to some but not all graduate attributes as these are developed through the totality of student learning experiences across the years of their study.

1.4 Assessment methods:

A variety of assessment methods that are appropriate to a given disciplinary/subject area and a program of study will be used to assess progress towards the course/program learning outcomes. Priority will be accorded to formative assessment. Progress towards achievement of learning outcomes will be assessed using the following: time-constrained examinations; closed-book and open-book tests; problem based assignments; practical assignment laboratory reports; observation of practical skills; individual project reports (case-study reports); team project reports; oral presentations, including seminar presentation; viva voce interviews; computerized adaptive testing; peer and self- assessment etc. and any other pedagogic approaches as per the context .

SECTION B

Detailed Syllabus based course learning outcome

Education means developing such creative thinking among the students by which they will create employment for themselves and for the society. In the B.Sc. Computer Science program, we focus on various subjective approach, in which students are studying computer science as well as Statistics Physics, Electronics Maths and other subjects. In order to impart technical knowledge to the students, computer science subject is intensively studied. The subject of Computer Science and application is shown in the following table (1) and (2). we are offering different subject at UG level

B.Sc. 1St year (Computer Science)

Paper I: Fundamental Computers

Unit	Topic	Outcome
Unit - 1	Computer Fundamental	After studying this unit students will: • Understand the basics of computer design • Understand hardware's and software's of computer • Understand the applications of computer science
Unit - 2	PC Application Software	After studying this unit students will: • Learn basics of application Software. • Understand working process of software. • To understand the difference between system software and application software
Unit - 3	Number System	After studying this unit students will: • Understand the basic concept of computer number system. • Learn different types of computer languages • Understand the computer binary, octal and hexadecimal codes.
Unit - 4	Computer Memories	After studying this unit students will: • Understand the primary and secondary memory of computer • To Understand concepts of memory management • Learn basic overview of memory concepts.
Unit - 5	Architecture of computer	After studying this unit students will: • Understand basic principle and structural operation of Architecture. • Learn the processing of microprocessor 8085 and 8086 • To understand Different types of processor generation and memory slots. • This unit will enhance the knowledge of students for the further advanced study and research.

Teaching-Learning Outcomes

B.Sc. 1St year (Computer Science)

Paper II: Programing in C

Unit	Topic	Outcome
Unit - 1	Classification of Programming language	After studying this unit students will: • Understand the basics of programming language • Enhance the knowledge of students for studying the top-down and bottom-up approach of programming languages • Understand, why a programming is essential for computer technology To understand the basic structure of program code and algorithms.
Unit - 2	Introduction to c language	After studying this unit students will: • Learn to understand the basic logics of programming aspects • Understand how declare variables in programming • Able to learn the memory occupation of bite and bye format • To understand the constant, variable, tokens and so on.
Unit - 3	Input/output operators	After studying this unit students will: • Understand the functions of c programming langue for inputting and output process of program. • Learn branching, lopping, continue, break and go to statement working flow • Also understand the formatted and unformatted inputs and outputs.
Unit - 4	Array & Pointer	After studying this unit students will: • Understand the declaration of pointer and memory management process. • Learn the working process of array.
Unit - 5	File handling in C	After studying this unit students will: • Understand the file system and memory management of programming • To learn the file access methods for create the file. • To understand graphic programming tools

Teaching-Learning Outcomes

B.Sc. 2St year (Computer Science)

Paper II: Object oriented programming concepts using C++

Unit	Topic	Outcome
Unit - 1	Introduction to C++	After studying this unit students will: • Understand the basics of programming language • Enhance the knowledge of students for studying the top-down and bottom-up approach of programming languages • Understand, why a programming is essential for computer technology To understand the basic structure of program code and algorithms.
Unit - 2	Declarations of C++	After studying this unit students will: • Learn to understand the basic logics of programming aspects • Understand how declare variables in programming • Able to learn the memory occupation of bite and bye format • To understand the constant, variable, tokens and so on.
Unit - 3	Functions	After studying this unit students will: • Understand the functions of C++ programming langue for inputting and output process of program. • Learn the private, Public and protected data member declaration • Also understand the concepts of global and local variable
Unit - 4	Constructers and Distracters	After studying this unit students will: • Understand the declaration. of Constructers and Distracters. • Learn the working process of inheritance and inherits process. • To understand the use of OPPs concepts and Class concepts
Unit - 5	Array and Pointer	After studying this unit students will: • Understand the file system and memory management of programming with Pointer • Learn how to work with array concepts

Teaching-Learning Outcomes

B.Sc. 2St year (Computer Science)

Paper II: Data Structure

Unit	Topic	Outcome
Unit - 1	Concepts of data structure	After studying this unit students will: • Understand the basics of data Structure • Enhance the knowledge of students for studying the complexity of algorithms • Understand, why a stack is used for memory management To understand the basic structure of Queue and circular Queue.
Unit - 2	Link List	After studying this unit students will: • Learn to understand the basic programming and concepts of link list • Understand how link list is different from other data structures • Able to learn the applications of link list • To understand the different designs of link lists.
Unit - 3	Tree structure	After studying this unit students will: • Understand the concepts of linear and nonlinear data structure concepts. • Learn the different types of tree data structure formations. • Also understand the applications of tree data structure
Unit - 4	Searching and sorting	After studying this unit students will: • Understand the how to search the data in memory. • Learn the working with arranging the nodes on ascending or descending order.
Unit - 5	Array and Pointer	After studying this unit students will: • Understand the graph theory and sets of data • Learn the navigation application of data structure • Understand how graph theory is essential for computer science

Teaching-Learning Outcomes

B.Sc. 3St year (Computer Science)

Paper II: Database Management System

Unit	Topic	Outcome
Unit - 1	Overview of a database	After studying this unit students will: • Understand the basics of data Structure • Of data base management system and traditional data base • Understand, the data base software and advantages of data base To understand applications of data base in different fields.
Unit - 2	Data models	After studying this unit students will: • Learn to understand the data models in different form • Understand the entities and entity relationships • Able to learn the applications data models
Unit - 3	Data base keys	After studying this unit students will: • Understand the use of data base and data base keys. • Learn the different types keys and its working • Also understand normalization process and use of key in normalization
Unit - 4	Normalization	After studying this unit students will: • Understand the how to normalize the databases • Learn the duplicate entries of database and removing anomalies of data base • Create the useful and normalize data base
Unit - 5	Hashing and indexing	After studying this unit students will: • Understand the process of storing data into data base • Learn the SQL and oracle data base for indexing and hashing • Understand how to create index and hash table in data base

Teaching-Learning Outcomes

B.Sc. 3St year (Computer Science)

Paper II: Operating System

Unit	Topic	Outcome
Unit - 1	Overview of operating system	After studying this unit students will: • Understand the basics of system software • Understand, difference between system software and application software • To understand applications operating system and working process of OS • To understand the history of OS
Unit - 2	Scheduling	After studying this unit students will: • Learn to understand scheduling process of CPU • Understand different scheduling algorithms for increasing CPU utilization • Able to learn the use of application of system software
Unit - 3	Memory management	After studying this unit students will: • Understand the concepts of segmentation and partition of memories • Learn the paging process and memory partition method • Also understand virtual memory concepts of memory management
Unit - 4	Process management	After studying this unit students will: • Understand the how to solve deadlock problem • Learn the algorithm for deadlock problem • To understand the recourse and requirement of process
Unit - 5	Linux	After studying this unit students will: • Understand the practical implantation on Linux operation system • Understand the hardware requirement of Linux • To learn Linux command shell and kernel for execution purpose

Teaching-Learning Outcomes
B.Sc. Computer Application 1st Year

Paper I: Fundamentals of Computer and PC Software (CA-101)

Unit	Topic	Outcome
Unit - 1	Introduction to Computer System	After studying this unit students will: • Understand how the units of a computer system are connected. • Understand how the CPU processes data and instructions and controls the operation of all other devices along with the components of CPU. • Identify the names, distinguishing features, and units for measuring different kinds of memory and storage devices. • Understand the difference between an operating system and an application program, and their use in a computer. • Understand the classification of programming languages and also able to differentiate between language processors.
Unit - 2	Operating System and MS Windows	After studying this unit students will: • Learn basic functions of operating system. • Understand types of various operating systems and their applications. • Get elementary idea of various common operating systems prevalent round the world. • Understand the features and functioning of MS windows. • Identify the Windows screen elements and parts of a window. • Understand the OLE features.
Unit - 3	Introduction to MS-Word, MS-Excel and MS-Power point	After studying this unit students will: • Understand the basic names and functions of the Word interface components. • Able to create, edit, save, and print documents included with text and tables. • Learn formatting of text, inserting of objects, setting a page layout and mail merge. • Learn how to use various functions and creating and applying formulas on data. • Able to create charts and graphs for pictorial representation of data. • Learn to create presentations with transitions and animation effects and performing slide show.

Unit - 4	Decision Support System, Expert Systems and Management Information System	After studying this unit students will: • Understand the importance and characteristics of DSS. • Understand the structure of decision making and identify DSS users. • Learn to provide support for various phases. • Understand characteristics and applications of MIS. • Understand the leadership role of Management Information Systems in achieving business competitive advantage through informed decision making.
Unit - 5	Internet, E-Banking and its benefits	After studying this unit students will: • Understand what the Internet is, how to access it and what it can be used for. • Learn all the protocols related to internet. • Understand the basics of internet security and terminologies related to it. • Understand about E-banking, its advantages and applications. • Learn various E-business models.

Teaching-Learning Outcomes
B.Sc. Computer Application 1st Year

Paper II: Desktop Publishing and Multimedia (CA-102)

Unit	Topic	Outcome
Unit - 1	DTP and Word Processing	After studying this unit students will: • Understand what DTP is, its importance and advantages. • Understand the DTP software and hardware. • Learn about commercial DTP packages which are used nowadays. • Learn about page layout and word processing programs. • Understand the difference between DTP and word processing software.
Unit - 2	Graphics, Fonts and Printers	After studying this unit students will: • Learn about graphics, its types and uses. • Understand about fonts and typefaces. • Understand the steps of creating fonts. • Learn about anatomy of typefaces. • Learn about all types of printers used in DTP along with plotter and scanner.
Unit - 3	PageMaker	After studying this unit students will: • Understand about PageMaker software, its history and its versions. • Learn to create a new page and setting page layout with the document setup dialog box. • Learn placing of text and graphics in document and formatting of text. • Learn to create master page and index. • Understand all the functions of control palette.
Unit - 4	Multimedia Elements	After studying this unit students will: • Understand about multimedia and its elements. • Understand the concept of plain text and formatted text. • Understand the concept of image, its types and image capturing methods. • Understand the concept of sound, its types and sound effects in multimedia. • Understand the basic concept of video and its types. • Understand the concept of animation and its principles and use.
Unit - 5	Multimedia and MIDI	After studying this unit students will: • Understand overview and features of multimedia. • Get knowledge of multimedia software tools and multimedia authoring. • Learn about various graphic file formats. • Understand the concept of MIDI and Instrume. • Learn about various MIDI devices.

Teaching-Learning Outcomes
B.Sc. Computer Application 2nd Year

Paper I: Internet and E-Commerce (CA-201)

Unit	Topic	Outcome
Unit - 1	Internet, Internet Services and E-Mail	After studying this unit students will: • Understand evolution, concept and growth of internet. • Learn about ISP and various ISP in India. • Understand various types of connectivity. • Understand about various services of internet. • Understand the concept of search engines and its types. • Understand about web server and various protocols used on the web. • Understand the concept of E-mailing, sending and receiving E-mail along with E-mail protocols, services, servers and programs.
Unit - 2	Introduction to E-Commerce	After studying this unit students will: • Understand emergence and commercial use of internet. • Understand emergence of World Wide Web. • Learn advantages and disadvantages of E-commerce. • Understand the E-commerce opportunities for industries.
Unit - 3	E-Commerce Models	After studying this unit students will: • Understand the concept of E-commerce models. • Learn the difference between various E-commerce models. • Understand the application and use of various E-commerce models. • Learn the classification of models based on relationship of transaction parties. • Learn the classification of models based on relationship of transaction types. • Learn various other E-commerce business models.
Unit - 4	E-Marketing versus Traditional Marketing	After studying this unit students will: • Identify web presence goals. • Understand browsing behavior model. • Learn the concept of online marketing and E-advertising. • Learn the trends of internet marketing. • Learn strategies of E-branding and E-marketing. • Understand difference between traditional and E-marketing.
Unit - 5	E-Security and E-Payment Systems	After studying this unit students will: • Understand the concept of information system security. • Understand E-business risk management issues.

		• Learn about environment of information security in India. • Understand the concept of digital payment and token-based E-payment system. • Understand the designing and risk of E-payment systems. • Learn about various security issues, security tools and security methods.

Teaching-Learning Outcomes
B.Sc. Computer Application 2nd Year

Paper II: Relational Database Management System (CA-202)

Unit	Topic	Outcome
Unit - 1	Evolution of Database Technology and Database System in the Organization	After studying this unit students will: • Understand the evolution of database technology. • Learn the difference between file oriented system and database system. • Understand the different architectures of database. • Understand strategic planning for database in an organization. • Learn about risk and cost factors of database in an organization.
Unit - 2	DDLC, Conceptual Database Design and Normalization	After studying this unit students will: • Understand various phases of DDLC and their working. • Learn principles of conceptual database design. • Learn terminologies related to E-R model. • Learn to draw entity relationship diagram between various entities and their attributes. • Learn the concept of functional dependency and decomposition. • Understand the Normalization process and various normal forms and various dependencies.
Unit - 3	Relational Algebra and Relational Implementation with SQL	After studying this unit students will: • Understand the relational algebra and various theoretical operations of it. • Understand the relational implementation with SQL. • Understand various database languages and their classification. • Understand about physical structure of table. • Learn various mathematical and group functions of SQL.
Unit - 4	Database Storage and Administration	After studying this unit students will: • Learn about various physical storage devices. • Learn factors of disk performance. • Learn to organize files and implementing addressing methods. • Understand the role of DBA and its functions. • Understand integrity, security and recovery of database.
Unit - 5	Components of SQL and its Queries, Set Operations and Constraints	After studying this unit students will: • Understand the components of SQL. • Learn the syntax and use of DDL, DML, DCL and TCL queries • Learn how to create, modify and delete schema. • Learn how to insert, delete and update data in table.

		• Learn how to grant and revoke permissions to user. • Learn how to control transactions of query. • Learn Set operations and Join operations. • Understand various data constraints.

Teaching-Learning Outcomes
B.Sc. Computer Application 3rd Year

Paper I: Web Designing (CA-301)

Unit	Topic	Outcome
Unit - 1	Overview of a Webpage and Basic Web Concepts	After studying this unit students will: • Understand the basic concept of webpage. • Learn about various elements of a webpage. • Understand difference between various types of sites. • Learn to create site structure. • Learn different methods for creating pages. • Learn how to publish and address a website.
Unit - 2	Basics of a Website	After studying this unit students will: • Learn about basic sections of a webpage. • Learn how to use various fonts, to change text size and to coloring text. • Learn how to write headings and its variations. • Learn how to align text in a webpage. • Learn to color background of a webpage.
Unit - 3	HTML Editors and Basic HTML Tags	After studying this unit students will: • Understand about various HTML editors. • Learn to do effective page design. • Understand how to find design ideas. • Learn about basic tags and attributes. • Learn to create ordered and unordered list. • Learn to use multiple tags on a single object.
Unit - 4	Advance HTML Tags	After studying this unit students will: • Understand about various advance HTML tags. • Learn to insert inline image, changing its size. • Learn to create a hyperlink as text and image. • Learn to create tables and adding border, cell, row, background color to tables. • Learn to use frames and adding columns to it. • Understand about how to setup a form and creating text box, radio button, submit button, etc.
Unit - 5	CSS and Adding Media to Webpages	After studying this unit students will: • Understand about CSS and its advantages. • Learn syntax of CSS. • Learn methods of applying CSS. • Learn linking and embedding sound files. • Understand about video signals and learn to embed a video file. • Learn how to registering, maintaining and maintaining a site.

Teaching-Learning Outcomes
B.Sc. Computer Application 3rd Year

Paper II: Digital Marketing (CA-302)

Unit	Topic	Outcome
Unit - 1	Introduction to Digital Marketing	After studying this unit students will: • Understand the basic concept and principles of marketing. • Understand the difference between digital and traditional marketing. • Learn visibility and its types. • Understand inbound and outbound marketing. • Learn conversion marketing and retention techniques.
Unit - 2	Internet and Website	After studying this unit students will: • Understand the concept of internet and web. • Learn about websites ant their types and parts of website. • Learn about web server, its features, process and architecture. • Understand the process of web hosting. • Learn to planning and conceptualizing a website.
Unit - 3	Understanding the Google Analytics	After studying this unit students will: • Understand about Google analytics. • Learn to setup analytics account. • Learn to add analytics code in a website. • Understand about goals and conversions. • Understand bounce rate and how to reduce it. • Learn to monitoring traffic sources.
Unit - 4	Marketing on Social Networking Websites	After studying this unit students will: • Understand about social media marketing and social network services. • Learn about viral marketing and its advantages. • Learn about Facebook and its marketing. • Learn about Twitter marketing. • Learn about LinkedIn marketing. • Learn about Video and Pinterest marketing.
Unit - 5	Search Engine Optimization	After studying this unit students will: • Understand about SEO and its importance. • Learn about Google AdWords and understand its algorithms. • Learn to create search campaigns. • Learn to create Ads. • Learn to track performance. • Learn to optimize search campaigns. • Learn to create display campaign.

Course/Learning outcomes

ELECTRONICS

Class: B.Sc. First Year

Paper I: Basics of semiconductors and devices

Units	Course content	Course/ Learning Outcomes: After completion of course the students will be able to-
Unit I	Passive Components	• Know about Concepts of Passive components & transformer and PCB circuits. • Demonstrate familiarity with basic electronics components and use them to design simple electronics circuit.
Unit II	Resonance circuits &Network theorems	• Understand how to apply ELECTRICAL CIRCUIT AND NETWORK theorems in complicated circuits • Students are able to know, how to solve numerical based on complicated network circuits.
Unit III	Semiconductor Physics	• Basic knowledge of concept of semiconductor
Unit IV	P-N Junction	• Knowledge of different types of semiconductor diodes and their applications
Unit V	Transistor	• Understand different types of transistors and their working modes.

Paper II: Electronic circuits and fundamental of Digital Electronics

Units	Course content	Course/ Learning Outcomes: After completion of course the students will be able to-
Unit I	Rectifiers and Power supply	• Know about Concepts of Rectifiers and Filter circuit & Power supply
Unit II	FET effect transistor	• Understand the concept of JFET and MOSFET and their parameters • The student will be able to utilize the knowledge of semiconductors at industrial level.
Unit III	Amplifiers	• Know about Concepts of amplifiers • . The students will be able to utilize the knowledge of different terms used in amplifiers.
Unit IV	Applications of Diodes and Transistors	• Understand the general terms used in different applications for multivibrators and Oscillators • .Uses of Oscillators in different circuits
Unit V	Basics of Digital Electronics	• Understand the Binary number system and their application in digital electronics. • Uses of binary system in Microcontroller system.

B.Sc. II Year

Paper I : Digital Electronics & Microprocessor

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Logic gates and Arithmetic circuits& Flip Flop	• Understand the Logic gates and flip flops circuits and their applications in different fields of computers.
Unit II	Logic families Counters and Registers	• Understand the different types of logic families • This study will help the students during post-graduation and competitive examinations.
Unit III	D/A and A/D converter.& Memories	• Understand the different kinds of converters and memory system.
Unit IV	Introduction to Microprocessor and instruction set of Microprocessor 8085	• Basic understanding of introduction to Microprocessor and instruction set • Application in the field of micro computers
Unit V	Interfacing devices and personal computers	• Recognize different elements of Interfacing devices • Learn the applications of input and out devices in personal computers.

Class: B.Sc. Second Year

Paper II: Operational Amplifier and Instrumentation

Units	Course content	Course/Learning Outcomes: After completion of course the students will be able to-
Unit I	Differential Amplifier Op Amp. Parameters of Op Amp.	• Know about Concepts of Operational amplifier & Applications. • This study will help the students to determine the parameter of Op-Amp.
Unit II	Applications of Op-Amp.& Signal Generators	• Understand different terminologies used in. Op-Amp .& Signal Generators
Unit III	Cathode Ray Oscilloscope and Liquid Crystal Displays	• Understand the Basic operations of CRO. • Construction of CRO • Concept of LCD • Applications of CRO in different fields
Unit IV	Measuring Instruments and Multimeters	• . Know the different kinds of Multimeters and use of Multimeters in different frequency and period measurement. • Understand the mechanism of Measuring Instrumentation Technology
Unit V	Biomedical Instrumentation ECG Fundamentals X-Rays Machine	• Students are able to. Understand the mechanism of • Biomedical instruments like ECG and X-ray machine

B.Sc III year

Paper I : Thyristors, IC Technology, Microprocessor and Electrical Motors

Units	Course content	**Course/Learning Outcomes:** After completion of course the students will be able to-
Unit I	Power Devices; UJT,SCR	• Learn the Uses of switching devices. • Understand the Working of UJT and SCR • Students are able to design device and conduct digital experiment.
Unit II	Applications of SCR	• Understand uses of SCR as a switch. • They will able to utilize this knowledge in power circuits as well as industrial area.
Unit III	IC Technology	• Understand the basic concepts of production of silicon based devices • They will learn different techniques of implantation and diffusion techniques which will be useful for making silicon crystals. • The students are able to use the applications of electronics in mathematical computation.
Unit IV	INTEL 8086 Microprocessor	• Understand the register organization, architecture description of 8086 • Utilize this knowledge in Addressing modes of 8086
Unit V	Electrical Motors	• Understand the different types of motors. • Applications of Motors indifferent field of engineering. • Students are able to recognize a variety of exciting high tech products and systems.

Paper II : Communication Electronics

Units	Course content	Course/ Learning Outcomes: After completion of course the students will be able to-
Unit I	Noise Radio wave propagation	• Understand the different types of Noise and their removal. • Understand the different types of wave propagation • Develop problem solving skills and able to use it in plasma physics.
Unit II	Modulation	• Understand the different types of Modulation. • Application of modulation in different fields.
Unit III	Generation of Frequency Modulation	• Understand the methods of Demodulation and Transmitting and Receiving systems of PCM
Unit IV	Antenna Television Engineering	• Students will be able to understand different types of Antenna • Understand the procedure of TV Transmitter and Receiver. • Utilize this knowledge during further higher studies and also during research.
Unit V	Fiber Optic Communication Wireless Communication system	• Understand the principles of Fiber Optics and Photo Detectors • Understand the role of Cellular Telephony and GSM. • Know the practical applicability of different Fiber Optics And Cellular Telephony and GSM. Students are able to demonstrate an understanding of the impact of electronics and science on society.

Course/Learning outcomes

B.Sc. Geography

B.Sc. I Year

Paper-I Physical Geography (Lithosphere)

Units	Course content	Course/ Learning Outcomes: After completion of course, the students will be able to-
Unit I	Introduction to Geography	Introduce the latest concepts in physical Geography, essentially geomorphology, to the students of geography.
Unit II	Interior of the Earth	
Unit III	Theory of Isostasy	
Unit IV	Geomorphic Agents and Processes	
Unit V	River Channel Morphology	

B.Sc. I Year

Paper-II Introduction to Geography & Human Geography

Unit	Course content	Course/ Learning Outcomes
Unit I	Definition, Nature, Objectives, Scope and development of Human Geography. Interrelation of human geography with other social sciences. Concept of areal differentiation and regional synthesis.	The paper intends to acquaint the students with distinctiveness of geography as a field of learning in social science as well as in natural science. The philosophy and methodology of the subject is discussed in such a way that students develop a keen interest in the subject and pursue it for higher studies.
Unit II	Man and Environment relations	
Unit III	Human adaptation to the environment	
Unit IV	Population	
Unit V	Human settlements	

Course/Learning outcomes
B.Sc. Geography
B.Sc. II Year
Paper-I Physical Geography (Atmosphere and Hydrosphere)

Unit	Course content	Course/ Learning Outcomes
Unit I	Weather and Climate	This paper on Physical Geography is structured into components of Atmosphere and Hydrosphere. This paper emphasizes the constituents of the atmosphere the dynamic nature of the processes associated with it and their contribution in making the earth habitable. The course content also leads to the identification of climatic differentiation on the earth and the consequences of human activities on the atmospheric processes. The component of Oceanography similarly deals with the coastal processes and describes the vast and diversified resources that oceans hold.
Unit II	Atmospheric Pressure	
Unit III	Air masses, fronts	
Unit IV	Hydrosphere	
Unit V	Marine temperature, salinity, movements of oceanic water	

B.Sc. II Year
Paper-II Economic Geography

Unit	Course content	Course/ Learning Outcomes
Unit I	Definition and scope of Economic Geography	The objectives of this course are to acquaint the students with the spatial pattern of the world economy consisting of activities ranging from primary to tertiary sectors, their bases and causes of regional variation, recent world-wide changes in economy particularly in context of the globalization and to comprehend the contemporary issues facing the global economy.
Unit II	Major mineral and power resources	
Unit III	Regional Development and Planning	
Unit IV	Manufacturing industries	
Unit V	Transport	

Course/Learning outcomes
B.Sc. Geography
B.Sc. III Year
Paper-I Geography of India

Unit	Course content	Course/ Learning Outcomes
Unit I	Locational characteristics	This paper deals with study and teaching to the students the Physical, Cultural conditions and acquaints the students relating to sustainable development and regional specialization, diversification and environmental impact in the Globalization process.
Unit II	Natural Resources	
Unit III	Cultural landscape of India - Population and it's characteristics. Indian Economy	
Unit IV	Madhya Pradesh- Physical and Cultural	
Unit V	Political Aspects	

B.Sc. III Year
Paper-II Environment and Resource

Unit	Course content	Course/ Learning Outcomes
Unit I	Environment	Through this paper students will be acquainted with inter relationship of resources and Environment and the sustainable development. This paper also deals with Conservation and management for solving the environmental Problems.
Unit II	Biodiversity and Sustainable development, Quality of human life and environment, Environmental policy, Environmental education and Legislation.	
Unit III	Sustainable Development	
Unit IV	Soil	
Unit V	Environmental Conservation and Management	

COURSE / LEARNING OUTCOME

CLASS: B.SC.-I YEAR

Department of Geology

Paper-II: Crystallography and Mineralogy

Unit	Topic	**Course/ Learning Outcomes:** After completion of course, the students will -
Unit-I	Crystal	• have the conceptual understanding and knowledge of the crystal and crystal forms. • Understand relationship between Parameters and Miller Indices. • Drive Miller Indices from Parameters.
Unit-II	Classification of crystals Twinning	• Classify the various crystals into crystal system. • Have knowledge of forms of normal class with Miller Indices. • Will have basic concept of twinning, types and Laws of twinning.
Unit-III	Silicate Structures Physical Properties of Minerals	• Learn to derive chemical composition of minerals from the fundamental units of given silicate structures- Neso-, Ino-, Phyllo-, Tecto-, Soro-, Cyclosilicate. • Learn to identify & describe the minerals on the basis of their Physical Properties.
Unit-IV	Nicol Prism Petrological Microscope Optical Properties of Minerals	• Learn construction and working of Nicol Prism. • Learn various parts of Petrological Microscope and their function. • Be able to use Petrological microscope to identify the minerals on the basis of their optical properties. • Have knowledge of optical properties of minerals.
Unit-V	Mineral Groups- Olivine, Garnet, Mica, Pyroxenes, Amphiboles, Feldspar, Silica, Zeolite	• Have acquired knowledge to identify & describe the various minerals on the basis of their Physical & Optical Properties of mineral families/group • Have knowledge of Mineral Composition & Crystal System

CLASS: B.SC.-II YEAR

Paper-II: Structural Geology

Unit	Topic	**Course/ Learning Outcomes:** After completion of course, the students will -
Unit-I	i) Identification of beds and Attitude of beds ii) Top and Bottom of beds iii) Rock deformation	• Learn how to identify beds/strata & find attitude of beds with the help of Clinometer/ Brunton Compass. • Learn working of Clinometers/ Brunton Compass. • Learn how to determine the top and Bottom of Beds. • Learn how the internal & external forces bring about deformation in the Rock
Unit-II	Fold	• Learn morphology of fold & mechanics of folding • Learn how the folds are classified on Genetic & Geometric basis • Have knowledge of identifying folds in the field and on map • Learn how folding effects the outcrops
Unit-III	Fault	• Learn morphology of fault & mechanics of faulting • Learn classification & identification of fault in the field and on geological map • Learn how the faulting effects the outcrops
Unit-IV	Joint Foliation Lineation	• Be able to differentiate between Joint & fault • Learn types & origin of foliation, lineation & their relation to major structures
Unit-V	Unconformity Tectonics	• Learn about developmental stages of unconformity, kinds & how to identify them in field as well as on geological maps • Learn how overlap, offlap are produced by marine transgression & regression • Learn about tectonic framework of India

CLASS: B.SC.-III YEAR

Paper-I: Paleontology and Stratigraphy

Unit	Topic	**Course/ Learning Outcomes:** After completion of course, the students will -
Unit-I	Paleontology Graptolite Foraminifera Trilobite	• Learn about fossils, Index fossils their importance & uses. • Be able to know how fossils are preserved in nature • Learn about classification, morphological characters geological history of Graptolite, Foraminifera, Trilobite.
Unit-II	1.Echinoids, Brachiopoda, Mollusca, Coral 2. Hominidae	• Learn about classification, morphological characters, geological history of Phylum Echinoidea, Brachiopoda, Mollusca. • Learn about the evolutionary trend of Ape
Unit-III	Stratigraphy Geological Time Scale Supergroups- Dharwar, Cuddapah & Vindhyan	• Learn basic concept of Litho-, Bio-, Chrono-, & magnetostratigraphic units & their interrelationship. • Learn about Geological Time Scale. • Learn about Stratigraphic Succession, geographic distribution & economic Importance of Dharwar, Cuddapah & Vindhyan Supergroup.
Unit-IV	Supergroups/ Groups- Gondwana, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Tamilnadu, Bagh & Lameta beds, Tertiary of Assam, Siwalik, Deccan traps	• Learn about Stratigraphic Succession, fossil content, Paleoclimate, age, geographic distribution & economic Importance of following Supergroups/ Groups- Gondwana, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Tamilnadu, Bagh & Lameta beds, Tertiary of Assam, Siwalik, Deccan traps.
Unit-V	Stratigraphic Boundary Problems Himalaya	• Learn about the Stratigraphic Boundary Problems between-Precambrian-Cambrian, Permian-Triassic, Cetaceous-Tertiary, Pliocene-Pleistocene. • Have knowledge of evolutionary history of Himalayas.

LOCF
Learning Outcome Based Curriculum frame work
Adopted by UGC

INFORMATION TECHNOLOGY

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION/ POSTGRADUATE EDUCATION BASED ON BLOOM'S TAXONOMY AND REVERSE BLOOM'S TAXONOMY.

SECTION A

1.1 Introduction.

Information Technology (IT) encompass the study and application of computers and any form of telecommunications that store, retrieve and send information. IT includes a combination of hardware and software used together to perform the essential functions people need and use every day. Most IT professionals will work with an organization to focus on and meet their needs technologically by understanding what they need, showing them options on what current technology is available to do their needed tasks, then implementing the technology into their current setup, or creating a whole new set up.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution

Information technology Studies is originally designed as a job-oriented approach so that students are expected to learn skills which are essential to their future jobs.

- Disciplinary knowledge: a student wants to become a computer programmer, students should be able to write programs using different languages such as C++ or JAVA upon the completion of the program studies.
- Communication Skills: there exist good and soft communication skills between the students and teaching faculty. Technical words are used as keywords in computer language during the class.
- Critical thinking: information technology department improved its class strength and Potential during in last 10 yrs. The main objective of this stream of computer is to produce good quality that make student for many functions like computer programmer and software and hard ware specialist.
- Problem solving: In this process we examine four components: asking questions, collecting appropriate data, analyzing the data as result form, and interpreting the results. This session involves may solution related to programming doubts in various language. The subject is completely Problem solving for making good result.
- Analytical reasoning: In this Analytical reasoning we provide information with best quality and it is helpful in nature. student valuation is focused on their ability to study and process a given set of information logically to arrive at a decision, or make an inference, or find patterns. All verifying these questions will not require prior training in any of the established disciplines.
- Research-related skills: with the help of this stream student can help in research-oriented problems.

Data Collection, Analysis, problem solving, and new development related to algorithm and software development.

- Cooperation/Team work: There is good cooperation between the faculty and students. Assignment (survey / Data Collection or internship) and project work are completed. The groups or team performed under the guidance of teaching faculty.

- Scientific reasoning**:** The field of science education includes work in scientific contents, the scientific methods, scientific reasoning, scientific literacy and teaching pedagogies. To enhance scientific contents, investigative skills that help students to acquire problem solving and lifelong learning skills, the assessment of scientific reasoning in science education has gained momentum of late. The purpose of this paper is to review and synthesize empirical studies on scientific reasoning skills and science education. Different methods were used to select and identify studies for this review. Amongst others, the findings from the literature reveal that, science education is vital as it promotes a culture of scientific thinking and inspires citizens to use evidence-based reasoning for decision making, ii) ensures that citizens have the

- Reflective thinking: The purpose of this study is to examine the effects of reflective thinking effects in the process of designing software on students' learning performances. The study contends that reflective thinking is a useful teaching strategy to improve learning performance among lower achieving students. Participants were students from two groups: Higher achieving students were the control group, and lower achieving students were the experimental group. The experimental group students wrote weekly diaries demonstrating reflective thinking in the processes of designing software. The study's results show the evaluation scores of the two groups of students' software designs were comparable. The abilities of the experimental group to comment on a design improved. This shows that a reflective thinking strategy did have positive effect on improving lower achieving students' learning performances, especially in the process of software design. Discussion of the results and suggestions for future study appear at the end of this study.

- Self-directed learning: Self-directed learning is an important trend in education. It has been around since the beginnings of this stream and is a natural pathway to deep understanding and efficacy. By being mindful of the ways self-directed learning can appear in the classroom, and leveraging it as an integral part of how we learn, we can create a more meaningful learning experience for students that will last beyond the regurgitation of memorized content. Self-directed learning is something we live.

- Multicultural competence: students belong to different area and culture that help to develop the multiple competence in the students.

- Moral and ethical awareness/reasoning: Information that could, in principle, be recorded and stored for future use. For instance, one might use the older forms of information technologies of pen and paper and keep a detailed diary listing all the things one did and thought during the day. It might be a daunting task to record all this information this way but there are a growing list of technologies and software applications that can help us collect all manner of data, which in principle, and in practice, can be aggregated together for use in building a data profile about you, a digital diary with millions of entries. each and every day and how that same data might be efficiently collected and stored though the use of information technologies.

- avoid unethical behavior. Misuse of data is unethical. Data theft is the act of stealing information stored on computers, servers, or other devices from an unknowing victim with the intent to

compromise privacy or obtain confidential information. Data theft is a growing problem for individual computer users as well as large corporations and organizations. we should avoid it.

- Leadership readiness/qualities: the subject develop the leadership in the students. The whole world is moving on data. Income / expenditure, budget, crime, agriculture, medicine, business and industrial sector data or statistics is leading the all subjects

- Lifelong learning: students can develop their own software that is useful for their earning and the practice for hardware related work also so that they open their own business for life long. practice make perfection i.e., day to day use of information technology improve the learning area increase capacity. software development is lifelong learning tool for students.

1.3.2 Qualification descriptors

Qualification descriptors are generic statements of the outcomes of study. Qualification descriptors are in two parts. The first part is a statement of outcomes, achievement of which a student should be able to demonstrate for the award of the qualification. This part will be of interest to those designing, approving and reviewing academic programme. They will need to be satisfied that, for any program, the curriculum and assessments provide all students with the opportunity to achieve, and to demonstrate achievement of, the outcomes. The second part is a statement of the wider abilities that the typical student could be expected to have developed. It will be of assistance to employers and others with an interest in the general capabilities of holders of the qualification.

Qualification descriptors for a Bachelor's Degree program:

On completion of B.Sc. with information technology, the expected learning outcomes that a student should be able to demonstrate are the following.

- Fundamental understanding of the principles of information technology and its connections with other disciplines.
- Procedural knowledge that creates different types of professionals related to Computer Science, including research and development, teaching and industry, government and public service.
- Skills and tools in areas related to information technology and current developments in the academic field of study.
- Use knowledge, understanding and skills required for identifying problems and issues, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, and their application, analysis and evaluation using methodologies as appropriate to information technology for formulating solutions.
- Communicate the results of studies undertaken in information technology accurately in a range of different contexts using the main concepts, constructs and techniques.
- Meet one's own learning needs, drawing on a range of current research and development work and professional material.Program learning outcomes: Information technology Studies is originally designed as a job-oriented approach so that students are expected to learn skills which are essential to their future jobs.

Relationship of data and their presentation

1.3.3 Analyze a problem and identify and define the computing requirements for the appropriate solutions. Plan, install, manage, and troubleshoot a computer network. Apply telecommunications principles to design and configure a network. Plan and implement security technology.

1.4 Assessment methods

With the methods of Assignments and classroom surprise test, Power Point Presentation, Poster Making etc are involve for their evaluation.

SECTION B

Detail Syllabus based course learning outcome.

On completion of the syllabus, student will be able to understand programming. they will understand to develop software and testing of that software. Students are able to work on hardware as well as software. Unit wise learning outcomes are as follows.

B.Sc. (IT) First Year
Introduction to Information Technology & Computer organization
Paper First

Units	**Course Contents**	**Course /Learning Outcomes:** After Completion of course, the students will able to -
01	● Introduction to computer ● Memory and its types. (RAM and ROM……)	learn about computer basics
02	● Computer soft ware ● Types of Software	use the knowledge of software and its concept.
03	Word Processing : MS word MS Excel MS power point	work on MS-Office tools
04	● Number System. ● Logic gates ● Counter and shift registers.	know about number system
05	Storing data and Program in Memory	learn about storing data and program in memory.

B.Sc. (IT)
First Year
Programming & Problem Solving through C & C++

Units	Course Contents	**Course /Learning Outcomes:** After Completion of course, the students will able to -
01	Basics of C Programming	learn about C language concept
02	Functions of C Programming	learn about Array and its concept.
03	Concepts of Object-Oriented Programming	know about OOPS concepts.
04	● Introduction of constructor, types of constructors. ● Introduction of Destructor. ● Operator overloading. ● Inheritance and types of inheritance.	understand about constructor and destructor.
05	● Pointer and its working ● Virtual function ● Polymorphism. ● Pure virtual function.	learn about pointer and file streams.

B.Sc. (IT)
Second Year
Operating System Concepts & Computer Network
Paper First

Units	**Course Contents**	**Course /Learning Outcomes:** After Completion of course, the students will able to -
1	● Introduction to Operating system. ● Unix	know about Operating system concepts and uses of Operating System.
2	● Dead lock Problem its condition ● Paging concepts ● Demand paging ● Page replacements algorithm.	learn about Concepts of Dead lock.
3	● Fundamentals of Computer Network ● OSI and TCP /IP model ● LAN, MAN, WAN and topology ● Switching technique ● CRC and hamming code	understand about Computer Network and it's working
4	● Simplex protocol ● stop – wait protocol ● MAC sub layer ● ALOHA ● CSMA. ● IEEE MAC sub Layer 802.3… ● Sliding window protocol	learn about data link protocol.
5	● DBST, FLOODING ● The network layer in Internet ● Transport layer protocol	Work with networking Algorithm.

B.Sc. (IT)
Second Year
Internet Programming using JAVA
Paper Second

Units	Course Contents	**Course /Learning Outcomes:** After Completion of course, the students will able to -
01	● Client server Architecture ● DNS, WWW, HTPP SMTP, FTP, telnet. ● Introduction JAVA, Structure of JAVA ● Token of java ● Operator of java ● Conditional statement of java ● Loop control statement	learn about Internet Programming using JAVA
02	● Define a class and its members ● Constructor and method over loading ● Type of Inheritance ● Array – one D, Two D ● Package and Interface	Understand about Class
03	● Local and Remote applets ● Applets life cycle. ● HTML pages using Applets.	learn about Local and Remote applets
04	● Servlet Development process. ● Servlet life cycle. ● Servlet package and Inheritance ● Java Data base connectivity JDBC.	know about JAVA Servlet
05	● JSP basic ● Expiration language (EL) ● MS SQL server ● JAVA SQL Package	learn about JSP

B.Sc. (IT)
Third Year
DBMS and RDBMS using Oracle
Paper First

Units	**Course Contents**	**Course /Learning Outcomes:** After Completion of course, the students will able to -
01	● Basics of DBMS ● Data base system architecture. ● DBA ● ER Concepts Attributes, Relationship	Know about DBMS, RDBMS
02	● Evaluation of SQL ● function of SQL. ● Introduction Relation Algebra. ● Relation Calculus ● Domain Relation Calculus	learn about Database languages
03	● Definition Relation Data base. ● CODD 'S rule ● Normal form ● BCNF and multi-valued dependency. ● SQL Query	Learn about Relation Data base.
04	● Transaction Management ● ACID Properties ● Data Ware house ● Data Mining	understand about transaction Management.
05	Basics of PL/SQL	Learn about PL/SQL

B.Sc.(IT)
Third Year
Information Technology Trends
Paper Second

Units	**Course Contents**	**Course /Learning Outcomes:** After Completion of course, the students will able to -
01	● Concepts of Distributed system ● ESCM and its concepts. ● ECRM and its concepts.	Understand about Distributed system
02	● Introduction Data warehouse ● Data warehouse components, ● Metadata ● Data mining	learn about Data warehouse and Marts
03	● Mobile commerce, ● GSM ● CDMA ● GIS	learn about Modern Communication and telephony
04	● CDMA ● Communicationn technologies – 2G, 3G, 4G, 5G ● ISDN ● Network Security. ● Encryption and decryption.	Know about Modern Communication and telephony
05	● Multimedia Concepts ● AI (Artificial intelligence) ● Expert System. ● IOT an embedded system ● Cloud computing.	Know about Multimedia Concepts

DEPARTMENT OF PHYSICS

Course/Learning outcomes

Class: B.Sc. First Year

Paper I: Mechanics and Properties of Matter

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Mathematical Physics	• Differentiate between scalar and vector quantities. • Students will also be able to use differentiation and integration of different variables • The applications of different theorems
Unit II (A and B)	Mechanics	• The kinematics and their graphical representation • Be aware about the dynamics , • laws of motion and diff. types of forces.
Unit III	General Properties of Matter	• Understand that how to determine different elastic constant and relation among them. • Determination of Surface tension of different liquids and their properties • C Viscosity and their applications in different fields.
Unit IV	Oscillations	• Learn the different types of Oscillations and their mechanism. • Moment of Inertia of different bodies and their applications.
Unit V	Relativistic Mechanics and Earlier Development in Physics	• Understand different types of frame of references. • Understand the Mass Energy relation • Knowing the contribution of scientists in Physics up to 18th century

Course/Learning outcomes

Class: B.Sc. First Year

Paper II: Thermodynamics and Statistical Physics

Units	Course content	Course/ Learning Outcomes: After completion of course the students will be able to-
Unit I	Thermodynamic I	• Describe basic concepts of thermodynamics. • Restate definition of system, equation of state, equilibrium and equation of state. • To use 1st and 2nd law of thermodynamics. • Students will be define efficiency of Carnot's engine
Unit II	Thermodynamic II	• The concepts of entropy and understand how to change the entropy of the universe in a reversible and irreversible process. • The second law of thermodynamics in terms of entropy. • Students will be define T.S .diagram • Students will be define relation between thermodynamic variables
Unit III	Statistical Physics I	• Understand the significance of statistical approach • restate definition of micro states and Macro states of a system, Equilibrium states • Principle of equal a Priori Probability • Understand the concepts of Phase Space
Unit IV	Statistical Physics II	• Understand the Boltzmann's partition function. • Students will be able to explain the properties of Bose-Einstein statistics, Maxwell-Boltzmann statistics and Fermi -Dirac statistics. • Understand the Black body radiation
Unit V	Contributions of Physicists	• Understand Planck's constant • Knowing the contribution of scientists in Physics up to 18 th century

Course/Learning outcomes

Class: B.Sc. Second Year, Physics

Paper I: Optics

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Geometrical optics	• Differentiate between Reflection and Refraction. • To use multiple lenses in Rusden and Huygens eyepiece, • The applications of Aplanatic points
Unit II (A and B)	Interference of light	• The interference and its application. • The Newton rings. • Wavelength and Fabry-perot interferometer.
Unit III	Diffraction	• Understand that how to determine the resolving power of Telescope and microscope • Differentiate between Fresnel's and Fraunhofer diffraction. • Half Period Zone, Zone Plate.
Unit IV	Polarization	• Learn the different types of Polarization and their applications • Nicol Prism, Babinets compensator, Propagation of electromagnetic waves.
Unit V	Fiber optics and Laser	• Understand different types of types of Laser, Photodiodes, and phototransistors. • Understand the Principle of Fiber Optics. • Knowing the Einstein's coefficient.

Course/Learning outcomes

Class: B.Sc. Second Year Physics

Paper II: Electrostatics, Magneto statics and Electrodynamics

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Electrostatics	• Students will also be able to use Capacitors. • The Dielectrics and also the applications of Gauss theorem, Claussius-Mossotti equation.
Unit II	Magneto statics	• The Biot and Savart law. • Magnetic Dipole moment. • The Amperes law, Relation between B, H and M.
Unit III	Current Electricity and Bioelectricity	• Understand that how to determine different circuit currents LCR, LR, CR • Determination of RMS value of A.C. • Origin of Bioelectricity
Unit IV	Motion of Charged particles in Electric and Magnetic fields	• Learn about the different types of accelerating field, CRO, Electron gun, Cyclotron. • Mutually Perpendicular and Parallel E and B fields.
Unit V	Electrodynamics	• Understand differential form of Faradays law, Rayleigh scattering • Understand the Reflection and Refraction by Ionosphere. • Knowing the Electromagnetic field Tensors.

Course/Learning outcomes

Class: B.Sc. final year

Paper: 1-Quantum Mechanics and Spectroscopy

Units	**Course content**	**Course/ Learning Outcomes:** After completion of course the students will be able to-
Unit I	Quantum mechanics -I	• Know about the Optics phenomenon 1-Photoelectic effect ,2-Black body radiation 3- Compton effect • Understand the concepts of wave packets and concepts of phase and group velocity. • Understand basic postulates and formalism of Schrodinger's equation.
Unit II	Quantum mechanics -II	• knowing about the different time independent Schrodinger's equation like one dimension box and SHM. • Understand boundary conditions. • wave function for ground state. • Know about Rigid rotator.
Unit III	Atomic Spectroscopy	• Understand the concepts of Spectra. • Differentiate between different Spectra. • To know about Bhor model and selection rules. • Zeeman effect and Moseley's law
Unit IV	Molecular Spectroscopy	• Understand the concept of Spectra • To know about Singlet and Triplet states • Understand the Frank Condon principle • Students will demonstrate written and oral communication skills in communicating physics related topics.
Unit V	Nuclear Physics	• To know about basic properties of nucleus. • Geiger Nuttel law. • Application of selection rules and Q-value.

Course/Learning outcomes

Class: B.Sc. Final Year

Paper:II-Solid State Physics

Units	Course content	Course/ Learning Outcomes: After completion of course the students will be able to-
Unit I	Solid state physics I	• Understand Crystalline and amorphous solids • Know about Lattice and basis ,Unit cell • Understand Kronig-Penny model
Unit II (A and B)	Solid state physics II	• Dulong Petit and Einstein and Debye theories of specific heats of solids • Understand Curie's law • Wiedemann-Franz law
Unit III	Semiconductor Devices -1	• Understand the types of Semiconductors • To know about the energy bands • Learn about drift velocity and PN Junction • LED, Solar cell ,Photodiode
Unit IV	Semiconductor Devices -2	• .To Know about Use of Amplifiers • Understand the concepts of Barkhausen criterion • Basic concepts of Amplitude • RC phase shift oscillators • Students will design and conduct an experiment, demonstrating their understanding of the scientific method and process.
Unit V	Nano Materials	• Understand the basic concepts of Nano materials • To know about the application of Nano materials • Wet Chemical method • Students will demonstrate an understanding of the impact of physics and science on society.

LOCF
Learning Outcome Based Curriculum framework
Adopted byUGC

Statistics

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION/ POSTGRADUATE EDUCATION BASED ON BLOOM'S TAXONOMY AND REVERSE BLOOM'S TAXONOMY.

SECTION A

1.1 Introduction.

Statistics is a mathematical body of science that pertains to the collection, analysis, interpretation or explanation, and presentation of data, or as a branch of mathematics. ... Descriptive statistics can be used to summarize the data or any set of population.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution

- To develop a vision for curriculum Enrichment and Execution data collection (Primary and secondary), graphical and diagrammatic study, study of variation in daily life observed. Some mathematical problems assign to student that develops the vision for curriculum Enrichment and Execution.

- Disciplinary knowledge: In the Study of Statistics Basic mathematics or disciplinary knowledge of mathematics like counting, algebra (addition, subtraction, multiplication, and division) required.

- Communication Skills: there exist good and soft communication skills between the students and teaching faculty. Technical words are used giving the class.

- Critical thinking: the department of statistics improved its class strength and Potential during in last 10 yrs. The main object of the subject is to produce good quality that make student for many functions like
- Problem solving: In this process we examine four components: asking questions, collecting appropriate data, analyzing the data, and interpreting the results. This session investigates the nature of data and its potential sources of variation. Variables, bias, and random sampling are introduced. The subject is completely Problem solving

- Analytical reasoning: student valuation is focused on their ability to study and process a given set of information logically to arrive at a decision, or make an inference, or find patterns. Answering these questions will not require prior training in any of the established disciplines.

- Research-related skills: with the help of this subject student can help in research-oriented problems. Data Collection, Analysis, ANOVA, large sample and small sample test, Design of Experiment are the course contents through which any research problem related to Agriculture, Medical industry and business can solve.

- Cooperation/Team work: There is good cooperation between the faculty and students. Assignment

(survey / Data Collection or internship) and project work are completed. the groups or team performed under the guidance of teaching faculty.

- Scientific reasoning: Statistics is the science of counting and data. In a scientific manner statistic has very strong application in different scientific areas like: ISRO, DRDO, Actuarial Science, management and business.

- Reflective thinking: the subject develops a reflective thinking about data. With the knowledge of subject student Can approach Data and information, Data Science, concept of Variation, sampling, Estimation and optimization.
- Information/digital literacy: Digital literacy refers to an individual's ability to find, evaluate, and compose clear information through writing and other media on various digital platforms. Digital literacy is evaluated by an individual's grammar, composition, typing skills and ability to produce text, images, audio and designs using technology. The American Library Association (ALA) defines digital literacy as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills." While digital literacy initially focused on digital skills and stand-alone computers, the advent of the internet and use of social media, has caused some of its focus to shift to mobile devices. Similar to other expanding definitions of literacy that recognize cultural and historical ways of making meaning, digital literacy does not replace traditional forms of literacy, and instead builds upon and expands the skills that form the foundation of traditional forms of literacy. Digital literacy should be considered to be a part of the path to knowledge.
  Digital literacy is built on the expanding role of social science research in the field of literacy as well as on concepts of visual literacy, computer literacy,] and information literacy or Data Science or statistics.
  Overall, digital literacy shares many defining principles with other fields that use modifiers in front of literacy to define ways of being and domain specific knowledge or competence. The term has grown in popularity in education and higher education settings and is used in both international and national standards.
- Self-directed learning: some of the students who belongs to rural areas and unable to attend regular class can study with online consultation and notes through self-directed learning.

- Multicultural competence: students belong to different area and culture that help to develop the multiple competence in the students.

- Moral and ethical awareness/reasoning: the use of data or information in a right manner is very important. Data should be analyzed to make a policy, budget and support to nation. Avoid unethical behavior. Misuse of data is unethical. Data theft is the act of stealing information stored on computers, servers, or other devices from an unknowing victim with the intent to compromise privacy or obtain confidential information. Data theft is a growing problem for individual computer users as well as large corporations and organizations. we should avoid it.

- Leadership readiness/qualities: the subject develop the leadership in the students. The whole world is moving on data. Income / expenditure, budget, crime, agriculture, medicine ,business and industrial sector data or statistics is leading the all subjects

- Lifelong learning: practice make perfection i.e. day to day use of data and statistic improve the learning area Net capacity

1.3.2 Qualification descriptors

Who can analyze the complex data and make prediction can be a statistician.

Qualification descriptors for a Bachelor's Degree program:

1.3.3 Programmed learning outcomes: the program outcomes are: survey, organization of data.

Relationship of data and their presentation

1.3.4 Course learning outcomes. Estimation and prediction with data behavior. Use of ANOVA and Design of Experiment and research oriented test .(Widely used in NSSO, CSO,TIFR and others)

1.4 Assessment methods

With the methods of Assignment and classroom surprise test students are evaluated.

SECTION B

Detailed Syllabus based course learning outcome.

On the completion of the syllabus, student will be able to understand data analysis and their presentation (Graphical and diagrammatic) .they will understand the sampling , research tools (t,F, Z nad other tests) , inference (Testing of hypothesis and Theory of Estimation) and applied statistics (Quality Control, Vital Statistics, ANOVA and Design)

B. Sc. First year
Paper 01
Statistical Method

UNIT	Topic	Outcome
01	Statistics: Definition, importance and scope Limitation of Statistics and Data collection Primary and secondary data. Different methods of collection Classification and Graphical Presentation: Histogram, Frequency polygon, frequency curve and Cumulative frequency curve. Diagrammatic presentation: Bar diagram, duo-directional bar diagram, two-dimensional diagram, Pie- diagram. Measures of central tendency: Mathematical and Positional averages. (Formula and Derivation) Based numerical on Mathematical averages. Determination of Median	knowledge of Data and its Presentation and analysis Statistics: Definition, importance and scope Limitation of Statistics and Data collection Primary and secondary data. Different methods of collection Classification and Understanding with Diagrammatic presentation: Bar diagram, duo-directional bar diagram, two-dimensional diagram, Pie-diagram.
02	Requisites of ideal measure, Range, Quartile Deviation, Mean Deviation, Standard deviation and their merits, demerits. Root mean square deviation and its relation with standard deviation, various formulae for calculating variance, variance of composite series, coefficient of variation. Moments: moments about mean in terms of moments about any point and vice-versa. Properties of moments, cumulates, Karl Pearson's beta and gamma coefficients, Sheppard's corrections . skewness, kurtosis and their measures	To understand data collection and its presentation Root mean square deviation and its relation with standard deviation, various formulae for calculating variance, variance of composite series, coefficient of variation. Moments: moments about mean in terms of moments about any point and vice-versa. Properties of moments, cumulates, Karl Pearson's beta and gamma coefficients, Sheppard's corrections. skewness, kurtosis and their measures.

03	Bivariate Distribution: scatter diagram, Karl Pearson's coefficient of correlation, determination of correlation coefficient. Spearman's Rank correlation coefficient (Repeated ranks also)	To understand data collection and its presentation
04	Plane of regression, Properties of residual, Yule's Notation. Multiple and Partial regression, Multiple and Partial correlation coefficients (For three variables only) and their properties.	Identify and collection of statistics. Presentation and analysis of Data through Graphs and Diagrams.
05	Theory of attribute, class frequencies order of classes consistency of data condition for consistency of data. Independence of attribute, criteria for Independence of attribute, yule 's coefficient of association.	Understanding with variations, different tools to measure variations

PAPER 02
Probability & Probability distribution

UNIT	Topic	Outcome
01	Introduction of probability Trail event and sample space Exhaustive events Favourable space Equally likely events Independent events Dependent events Mathematically and statistical definition of probability with their limitation Axiomatic definition of probability Additional law of probability Conditional probability Multiplication law of probability and Baye's theorem with proof	Understanding with probability and its measures
02	Random variable Descript and continuous variable Distribution function and their property Probability mass function Probability density function and their property Joint marginal and conditional probability function Probability generating function Characteristic function Inversion theorem Stochastic independence Mathematically expectation Properties of Mathematically expectation Means and variance of linear combination of random variable	Understanding with Random variable Descript and continuous variable and its measures
03	Theoretical discrete distribution Bernoulli distribution Binomial distribution Limiting from of binomial distribution Negative binomial distribution Geometric distribution Hyper geometric Properties	Understanding of Theoretical discrete distribution Bernoulli distribution Binomial distribution
04	Theoretical continuous distribution: Rectangular or Uniform distribution, Normal distribution, Gamma distribution, Beta distribution (First and Second kind), Exponential distribution, Cauchy distribution and their properties.	Understanding of Theoretical continuous distribution : Rectangular or Uniform distribution , Normal distribution, Gamma distribution, Beta distribution (First and Second kind), Exponential distribution
05	Bivariate Normal distribution - Marginal and conditional distribution , moment generating function ,	Understanding of Bivariate Normal distribution

	their properties and limitation (without proof) Cumulants of Bivariate Normal distribution and their properties Chebyshev's inequality, convergence in probability , week law of large numbers, Bernoyllli 's law of large numbers. Central limit theorem - Lindeberg - Levy and De- movie _ Laplace theorem (with proof)	its measures

B. Sc. Second year
Paper 01 Statistical Inference

UNIT	Topic	Outcome
1	Theory of Estimation Definition of a random sample, Parameter and statistic, concepts of point and interval estimation, criterion of a good estimator, Unbiasedness, consistency, efficiency and sufficiency; Mean square error of an estimate, Method of maximum likelihood estimation. Cramer - Rao inequality and its application confidence interval.	Understanding of Use of Theory of Estimation. Student will able to identify the causes variation and control quality of any manufacturing unit.
2	Testing of hypothesis Concepts of test of significant Null and alternative hypothesis Simple and composite hypothesis Type one and type two error Critical region and level of significant One and two tailed tests New man person lemma for construction of most power tested for sample Null versus simple alternative for the parameters of binomial Poisson distribution Normal distribution Likelihood, ratio test	Understanding of Use of Testing of hypothesis Concepts of test of significant
3	Non parametric test Order statistics Definition of distribution of single Joint and marginal density function Advantages of non parametric method disadvantages of non parametric method run test for randomness Sign tested for univariate and bivariate distribution Wilcoxon's sign Ranked test for univariate and bivariate distribution, Mann Whiteney U test , Wald Wolfowitz run test, Median test .	Understanding of Non parametric test Order statistics
4	Sampling Distribution Sampling distribution of statistic, definition of standard error and some examples. sampling distribution of sum of binomial and Poisson variants. Sampling distribution of mean of normal distribution. Derivation of Chi- square, student's, Fisher's and F distributions with their properties, relation between Chi- square, t and F.	Understanding of Sampling Distribution
5	Large sample test Test of significance of single proportion, z - test of significance for single mean and for difference of means. small test: t Test for single mean, and difference of means, paired t test F- test for equality of population variances conditions for the validity of chi-square test for goodness of fit test for independence of attributes. Fisher's Z - transformations and their application .	Understanding of Large sample test

Paper 02 Sample Techniques

UNIT	Topic	Outcome
1	Sample survey :- Introduction Sample survey Concepts of population and sample Need for sampling Steps in sample survey Principles of sample survey Sampling and non-sampling error Requirements of good sample Complete census VS sample survey Limitation of sampling	Understanding of Use of Sample survey Concepts of population and sample Need for sampling Student will able to identify the causes variation and control quality of any manufacturing unit.
2	Simple random sampling Definition of simple random sampling Simple random sampling with without replacement Un biasedness of the sample mean Mean square error of the sample mean Merit and demerit Limitation of simple random sampling Confidence limit Size of sample for specified precision Simple random sampling by attributes	Understanding of Simple random sampling Un biasedness of the sample mean Mean square error of the sample mean Merit and demerit Limitation of simple random sampling Confidence limit Size of sample for specified precision
3	Stratified random sampling Definition and advantage of Stratified random sampling Proportional allocation Optimum allocation Cost function Comparison Stratified random sampling Simple random sampling without stratification Proportional allocation Versus simple random sampling Nyman allocation versus simple random sampling Gain in precision due to the stratification	Understanding of Stratified random sampling Definition and advantage of Stratified random sampling
4	Systematic sampling :- Definition, linear Systematic sampling, Circular Systematic sampling, mean and variance of a Systematic sample mean, comparison of systematic sampling to simple random sampling, Systematic sampling versus stratified random sampling, stratified random sampling versus simple random sampling for a population with linear trend, merits and demerits of systematic sampling.	Understanding of Systematic sampling linear Systematic sampling, Circular Systematic sampling, mean and variance of a Systematic sample mean, comparison of systematic sampling to simple random sampling, Systematic
5	Ration Method of Estimation :-	Understanding of Ration Method of

	Definition, bias of ration estimate, expected value of ratio estimate for first approximation under simple random sampling without replacement, variance of ratio estimates for first approximation under simple random sampling without replacement Regression Method of Estimation Definition, simple regression estimate. Determination of beta, expected value of regression estimate for first approximation under simple random sampling without replacement, variance of regression for first approximation under simple random sampling without replacement.	Estimation Regression Method of Estimation Definition, simple regression estimate.

B. Sc. Third year
Paper 01
Vital Statistics

UNIT	Topic	Outcome
1	Vital statistic Introduction Use of Vital statistic, Method of obtaining Vital statistic. Registration method, census method. Measurement of mortality, Crude death rate, Standardized death rates, Age specific death rate. with their relative merits and demerits. Infant Mortality rate. Completed life table and its main components, Uses of life table.	Understanding of Use of Vital statistic, Method of obtaining Vital statistic. Registration method, census method.
2	Stationary and stable population Lotka and doglin s model for stable population Central mortality rate Force mortality rate Measurement of fertility rates Crud birth rate Age specify birth rate General fertility rate Total fertility rate Merit and Demerit General fertility rate numerical and examples Measurement of population growth rate : Crud rate of natural increase and Pearle's vital index .GRR, NRR .	Student will able to make an estimator. Find MLE Understanding of Stationary and stable population Lotka and doglin s model for stable population Central mortality rate
3	Index number , introduction and definition Problem in constructing index number Price quantity and volume relatives Link and chain relatives Computation of index number b Laspeyre S paasche S marshal edge worth Fisher s index number Chain base index number Criteria of a good index number Cost of living index number	Understanding of different index numbers with major, variation in p/q .index number b Laspeyre S paasche S marshal edge worth Fisher s index number Chain base index number Criteria of a good index number Cost of living index number
4	Time series Introduction components of Time series , mathematical models for time series Uses of time series measurement of trends; graphical method , Method of semi averages, method of moving average , method of least square , growth curves and their fitting . |Modified exponential curves and its fitting. methods of determination of seasonal variation .	Understanding of Time series , mathematical models for time series Use of time series measurement of trends
5	Demand analysis Introduction, definition of demand and supply, laws of supply and demand , price elasticity of demand price elasticity of supply ,types of data required for estimating Elasticity. Pareoto's law of income distribution, curve of concentration log normal distribution.	Student will able to identify the causes variation and control quality of any manufacturing unit.

Paper 02

SQC and design of Experiments

UNIT	Topic	Outcome
1	General theory of control charts Causes of variation Process and product control 3 sigma control limits Control charts for variable Mean and R charts Criteria for detecting lack of control in X bar and R charts Control charts for attributes P, np, c charts application of C charts Different types of charts with examples Definition of X bar and R charts Definition of control charts Numerical on control	Student will able to identify the causes variation and control quality of any manufacturing unit.
2	Principles of acceptance sampling Definition of AQL, Definition of LTPD, Producer Risk consumers, Risk consumers, Definition of AOQL, Definition of LTPD Definition of ASN, Definition of ATI Definition of OC curves Single and double sampling plan, Attribute and variables Concept of reliability, failure rate and reliability function series Sequential sampling plan, parallel systems and other simple configuration	Through knowledge of Principles of acceptance sampling Definition of AQL, Definition of LTPD, Definition of OC curves Single and double sampling plan, Attribute and variables
3	Analysis of variance Definition of different terms One way classification, two-way classification, One observation per cell, Two way classification with m observation per cell Fixed effect model, Analysis of co variance One way classification Analysis of covariance with one way clarification.	Students can understand the need of ANOVA and its applications
4	Fundamental principles of design: randomization, replication and local control layout and analysis of completely randomized block design (RBD), Estimation and analysis of one and two missing observation in RBD efficiency of RBD relative to CRD.	Students can understand the need of (RBD) and its applications
5	Layout and analysis of Latin square design. Estimation and analysis of one missing observation in LSD. Efficiency of LCD relative to LSD relative CRD and RBD Factorial experiments, advantages of factorial experiments 2^2 and 2^3 designs main and interaction effects contrast definition of confounding complete and partial confounding.	Students can understand the need of LSD. Efficiency of LCD relative to LSD relative CRD and RBD and its applications

हिन्दी भाषा एवं नैतिक मूल्य

प्रस्तावना

1.1 वर्तमान समय सूचना क्रांति का है। आधुनिक समय में विद्यार्थी अपनी मातृभूमि, अपनी मातृभाषा से जुड़ा रहे– यह महत्वपूर्ण है। हिन्दी भाषा एवं नैतिक मूल्य का स्नातक स्तर का अधिगम आधारित पाठ्यक्रम कुछ विशेष उद्देश्यों को लेकर निर्मित किया गया है। पाठ्यक्रम की संरचना इस प्रकार की गई है कि इसमें विद्यार्थी मातृभाषा के माध्यम से अपने व्यक्तित्व में नैतिक मूल्यों को विकास कर सके। अधिगम परिणाम आधारित पाठ्यक्रम संरचना के निर्माण की सार्थकता इसी बात में है कि विद्यार्थी विज्ञान विषय के होकर भी अपनी मातृभाषा के माध्यम से नैतिक मूल्यों पर आधारित शिक्षा प्राप्त कर सके। पाठ्यक्रम में चयनित पाठ्यों के आधार पर विद्यार्थीगण अपने जीवन में भाषागत प्रयोगों पर शुद्धता लाने के साथ ही नैतिक शिक्षा भी प्राप्त कर सकते है।

1.2 Learning outcomes based approach to curriculum enrichment and execution

हिन्दी भाषा और नैतिक मूल्य, विषय का पाठ्यक्रम संवर्धन और निष्पादन पर केन्द्रित है। हिन्दी भाषा सर्वाधिक वैज्ञानिक भाषा है। उच्चारण अवयवों की सहायता से हिन्दी भाषा की वर्तनी का क्रमिक ढंग से उच्चारण किया जाता है और यही इसकी सबसे बड़ी शक्ति है। विद्यार्थियों के ज्ञान और कौशल के विकास में स्नातक प्रतिष्ठा पाठ्यक्रम गुणात्मक परिवर्तन लाने में सक्षम है। अध्ययन अधिगम आधारित पाठ्यक्रम संरचना की दृष्टि से स्नातकों को प्रशिक्षित करने के लिए निम्नलिखित बिन्दु आवश्यक है। जो इस प्रकार है –

1. व्यावहारिक प्रशिक्षण
2. रोजगारपरक पाठ्यक्रम का निर्माण
3. विवेचन और विश्लेषण की क्षमता का विकास
4. संप्रेषण कौशल का विकास
5. रिपोर्ट, आलेख, रचनाएँ और लेखन की प्रवृत्ति का विकास
6. विभिन्न क्षेत्रों के लिए कौशल संबंधी पाठों का निर्माण आदि।

आज के भौतिकवादी रूप की प्रधानता वाले युग ने विज्ञान और तकनीकी की जय–जयकार ही की है। इसका परिणाम यह हुआ कि भावना और जीवन की सत्यता का बोध कराने वाले विषय गायब होते गए। यदि भाषा के द्वारा विद्यार्थियों में नैतिक मूल्यों का रोपण किया जाए – तो यह सुखद भविष्य की ओर संकेत करता है। 'हिन्दी भाषा एवं नैतिक मूल्य' के अधिगम परिणाम आधारित पाठ्यक्रम

की संरचना विश्वविद्यालय अनुदान आयोग द्वारा उपलब्ध कराए मानदंडों के आधार पर की गई। समाज के उपयोगितावादी दृष्टिकोण, विज्ञान और तकनीक के क्षेत्र में आए परिवर्तनों और वैश्विक परिप्रेक्ष्य में शिक्षण में नवाचार के फलस्वरूप उच्च शिक्षा का वर्तमान परिदृश्य बदला है। इसी कारण परिणाम आधारित प्रशिक्षण पर बल देना आज की महती आवश्यकता बन चुकी है। इसी परिप्रेक्ष्य मं स्नातक स्तर पर हिन्दी भाषा एवं नैतिक मूल्य के अध्ययन को अनुभवजन्य बनाने का प्रयास किया गया है। हिन्दी के स्नातक पाठ्यक्रम का उद्देश्य विद्यार्थियों को संवेदनशील नागरिक बनाना, उन्हें समाज और समदाय के प्रति संवेदनशील दृष्टिकोण प्रदान करना है। साथ ही उनमें मानवीय मूल्यों के साथ राष्ट्रीय चेतना का विकास हो सके– यह भी एक महत्वपूण्र उद्देश्य है। भाषा के मूलभूत कौशल जैसे लेखन, श्रवण और अभिव्यक्ति को भी यह विकसित करता है। स्नातक के विद्यार्थियें के भाषा संबंधी कौशल का विकास होने के साथ ही उन्हें उच्चारण वर्तनी और लिपि का सही सही ज्ञान कराता है। 'हिन्दी भाषा एवं नैतिक मूल्य' के स्नातक स्तर के पाठ्यक्रम की विशेषताएँ निम्नलिखित बिन्दुओं के माध्यम से प्रकट की जा रही है –

Disciplinary knowledge (विषय का ज्ञान)

1. पाठ को शुद्ध उच्चारण सहित पढ़ने की योग्यता
2. विभिन्न संदर्भों में प्रश्नानुकूलता की योग्यता
3. विभिन्न विधाओं के तथ्य, ऐतिहासिक संदर्भ को जानने कीी योग्यता का विकास
4. साहित्यिक एवं समीक्षात्मक अवधारणाओं को समझने की योग्यता
5. मातृभाषा के उच्चारण एवं वर्तनी संबंधी शुद्धताओं को समझना

Communication Skills (संप्रेषण कौशल)

1. मातृभाषा हिन्दी को बोलने और लिखने के कौशल का विकास
2. स्पष्ट रूप से समीक्षात्मक अवधारणाओं का प्रयोग करने की योग्यता
3. अभिव्यक्ति के कौशलों का विकास
4. नैतिक मूल्यों का व्यक्तित्व में रोपण
5. संप्रेषण कौशल का विकास करना

Critical Thinking (आलोचनात्मक दृष्टिकोण)

1. गद्य–पद्य पढ़ने के प्श्चात आलोचनात्मक दृष्टिकोण का विकास
2. विभिन्न संदर्भो में पाठ निर्धारण की योग्यता
3. साहित्य संबंधी पुनरावलोकन की क्षमता का विकास
4. ऐतिहासिक संदर्भों में पाठ निर्धारण करने की योग्यता संबंधी विकास

Problem solving (समस्याओं का समाधान)

1. अनुवाद जैसे पाठ्य के माध्यम से द्विभाषी योग्यता का विकास
2. विश्लेषण संबंधी कौशल का सांानात्मक विकास
3. उच्चारण एवं वर्तनीगत अशुद्धियों के निराकरण संबंधी योग्यता का विकास

Analytical reasoning (विश्लेषणात्मक और तार्किक दृष्टि का विकास)

1. समीक्षा संबंधी नए बिन्दुओं के अन्वेषण की योग्यता
2. तार्किक रूप से साहित्य के अनुशीलन की योग्यता
3. विश्लेषण संबंधी दृष्टिकोण का विकास

Research related skills (अनुसंधान कौशल)

1. प्रश्न अंकित करने की योग्यता का विकास करना, ताकि जिज्ञासाओं का विभिन्न उत्तरों द्वारा निराकरण किया जा सके
2. समस्याओं को खोज कर उनके समाधान पर बल देना
3. अनुसंधान संबंधी उत्सुकता को बढावा देना

Cooperation or Team work (समूह का कार्य)

1. समूह कार्य में योगदान करने संबंधी रूचि को जागृत करना
2. समूह निर्माण की योग्यता
3. समूह कार्य को बराबर आवंटित करने संबंधी कौशल का विकास
4. समूह निर्माण की योग्यता
5. कक्षा समूह की समूह चर्चा में सकारात्मक रूप से प्रतिभागी बनने की योग्यता का विकास

Scientific reasoning (विज्ञान आधारित स्पष्टता)

1. कथा, यात्रा संस्मरण में वर्णित पाठ्य को विज्ञान से जोड़ने की क्षमता का विकास

Reflective thinking (प्रतिउत्तर या प्रत्युत्तर देने संबंधी सोच)

1. प्रश्न निर्माण और उत्तर देने की क्षमता का विकास
2. स्वाध्याय की भावना विकसित होना

Digital Literacy (डिजिटल साक्षरता)

1. सूचना एवं तकनीकी कौशल से परिचय
2. डिजिटल प्लेटफॉर्म का ज्ञान करवाना

Self directed learning (स्वयं को दिशा प्रदान करने संबंधी अधिगम का विकास)

1. आलेख, प्रतिवेदन तैयार करने संबंधी कौशल का विकास
2. स्वतंत्र रूप से नया कार्य सीखने और करने की योग्यता का विकास

Multicultural competence (बहुसांस्कृतिकता)

1. बहुसांस्कृतिकता को आत्मसात करने की योग्यता का विकास
2. विभिनन विधिताओं को स्वीकार कर पाने की अभिक्षमता का विकास

Moral and ethical awareness (नैतिक एवं सामाजिक मूल्य)

1. सामाजिक मूल्यों को स्पष्ट रू॰ से समझने के कौशल का विकास
2. नैतिक मूल्यों के प्रति जागरूकता ओर उनके प्रचार–प्रसार के लिए रूचि उत्पन्न करना
3. गद्य की विभिन्न विधाओकं के माध्यम से सामाजिक समस्याओं का निराकरण

Avoid unethical behaviour (नैतिकता के विरूद्ध व्यवहार का शमन)

विद्यार्थियों में विवेचना पद्धति का प्र्याप्त विकास है, वे नैतिकता के विरूद्ध व्यवहार ना करें– यह सब कार्यक्रम अधिगम का ही परिणाम है।

Leadership qualities (नेतृत्व गुण)

'हिन्दी भाषा एवं नैतिक मूल्य' पाठ्यपुस्तक द्वारा विद्यार्थियों में लेखन, वाचन एवं श्रवण के साथ–साथ कल्पनाशक्ति का विकास किया जाता है, जिससे कि उसके समग्र व्यक्तित्व में निखार आता है।

Lifelong learning (जीवनपर्यन्त प्रशिक्षण)

'हिन्दी भाषा एवं नैतिक मूल्य' पाठ्यपुस्तक में ऐसी पाठ्य–सामग्री का चयन किया गया है जो चिरकालिक महत्व की रचनाएँ है, उनकी पाठ्य सामग्री जीवन संघर्ष की प्रेरणा देती है।

1.3.2 Qualification descriptors (योग्यता विवरणक)

हिन्दी भाषा और नैतिक मूल्य पाठ्यचर्या भारत के साहित्यिक, सांस्कृतिक और भाषाई विविधता को जानने के प्रति जागरूकता उत्पन्न करती है। प्रत्येक स्तर पर जीवन मूल्यों और साहित्यिक मूल्येां का निर्धारण करने की क्षमता और ज्ञान का विकास करने की क्षमता भी इसमें समाहित है।

Qualification description for a Bachelor's Degree Programme (स्नातक स्तर कार्यक्रम के लिए योग्यता विवरण)

स्नातक स्तर पर चलाए गए 'हिन्दी भाषा एवं नैतिक मूल्य' कार्यक्रम (पाठ्यक्रम) में सीखने की क्षमता के अनेक तत्व समाहित है। शिक्षण अधिगम प्रक्रिया में निर्णय आधारित दृष्टिकोण के बजाय प्रयोगिक प्रक्रिया पर आधारित दृष्टिकोण पर केन्द्रित है – यह उत्तम है।

संबंध विषय पर आधारित व्याख्यान विद्यार्थियों की भाषा संबंधी रूचि जाग्रत करने में सक्षम है।
कक्षाध्यापन में संवाद के लिए उचित परिवेश का सृजन करने के लिए प्रयास किए जाते हैं। यह संवाद वाचन, अभिनय या सामान्य पाठ वाचन द्वारा भी संभव हो सकता है।

1.3.3.

Programme Learnilng Outcome (कार्यक्रम अधिगम परिणाम)

1. पाठ को शुद्ध उच्चारण सहित पढ़ने की योग्यता का विकास
2. विविध शैलियेां एवं समीक्षात्मक दृष्टि का विकास करना
3. हिन्दी भाषा एवं उसके माध्यम से नैतिक मूल्यों के आधार बिन्दुओं की जानकारी देना, ताकि विद्यार्थियों में भाषा कौशल संबंधी समझ विकसित हो सके
4. भाषा का तर्कसंगत एवं व्यवस्थित ज्ञान कराना, जिससे विद्यार्थी भाषा कौशल संबंधी समझ विकसित हो सके
5. विद्यार्थियों में समीक्षात्मक दृष्टि का विकास करने का प्रयास करना

1.3.4 Course Learning Outcomes

(पाठ्यक्रम अधिगम परिणाम)
'हिन्दी भाषा एवं नैतिक मूल्य' पाठ्यक्रम का अधिगम परिणाम गुणवत्ता निरूपक दिखाई देता है। स्वतंत्रता एवं उत्तरदायित्व पाठ्यक्रम अधिगम परिणामों को सकारात्मक रू‍प में प्रस्तुत करने में सहायक सिद्ध होते हैं। शैक्षणिक संस्थान की उत्कृष्टता इस बात पर निर्भर करती है कि पाठ्यक्रम के अध्ययन पश्चात् उसके विद्यार्थी किस प्रकार के परिणाम प्राप्त कर रहे है? साथ ही यह भी महतवपूर्ण है कि वे अपने लक्ष्यों की पूर्ति में कितने सफल हैं। इस दृष्टि से नवाचार करने की स्वतंत्रता एवं परिणामों का उत्तरदायित्व लेने का बोध शिक्षक में होना चाहिए।

1.4 Assessment methods (मूल्यांकन पद्धतियॉ)

महाविद्यालय में 'हिन्दी भाषा एवं नैतिक मूल्य' विषय के मूल्यांकन हेतु यूजीसी निर्मित पाठ्यक्रम को ही आधार बनाया जाता है। आंतरिक मूल्यांकन हेतु 05 अंक निर्धारित है एवं परीक्षा कक्ष में 30 अंक का थ्योरी पेपर विद्यार्थियों को हल करना होता है। आंतरिक मूल्यांकन सीसीई हेतु दो प्राकर की परीक्षा प्रणाली अपनाई जाती है –

1. आलेख पद्धति (Assignment work)
2. बहुविकल्पीय पद्धति (MCQs)

विद्यार्थी इन पद्धतियों द्वारा आंतरिक मूल्यांकन में भाग लेते है।

Section 'B'

Detailed Syllabus based Course Learning Outcome

महाविद्यालयीन स्नातक स्तर पर पढ़ाए जा रहे सभसी वर्षों के पाठ्यक्रम की संरचना उसके अधिगम परिणामों के साथ यहॉ प्रस्तुत की जा रही है –

बी.एस.सी. प्रथम वर्ष (वार्षिक पद्धति)

हिन्दी भाषा एवं नैतिक मूल्य

(Hindi Language & Moral Values)

Units	Course Content	Course/Learning Outcomes : After Completion of the Course the students will be able to :
ईकाई 1 हिन्दी भाषा	पाठ 1 : स्वतंत्रता पुकारती (कविता)	1. जयशंकर प्रसार का जीवन परिचय 2. काव्य में निहित शब्दार्थ एवं भावार्थ 3. कविता का सारांश
	पाठ 2 : पुष्प की अभिलाषा (कविता)	1. कवि श्री माखनलाल चतुर्वेदी का जीवन परिचय 2. काव्य का भावार्थ एवं सारांश
	पाठ 3 : वाक्य संरचना और अशुद्धियॉ (संकलित)	1. वाक्य, अवयव, वाक्य के प्राकर एवं उउदाहरण 2. अशुद्धियों का अर्थ, उच्चारण, वर्तनीगत, शब्दागत शब्दार्थगत एवं वपाक्यगत अशुद्धियॉ 3. अशुद्धियों का निराकरण
इकाई 2	पाठ 1 : पूस की रात (कहानी)	1. श्री प्रेमचंद का जीवन परिचय 2. कहानी में वर्णित निम्नवर्ग की आर्थिक स्थिति 3. कहानी का उद्देश्य एवं सारांश
	पाठ 2 : अप्प दीपों भव (लेख)	1. श्री स्वमी श्रद्धानंद का जीवन परिचय 2. दीक्षांत समारोह की परम्परा एवं गरू महिमा (पाठ सारांश)
	पाठ 3 : पर्यायवाची, विलोम, कार्थी, अनेकार्थी एवं शब्द युग्म शब्द (संकलित)	1. पर्यायवायी श्ज्ञब्दों का अर्थ एवं उसके उदाहरण 2. विलोम शब्दों का अर्थ एवं उससे संबंधित उदाहरण 3. एकार्थी शब्द व उदाहरण 4. शब्दयुग्म शब्द एवं उनके उदाहरण

इकाई 3	पाठ 1 : भगवन बुद्ध (निबंध)	1. स्वामी विवेकानंद का जीवन परिचय 2. बौद्ध धर्म का वैशिष्ट्य एवं पाठ का मूल उद्देश्य
	पाठ 2 : कछुआ धरम (निबंध)	1. पाठ का सारांश एवं निहित भाव, शिल्पविन्यास 2. निबंध की विषयवस्तु एवं निबंध की विशेषताएँ
	पाठ 3 : नहीं रूकती है नदी (यात्रा संस्मरण)	1. लेखक श्री हीरालाल बाघेतिया का जीवन परिचय 2. नर्मदा के उद्गम स्थल, परिक्रमा सौंदर्य एवं प्रवाह पथ की जानकारी
इकाई 4	पाठ 1 : अफसर (निबंध)	1. लेखक श्री शरद जोशी का जीवन परिचय एवं योगदान 2. व्यंग्य विधा का परिचय एवं पाठ्यवस्तु का सारांश
	पाठ् 2 : भारत एक है (निबंध)	1. लेखक श्री रामधारी सिंह 'दिनकर' का परिचय 2. भारत की सांस्कृतिक एकता एवं विविधता की जानकारी 3. प्रस्तुत पाठ का सारांश एवं मूल उद्देश्य
	पाठ 3 : संक्षेपण (संकलित)	1. संक्षेपण का अर्थ एवं परिभाषाएँ 2. संक्षेपण के नियम एवं विधि
इकाई 5	पाठ 1 : नैतिक मूल्य – परिचय एवं वर्गीकरण (आलेख)	1. डॉ. शशि राय का जीवन परिचय 2. नैतिक मूल्यों का परिचय वर्गीकरण, अवधारणा, महत्व आदि का ज्ञान 3. नैतिक मूल्यों की विशेषताएँ परिवार एवं शिक्षण संस्थाओं की भूमिका
	पाठ 2 : आचरण की सभ्यता (निबंध)	1. लेखक श्री सरदार पूर्णसिंह का परिचय 2. आचरण की सभ्यता का महत्व, जीवन का परम उद्देश्य एवं समाज को संदेश
	पाठ 3 : अंतर्ज्ञान और नैतिक जीवन (निबंध)	1. लेखक श्री राधाकृष्णन का जीवन परिचय 2. धार्मिक चेतना एवं मानव मूल्यों की जानकारी 3. सृजनात्मक अंतर्ज्ञान एवं आध्यात्मिक चेतना का विकास 4. पाठ का मूल उद्देश्य एवं सारांश

बी.एस.सी. द्वितीय वर्ष (वार्षिक पद्धति) हिन्दी भाषा एवं नैतिक मूल्य
(Hindi Language and Moral Values)

Units	Course Content	Course/Learning Outcomes : After Completion of the Course the students will be able to :
ईकाई 1	पाठ 1 : वह तोड़ती पत्थर कविता (कविता)	1. महाकवि श्री सूर्यकांत त्रिपाठी 'निराला' का जीवन परिचय 2. काव्य का उद्देश्य, भावार्थ एवं परिस्थितिगत विश्लेषण
	पाठ 2 – दिमागी गुलामी (निबंध)	1. श्री राहुल सांकृत्यायन का जीवन परिचय 2. भारतीय जनमानस की मानसिकता एवं विदेशी मानसिकता का बोध
	पाठ 3 : वर्ण विचार (निबंध)	1. श्री विश्वनाथ प्रसाद मिश्र का जीवन परिचय 2. स्वयं–व्यंजन वर्गीकरण, उच्चारण स्थान आदि की जानकारी
इकाई 2	पाठ 1 : नारीत्व का अभिशाप (निबंध)	1. छायावादी कवियत्री महादेवी वर्मा का जीवन परिचय 2. भारतीय समाज में नारी की स्थिति एवं व्यवहार 3. नारी जाति का इतिहास एवं नारी के प्रति संवेदनशीलता
	पाठ 2 : चीफ की दावत (कहानी)	1. कथा लेखक श्री भीष्म साहनी का जीवन परिचय 2. संबंधकों की स्वार्थपरकता एवं लेखकीय संवेदनशीलता 3. कथा के तत्ववों के आधार पर कहानी की समीक्षा, चारित्रिक विशेषताएँ
	पाठ 3 : विराम चिन्ह (संकलित)	1. विराम चिन्हों की आवश्यकता, उपादेयता एवं महत्व 2. विराम चिन्हों की तालिका एवं क्रमवार विवरण व प्रयोग
इकाई 3	पाठ 1 : चली फगुनाहट बौरे आम (ललित निबंध)	1. निबंध लेखक श्री विवेकी राय का जीवन परिचय एवं पाठ भूमिका 2. भारतीय त्यौहार होली का सुरूचिपूर्ण वर्णन एवं प्रासंगिकता

	पाठ 2 : इन्द्रधनुष का रहस्य (वैज्ञानिक लेख)	1. डॉ. कपूरमल जैन का परिचय 2. प्रकाश का अपवर्तन, परावर्तन 3. सौर स्प्रेक्ट्रम, इन्द्रधनुष निर्माण की रोचक जानकारी
	पाठ 3 : संधि (संकलित)	1. संधि की परिभाषा, अर्थ, उदाहरण 2. संधि के प्रकार, उनकी परिभाषाएँ एवं उदाहरण
इकाई 4	पाठ 1 : सपनों की उड़ान (प्रेरक निबंध)	1. ए.पी.जे अब्दुल कलाम के उत्प्रेरक विचार 2. श्री कलाम की जीवन गाथा
	पाठ 2 : हमारा सौरमण्डल (संकलित)	1. सौरमण्डल की अवधारणा 2. सौरमण्डल के सभी ग्रहों का परिचय (वैज्ञानिक नामों सहित) 3. उल्कापिंड, आकाश गंगा के निर्माण की जानकारी
	पाठ 3 : प्रमुख वैज्ञज्ञनिक आविष्कार (संकलित)	1. आदिमकाल के आविष्कार 2. आधुनिक काल के विभिन्न आविष्कार 3. वैज्ञनिक आविष्कारों की प्रासंगिकता
	पाठ 4 : समास (संकलित)	1. समास का अर्थ, परिभाषाएँ उसके उदाहरण 2. समास के विभिन्न भेद एवं उनसे संबंधित उदाहरण
इकाई 5	पाठ 1 शिकागो व्याख्यान (व्याख्यान)	1. पाठ की पूर्व पीठिका एवं स्वामी विवेकानंद का अमेरिका प्रवास 2. पाठ में वर्णित भारतीय सभ्यता संस्कृति के विलक्षण तत्व
	पाठ 2 : धर्म और राष्ट्रवाद (लेख)	1. महर्षि अरविन्द का जीवन परिचय 2. सनातन धर्म से जुड़े पहलू 3. राष्ट्रवाद का अर्थ एवं उससे संबंधित श्री अरविंद के विचार
	पाठ 3 : सादगी (आत्मकथा)	1. महात्मा गांधी के जीवन अनुभव 2. जीवन में सादगी का महत्व
	पाठ 4 : चित्त जहॉ भयशून्य (कविता)	1. श्री रवीन्द्रनाथ टैगोर का जीवन परिचय 2. पराधीन भारत की युग चेतना 3. स्वतंत्रता प्राप्ति के प्रयास एवं योगदान संबंधी अवधारणा

बी.एससी. तृतीय वर्ष (वार्षिक पद्धति)
हिन्दी भाषा एवं नैतिक मूल्य
(Hindi Language and Moral Values)

Units	Course Content	Course/Learning Outcomes : After Completion of the Course the students will be able to :
ईकाई 1	पाठ 1 : मेरे सहयात्री (यात्रा वृतांत)	1. लेखक श्री अमृतलाल बेगड़ का जीवन परिचय 2. यात्रा वृतांत की विशेषताएँ 3. नर्मदा नदी का सौंदर्य एवं लेखकीय विचार
	पाठ 2 : मध्यप्रदेश की लोक कलाएँ (संकलित)	1. म.प्र. की संस्कृति का परिचय 2. म.प्र. की मालवी, बुंदेली, बघेली आदि लोककलाओं की जानकारी
	पाठ 3 : लोकोक्तियाँ एवं मुहावरे (संकलित)	1. लोकोक्तियों का अर्थ एवं विभिन्न उदाहरण 2. मुहावरें का अर्थ, परिभाषा एवं संबंधित उदाहरण 3. लोकोक्तियों एवं मुहावरों में अंतर
ईकाई 2	पाठ 1 : जनसंचार माध्यम (संकलित)	1. जनसंचार माध्यम का अर्थ 2. प्रिंट, इलेक्ट्रॉनिक एवं सोशल मीडिया की जानकारी
	पाठ 2 : दूरभाष और मोबाईल (संकलित)	1. दूरभाष (टेलीफोन) के आविष्कार की गाथा, प्रयोग 2. मोबाईल का इतिहास एवं इससे होने वाले लाभ व हानि
	पाठ 3 : संक्षिप्तियाँ (संकलित)	1. संक्षिप्ति का अर्थ, कोशगत परिभाषाएँ एवं उदाहरण 2. संक्षिप्ति की विशेषताएँ एवं प्रकार
इकाई 3	पाठ 1 : पत्रिकारिता के विभिन्न आयाम (संकलित)	1. पत्रकारिता का संक्षिप्त इतिहास 2. पत्रकारिता के विभिन्न प्रकार 3. अच्छे पत्रकार के गुण या विशेषताएँ
	पाठ 2 : मध्यप्रदेश का लोक साहित्य (संकलित)	1. म.प्र. के लोक साहित्य की विशेषताएँ एवं वर्गीकरण 2. म.प्र. की मालवी, बुंदेली, निमाड़ी आदि लोक साहित्य से संबंधित जानकारी 3.

	पाठ 3 : पत्र लेखन (संकलित)	1. पत्र लेखन के विभिनन प्रकारों की जानकारी व आवेदन करना 2. प्रारूपण, आदेश, परिपत्र, ज्ञापन, अनुस्मारक पत्र आदि के प्रारूप
इकाई 4	पाठ 1 : राजभाषा हिन्दी (संकलित)	1. हिन्दी की संवैघानिक एवम् व्यावहारिक स्थिति 2. संविधान में हिन्दी की स्थिति
	पाठ 2 : हिन्दी की शब्द संपादा (संकलित)	1. हिन्दी की शब्द संपदा के उदाहरण प्रस्तुत करना 2. तत्सम, तद्भव शब्द परिचय 3. देशज, विदेशज शब्द वर्गीकरण
	पाठ 3 : अनुवाद (संकलित)	1. अनुवाद का अर्थ, उदाहरण 2. अनुवाद के विभिन्न प्रकार 3. अनुवाद : विभिन्न उदाहरण
इकाई 5	पाठ 1 : विश्व के प्रमुख धर्म एवं महत्वपूर्ण विशेषताएँ	1. हिन्दू धर्म विषयक अवधारणा 2. जैन धर्म की जानकारी 3. बौद्ध धर्म : उद्भव, विकास 4. सिक्ख धर्म की मान्यताएँ 5. ईसाई धर्म की जानकारी 6. इस्लाम धर्म से संबंधित तथ्य
	पाठ 2 : सत्य के प्रयोग (महात्मा गांधी की आत्मकथा का संक्षिप्त संस्करण)	1. महात्मा गांधी का बचपन 2. विवाह एवं वकालत 3. विदेश जाना एवं प्रतिज्ञा 4. शाकाहार संबंधीप्रयोग 5. धर्म की झाँकी 6. असहयोग आंदोलन 7. उपसंहार

BCA Department-LOCF

1. Introduction

Computer Application (BCA) has been evolving as an important branch of science and engineering throughout the world in last couple of decades and it has carved out a space for itself like any other disciplines of basic science and engineering. Computer Application is a discipline that spans theory and practice and it requires thinking both in abstract terms and in concrete terms. Nowadays, practically everyone is a computer user, and many people are even computer programmers. Computer Application can be seen on a higher level, as a science of problem solving and problem solving requires precision, creativity, and careful reasoning. The ever-evolving discipline of Computer Application also has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both Computer Application expertise and knowledge of the particular application domain.

Computer Application has a wide range of specialties. These include Computer Architecture, Software Systems, GraphiBCA, Artificial Intelligence, Computational Science, and Software Engineering. Drawing from a common core of Computer Application knowledge, each specialty area focuses on specific challenges. Computer Application is practiced by mathematicians, scientists and engineers. MathematiBCA, the origins of Computer Application, provides reason and logic. Science provides the methodology for learning and refinement. Engineering provides the techniques for building hardware and software.

Universities and other HEIs introduced programmes of studies in computer application as this discipline evolved itself to a multidisciplinary discipline. Information Technology is growing rapidly. Increasing applications of computers in almost all areas of human endeavor has led to vibrant industries with concurrent rapid change in technology. Unlike other basic disciplines, developing core competency in this discipline that can be reasonably stable becomes a challenge. In India, it was initially introduced at the Master (postgraduate) level as MCA and M.Tech. Later on, engineering programmes such as B.Tech and B.E in Computer Application & Engineering

and in Information Technology were introduced in various engineering College/Institutions to cater to the growing demand for trained engineering manpower in IT industries.

1.2 Learning outcomes-based approach to curriculum Enrichment and Execution Disciplinary knowledge:

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes across all undergraduate programs in science, humanities, commerce and professional streams of higher education including Computer Application.

- **Communication Skills:**

The ability to communicate clearly and to work well in a team setting is critical to sustained and successful employment. Good communication and social skills involve the ability to listen to, as well as clearly express, information back to others in a variety of ways - oral, written, and visual - using a range of technologies. BCA courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc. SEC are at least 2 courses for Honors courses and 4 courses for General bachelor programmes. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work. The main purpose of these courses is to provide students life-skills in hands-on mode to increase their employability. The list provided under this category are suggestive in nature and each university has freedom to suggest their own papers under this category based on their expertise, specialization, requirements, scope and need.

- **Critical thinking.**

  The main objective of this whole exercise is to prepare a comprehensive course structure with detailed syllabus along with quality reading material in order to have a uniform standard of education in undergraduate Computer Application programme in the country. This document shall serve as a model document across the higher education institutes (HEIs) in the country for teachers, students and academic administrators. It is a student centric framework where they are expected to learn fundamentals of Computer Application along with the latest trends and techniques like Artificial Intelligence, Internet of Things, Machine Intelligence along with advanced skillsets that include Mobile Application Development, Object Oriented Programming among many other courses.

- **Problem solving**:

The course is aimed to develop problem-solving strategies, techniques and skills that can be applied to computers and problems in other areas which give students an introduction to computer and analytical skills to use in their subsequent course work and professional development. Emphasis of this course is to act as an introduction to the thinking world of computers, to help students develop the logic, ability to solve the problems efficiently using C programming. Knowledge in a programming language is prerequisite to the study of most of computer science courses. This knowledge area consists of those skills and concepts that are essential to problem solving and programming practice independent of the underlying paradigm.

Analytical reasoning:

Analytical aptitude questions and answers with explanation pdf, Logical / Analytical Reasoning, logical reasoning questions and answers pdf, in English language.

Logical reasoning involves puzzles in which the relationship among the groups of objects, people, cities and activities etc. is given. In such questions, a bunch of information is given that creates a puzzle in candidate's mind. the candidates are required to keep in mind these conditions, analyze the relationship and arrange them in suitable form to answer the questions. some basic suggestions to solve analytical reasoning questions.

. To solve these questions, students need to arrange the complicated set of information. so, read them carefully.

. Rather using lengthy expressions, use initials and symbols to save time.

. while reading the set of information, highlight the key words.

. Now, arrange the set of information in list, table or diagram.

try to eliminating the answer choices, then work through the remaining choices to get the correct answer.

- **Research-related skills:**

Computer and information research scientists create and improve computer software and hardware.

Creating and improving software involves working with algorithms, which are sets of instructions that tell a computer what to do. Some computing tasks are very difficult and require complex algorithms. Computer and information research scientists try to simplify these algorithms to make computer systems as efficient as possible. The algorithms allow advancements in many types of technology, such as machine learning systems and cloud computing.

Computer and information research scientists design new computer architecture that improves the performance and efficiency of computer hardware. Their work often leads to technological advancements and efficiencies, such as better networking technology, faster computing speeds, and improved information security. In general, computer and information research scientists work at a more theoretical level than do other computer professionals.

Some computer scientists work with electrical engineers, computer hardware engineers, and other specialists on multidisciplinary projects. The following are examples of types of specialties for computer and information research scientists:

Data science. Computer and information research scientists write algorithms that are used to detect and analyse patterns in very large datasets. They improve ways to sort, manage, and display data. Computer scientists build algorithms into software packages that make the data easier for analysts to use. For example, they may create an algorithm to analyse a very large set of medical data in

order to find new ways to treat diseases. They may also look for patterns in traffic data to help clear accidents faster.

Robotics. Some computer and information research scientists study how to improve robots. Robotics explores how a machine can interact with the physical world. Computer and information research scientists create the programs that control the robots. They work closely with engineers who focus on the hardware design of robots. Together, these workers test how well the robots do the tasks they were created to do, such as assemble cars or collect data on other planets.

Programming. Computer and information research scientists design new programming languages that are used to write software. The new languages make software writing more efficient by improving an existing language, such as Java, or by making a specific aspect of programming, such as image processing, easier.

- **Cooperation/Team work:**

Teamwork is recognized as an important skill for engineering and computer science professionals. Both potential employers and accrediting agencies, such as ABET, expect students to gain proficiency in teamwork skills through experiential learning. Teamwork based projects challenge the student to apply the technical knowledge they gain in school to solve meaningful and complex problems. However, to be truly proficient in teamwork, a student must also learn and practice a large number of peripheral skills. These include planning, estimating, tracking progress, taking corrective actions, managing change, controlling and managing risks, maintaining ethical and professional conduct, communicating complex ideas clearly and concisely, using design automation tools, leveraging web-based tools for team collaboration, and most importantly participating effectively as team members. It is essential that students should be taught these important skills. It is unlikely that without adequate faculty guidance students can pick up these skills through ad-hoc project experience. Yet, many engineering and computer science programs expect the students to do just that. We feel strongly that we need to employ a more pragmatic approach in teaching students the skills necessary to function as effective and productive team members. Additionally, we need to develop criteria for assessing the effectiveness of teaching teamwork and the tools to measure learning outcomes. Among the problems contributing to this situation are the following: engineering and computer science instructors themselves often have

had little or no experience operating in teams; training or guidance in effective ways to teach teamwork is seldom provided; and tools and effective approaches to assist in the teaching and assessment of teamwork are lacking.

- **Scientific reasoning:**

Computer scientists typically work on the theoretical side of computer systems, as opposed to the hardware side on which computer engineers mainly focus (although there is overlap). Although computer scientists can also focus their work and research on specific areas (such as algorithm and data structure development and design, software engineering, information theory, database theory, computational complexity theory, numerical analysis, programming language theory, computer graphics, and computer vision), their foundation is the theoretical study of computing from which these other fields derive.

- **Reflective thinking:**

This study aims to examine reflective capacity among students when learning about computers in education. The study involved 35 e-portfolios written by first-year students who enrolled on the Computers in Education course in the Faculty of Education, Universiti Kebangsaan Malaysia. All the students taking this course were required to publish "reflections" based on their weekly learning activities via individual e-portfolios. Thematic analysis was done using Nvivo 10 software to categorize the content of the students' reflections. The analysis reveals that a large percentage of the "reflections" were non-reflective rather than reflective actions. This finding has implications for the way the course is designed, requiring a supportive environment, mentoring and group discussions, as reflective thinking is not spontaneous, but should be deliberately stimulated by the educational context.

- **Information/digital literacy:**

Digital Literacy Program is a web based self E-Learning System with Online Exam Project features. This is an asp.net project that provides end to end solution. This project can be used by any university or institution. In brief *Digital Literacy Program project* gives a worldwide connectivity to spread knowledge. The idea behind this project is to provide the opportunity to all

those who cannot afford full time school/college. This platform provides an opportunity to gain knowledge and get certificate after attending final online examination system.

- **Self-directed learning:**

At B.C.A. our Teaching/Learning Methodology is based on the principles of Self-Directed Learning, known to B.C.A. as "U Direct Learning". At B.C.A. we believe that preparing students to gain admissions into university programs is half the battle. Preparing students with the confidence and critical thinking abilities needed to manage the coursework, learning environment at the university as well as meet dynamic expectations of their future employers, is vital to the academic and professional success of students. To this end, we employ the use of teaching/learning strategies that prepare our students for the task ahead.

- **Multicultural competence:**

Multicultural competency is defined as the knowledge, skills and personal attributes needed to live and work in a diverse world. Kansas State University acknowledges the importance of helping students develop these multicultural competencies. In 2000-2001 the Tilford Group conducted focus groups with faculty and students. The following synthesis of multicultural competencies was compiled as a result of what was learned from those and subsequent discussions.

- **Moral and ethical awareness/reasoning:**

The scope of the term "computer ethics" varies considerably. It can include such social and political issues as the impact of computers on employment, the environmental impact of computers, whether or not to sell computers to totalitarian governments, use of computers by the military, and the consequences of the technological and thus economic divisions between developed countries and poor countries. It can include personal dilemmas about what to post on the Internet and what to download. In this chapter we focus more narrowly on a category of professional ethics, similar to medical, legal, and accounting ethics, for example. We consider ethical issues a person might encounter as a computer professional, on the job. Professional ethics includes relationships with and responsibilities toward customers, clients, coworkers, employees, employers, others who use one's products and services, and others whom they affect. We examine ethical dilemmas and guidelines related to actions and decisions of individuals who create or use

computer systems. We look at situations where you must make critical decisions, situations where significant consequences for you and others could result

- **Avoid unethical behavior**

Unethical behaviors can plague a workplace, whether an executive steals money from the company or an associate falsifies documents. Unethical behaviors can damage a company's credibility, causing the business to lose customers and ultimately shut down. However, business owners and their management teams can work with employees to prevent unethical behaviors.

- **Leadership readiness/qualities:**

This overview provides an outline of all content components of this spotlight that are published on The Knowledge Loom Web site. The creator of this document may have printed only selected content from this spotlight. View complete content online (http://knowledgeloom.org/). The nation's schools have benefited from a wave of financial, political, and community support for the incorporation of technology in the learning process. Legislation such as the Improving America's Schools Act of 1994 and the Telecommunications Act of 1996 resulted in the development of a national educational technology plan, "Getting America's Schools Ready for the 21st Century," as well as significant funding, including the E-rate. Despite these and similar initiatives that have successfully provided access to technology, software, and teacher training, numerous studies and reports have shown that schools are still struggling to effectively use technology to improve teaching and learning. Technology integration is a complex challenge that is not easily addressed with a single intervention. While access to technology and teacher training are important, other key elements are necessary to ensure the effective use of technology in schools. One such element is leadership. The following principles, drawn from the findings of recent research, will help leaders-school administrators, technology staff, and innovative practitioners-make informed decisions and support the effective integration of technology.

- **Lifelong learning:**

The rapid development of ICTs influenced the educational branches of lifelong training, continuing vocational training and distance training. The arrival of modern web-based technologies and broadband networks also brought the arrival of e-learning and Open and Distance

Learning (ODL), considering that most of the teaching is carried out remotely in space and time. Under this scope, introduced the idea of virtual class for the electrical engineering sector which emphasized the need for the development of training courses connected with enterprise needs. And since individuals in order to maintain their employability need to return to education and training at different stages of their working life, it could be argued that lifelong learning has become a reality. Innovations in ICTs and the development of electronic learning could prove very appealing to small and medium enterprises that have to deal with financial, attitudinal and technological barriers. Conducted a research in North Wales, which is a rural and peripheral area, exploring employee and employers' attitudes towards e-learning. According to the findings, electronic learning encounters obstacles such as employers' attitudes and the lack of the fundamentals of computer systems. A positive approach towards e-learning is required by both employers and employees to encourage engagement in future learning as a means of developing the skills of employees and owner/managers and providing access to new opportunities for learning and development. The establishment of learn direct centers in local communities where existing and potential employees can access personal and work-related learning, under the umbrella of the University for Industry (which was renamed 'learn direct') was an UK government initiative aimed to provide a national infrastructure for lifelong learning.

- **1.3.2 Qualification descriptors LOCF Learning Outcome Based Curriculum frame work Adopted by UGC Qualification descriptors for a Bachelor's Degree programme :**

The Learning Outcome-based Curriculum Framework in Computer Application is aimed at allowing flexibility and innovation in design and development of course content, in method of imparting training, in teaching learning process and in assessment procedures of the learning outcomes. The emphasis in Computer Application courses, in outcome-based curriculum framework, help students learn solving problems, accomplishing IT tasks, and expressing creativity, both individually and collaboratively. The proposed framework will help Students learn programming techniques and the syntax of one or more programming languages.

Many of the learning outcomes of Computer Application can be achieved only by programming a computer for several different meaningful purposes. All students must, therefore, have access to a computer with a modern programming language installed.

Computer Application framework does not prescribe a specific language. The teacher and students will decide which modern programming languages students will learn. More importantly, students will learn to adapt changes in programming languages and learn new languages as they are developed.

The present Learning Outcome-based Curriculum Framework for bachelor's degrees in BCA is intended to facilitate the students to achieve the following:

- To develop an understanding and knowledge of the basic theory of Computer Science and Information Technology with good foundation on theory, systems and applications such as algorithms, data structures, data handling, data communication and computation.
- To develop the ability to use this knowledge to analyze new situations.
- To acquire necessary and state-of-the-art skills to take up industry challenges. The objectives and outcomes are carefully designed to suit to the above-mentioned purpose.
- The ability to synthesize the acquired knowledge, understanding and experience for a better and improved comprehension of the real-life problems.

The undergraduate programs in Computer Application builds on science-based education at +2 level. The +2 senior secondary school education aims and achieves a sound grounding in understanding the basic scientific temper with introduction to process of computation by introducing some programming languages. This prepares a young mind to launch a rigorous investigation of exciting world of Computer Application.

Framing and implementation of curricula and syllabi is envisaged to provide an understanding of the basic connection between theory and experiment and its importance in understanding the foundation of computing. This is very critical in developing a scientific temperament and to venture a career which a wide spectrum of applications as well as theoretical investigations. The undergraduate curriculum provides students with theoretical foundations and practical experience in both hardware and software aspects of computers. The curriculum in Computer Application is integrated with courses in the sciences and the humanities to offer an education that is broad, yet

of enough depth and relevance to enhance student employment opportunities upon graduation. As a Bachelor's degree program, the curriculum is based on the criterion that graduates are expected to function successfully in a professional employment environment immediately upon graduation.

1.3.3 Programme learning outcomes

These outcomes describe what students are expected to know and be able to do by the time of graduation. They relate to the skills, knowledge, and behaviors that students acquire in their graduation through the program

Programme Learning Outcomes for BCA

The Bachelor of Science with Computer Application (BCA) program enables students to attain, by the time of graduation:

PLO-A. Demonstrate the aptitude of Computer Programming and Computer based problem solving skills.

PLO-B. Display the knowledge of appropriate theory, practices and tools for the specification, design, implementation

PLO-C. Ability to learn and acquire knowledge through online courses available at different MOOC Providers.

PLO-D. Ability to link knowledge of Computer Application with other two chosen auxiliary disciplines of study.

PLO-E. Display ethical code of conduct in usage of Internet and Cyber systems.

PLO-F. Ability to pursue higher studies of specialization and to take up technical employment.

PLO-G. Ability to formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate.

PLO-H. Ability to operate, manage, deploy, configure computer networks, hardware

software operation of an organization.

PLO-I. Ability to present result using different presentation tools.

PLO-J. Ability to appreciate emerging technologies and tools.

1.3.4 Course learning outcomes

The IT Specialist program has program-level learning outcome defined for the both the certificate and associate degree programs, as well as, course-level learning outcomes defined for individual courses. The program-level learning outcomes define the high-level skill and knowledge areas in which students should be able to demonstrate competency upon the completion of the certificate or associate degree programs. Course-level learning outcomes define the specific skills and knowledge students should be able to demonstrate upon completion of a given course. The course-level learning outcomes are intended to be consistent with and used to build towards the program-level learning outcome.

Program Purpose: The IT Specialist Certificate program focuses on teaching students the essential skills required to effectively use and troubleshoot computers and computer applications.

Learning Outcomes: Students who earn the IT Specialist Certificate will have the IT Technical Skills required to effectively use and troubleshoot computers and computer applications in the following areas:

- **Applications**

  Students will learn to use and configure essential office applications including word processing, spreadsheets.

- **Operating Systems**

  Students will learn essential operating systems skills including how to use, setup, configure, troubleshoot and maintain a current microcomputer operating system.

- **Internet Technologies**

  Students will develop a basic understanding of technologies and protocols used on the Internet, and how to effectively use Internet tools technologies including current web-

based applications, e-mail, and social networking tools; developing searching strategies; and basic web authoring.

Learning Outcomes: Students who earn the IT Specialist A.A.S. will have the IT Technical and Professional Skills to implement, support, and troubleshoot computer and information technology systems in the following areas:

- **Computer Technology Trouble shooting**

  Students will learn essential IT support skills including installing, configuring, securing and troubleshooting operating systems and hardware. Students will learn to diagnose and solve operating system and hardware problems.

- **Network Infrastructure Support and Troubleshooting**

  Students will learn essential networking skills including installing, configuring, securing and troubleshooting the devices, protocols and services within a network infrastructure. Students will learn to diagnose and solve network problems.

- **Systems Administration**

  Students will learn essential systems administration skills related to server operating systems, system and network service administration, computer and information security, and directory services administration.

- **Cyber security**

  Students will learn the skills and knowledge required to support and secure network environments.

- **Independent Thinking and Research**

  Students will learn to research technology problems, provide technology support, and to learn new technology tools. Students will learn to acquire new skills, independently, in order to keep their skills current.

- **Human Relations and Technical Support**

  Students will learn to help other technology users, develop training and maintenance

plans and to translate their technical knowledge so that others can use it. Students will also learn to respect and meet the diverse technical support needs of computer users.

- **Professional Practices**

  Students will learn to document their work, write clearly and appropriately in an Information Technology context, respect user's data, including backup and security, and to think through the ethical consequences of Information Technology decisions.

Detailed Syllabus based course learning outcome

Class – BCA 1st year
Paper – Digital Electronics

Unit	Topic	Outcome
1	Data types and Number systems, Binary number system, Octal & Hexa-decimal number system, I's & 2's complement! Binary Fixed-Point Representation, Arithmetic operation on Binary numbers, Overflow & underflow, Floating Point Representation, Codes, ASCIL EBCDIC codes, Gray code, Excess-3 & BCD, Error detection & correcting codes	Upon successful completion of the program, students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
2	Logic Gates, AND, O& NOT GATES and their Truth tables, NOR, NAM) & XOR gates, Boolean Algebr4 Basic Boolean Law's, DeMorgan's theorem, MAP Simplification. Minimization techniques, K-Map, Sum of Product & Product of Sum	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications.

		• Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
3	Combinational & Sequential circuits, Half Adder & Full Adder, Full subtractor, Flip -flops- RS, D, JK & T Flip-flops, Shift Registers, RAM and ROM, Multiplexer, Demultiplexer, Encoder, Decoder, Idea about Arithmetic Circuits, Program Control, Instruction Sequencing	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
4	I/O Interface, Properties of simple I/O devices and their controller, isolated versus memory-mapped VO, Modes of Data transfer, Synchronous & Asynchronous Data transfer, Handshaking Asynchronous serial transfer, VO Processor.	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and

		presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
5	Auxiliary memory, Magnetic Drum, Disk & Tape, Semi- conductor memories, Memory Hierarchy, Associative Memory, Virtual Memory, Address space & Memory Space, Address Mapping, Page table, Page Replacement, Cache Memory, Hit Ratio, Mapping Techniques,	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced sheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

Class BCA 1st year
Paper - Mathematical Foundation of Computer Science

Unit	Topic	Outcome

1	Types of errors, Error approximation, truncation error, rounding error. Solution of transcendental equation by: Bisection, false position, Newton-Raphson Methods	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
2	Introduction and Approximation: Polynomial interpolation, Newton and Languages interpolation. Approximation of function by Taylor series, Numerical integration: Simpson's one third rule, Gauss quadrature formula.	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

3	Sets and Relation: Combinations of sets, finite and infinite sets, countable and uncountable infinite sets, Order sets. Properties of Binary Relations. Partial Ordering relations and Lattice.	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
4	Formal Languages and Finite Automata: Regular expressions, finite Automata from Regular Expression to finite Automata, Minimizing the number of States of DFA. Phrase structure Grammers, Types of Grammer and Languages	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

5	Graphs, Trees and Cut-Sets:Basic Terminology, Multigraphs and weighted graphs, Paths and Circuits, Shortest Paths, Eulerian Paths and circuits, Hamiltonian paths and circuits. Rooted tree Path lenglh in rooted trees, Binary search trees,Spanning trees, Minimum spanning trees	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

Class – BCA 1st year
Paper - Operating Systems and System Software

Unit	Topic	outcome
1	Introduction to Operating Systems: Operating system services, multiprogramming, time-sharing system, storage stuctures, system calls, multiprocessor system. Basic concepts ofCPU scheduling, Scheduling criteria, Scheduling algorithms, algorithm evaluation, multiple processor scheduling, real time scheduling, I/O devices organization, l/O devices organization, 1/0 devioes organization, I/O buffering	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions.

		• Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
2	Process concept3 process scheduling, operations on processes, threads, inter-process communication, precedence graphs, critical section problem, semaphores, problems of synchronization, Deadlock problem: deadlock characterization, deadlock prevention. deadlock avoidance, deadlock detection, recovery from deadloch Methods for deadlock handling.	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
3	Concepts of memory management: logical and physical address space, swapping, contiguous and Non- contiguous allocation, paging, segmentation, and paging combined with segmentation.	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism.

		• Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
4	Concepts of virtual memory, demand paging, page replacement algorithms. allocation of frames, thrashing, demand segmentation, Security threads protection, Intruders- Viruses- trusted system	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
5	Disk scheduling, file conoepts, file access methods, allocation methods, directory systems, file protection, introduction to distributed systems and parallel processing case study.	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications.

		• Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

Class –BCA 1st year
Paper - Financial Accounting and Principle of Management

Unit	topic	Outcome
1	The basic Financial Accounts, types of accounts, Rules of Entries of transactions, Journals.Cash Book - Types, Format of Cash Boolq Balancing of Cash Book, Subsidiary books - Purchase, Sales. Purchase return and sales return. Ledger, posting of entries	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
2	Trial Balance, Rectification oferrors, adjustment entries. Depreciation	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications.

	and Inflation. Principles ofCost Accounting, Valuation of Stocks, Allocation ofOverheads, Methods of material issues.	• Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
3	Pay roll departrnent, preparation of pay roll, Preparation of wage record, Methods of payments of wages, overview of computerized method for payroll preparation. Inventory account and store record, inventory or stock control and cost accounting, Department demand and supply method of stock control. Classification and condition of material Report on	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

	material handling. Overview of computerized accounting process - Introduction to accounting system software, their features and some basic operations	
4	Management Concept: Managements, Administration, Organization Management and Administration, Difference and Relationship between Organizations, importance of Management, characteristics of Management. Scientific Management, Principles of Management, Process of Management, Functions of Management, Levels of Management, Project Management	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
5	Decision Making: Introduction	Upon successful completion of the program, Students will have the skills to:

	and Definition, Types of Decision, Techniques	• Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

Class – BCA 1st year
Paper - Fundamental of Computers and PC-Packages

Unit	topic	outcome
1	Computer Fundamental: Characteristics of Computers, History of Computer, Evolution of Computers, Computer Generations, Types of Computer, Components of a Computer: Registers, Instruction Set, Bus Architecture, Computer	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions.

	Hardware: Input Devices, Output Devices, Storage Devices: Primary Storage capacity, Memory Types, Memory Measuring Units, Secondary Storage Device Software and Computer Applications: Software &Software Types, Computer Languages, Compiler, Interpretet Editor, Computer Ethics, Computer applications, Introduction of Programming: Procedure Oriented Programming, Object oriented programming, Concepts used in OOP, Benefits of OOP, Main advantages and disadvantage of OOp, Applications of OOP, OOP vs. POP	• Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

2	Operating System Overview: Computer System Startup, Computer System Structure, computer system components, operating System classifications, operating System Services, Major. Functions of operating system, Process Management, cpu Scheduling, Scheduling Criteria, Memory and File Management: Memory Management Requirements, Swapping, Memory Management Techniques, Virtual Memory, File Management, Fite Access Method, Protection. Introduction to DBMS: File System, Traditional File Oriented	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

	Approach, DBMS- Advantages and Disadvantage Role of DBMS, Three views of data, DBMS Architecture. Data Models, Data Independence, Major components of DBMS, Data Dictionary, Types of Users, DBMS applications, Keys in Databases, Database Languages.	
3	introduction to computer Networks: computer Network Definition, Importance of Networking, Types of Networks, Network Topology, Advantages and Disadvantage of computer Networks, Applications of computer networks, Reference Model, Intimet. introduction to Internet Technology,	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

	Electronic Mail, World Wide Web. MS windows: Introduction to MS windows; Features of windows; working with windows; My computer & Recycle bin; Desktop, Icons and windows Explorer; Screin description & working styles of windows; Dialog Boxes & Toolbar; working with files & FoldersiSimple operations like copy, delete, moving of files and folders from onl drive to another; Accessories and. windows settings using control panel-setting common devices using control panel, modem, printers, audio, network, fonts, creating users, internet settings, Start bitton & program lists ;Installing	

	and uninstalling new Hardware & software program on your computer.	
4	MS word Basics - Introduction to MS office; introduction to MS- word; Features & area of use, working with MS- word; Menus & commands; Toolbars & Buttons; shortcut Menus, wizards & Templates, creating a New Document; Different page views and Layouts; Applying various Text Enhancements; working with - Styles, Text .Attributes; paragraph PaBe. Formatting; Text Editing using various features; Bullets, Numbering, Auto formatting, Advanced Features of MS-	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

	word- Spell check, Thesaurus, Find & Replace; Headers & Footers: Inserting- Page Number, Pictures, Files, Autotexts, Symbols etc.; working with columns, Tab& Indents; Creation and working with Tables including conversion to and from text; Margins and Space management in Documents; Adding references and Graphics; Mail Merge, Envelops & mailing Labels. Importing and Exporting to and from various formats.	
5	MS Excel: Introduction and area of use; working with MS Excel: concept of workbook and worksheet; Using Wizards; Various Data Types; Using dilferent	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and

	features with Data, Cell and Texts; Inserting, Removing & Resizing of Columns & Rows; Working with Data & Ranges; Different views of Worksheet; Column Freezing, Labels, Hiding, Splitting etc.; Using different features ofData and Text; Use ofFormulas, Calculation & Functions; Cell formatting including Borders and Shading; Working with Different Chart Types; Printing of Workbook & Worksheets with Various options. MS PowerPoint: Introduction and area of use; Working with MS PowerPoint; Creating a New Presentation; Working with Presentation; Using Wizards; Slides &its Different	presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

	Views; Inserting, Deleting and Copying of Slides; Working with Notes, Handouts; Columns and Lists; Adding Graphics, Sounds and Movies to a slide; Working with PowerPoint Objects; Designing and Presentation ofa Slide Show; Printing hesentations; Notes, Handouts witl print options.	

Class – BCA 1st year
Paper Programming and Problem Solving in C

Unit	Topic	Outcome
1	hobble identificatiorq analysis, design, coding, testing & debugging, implementation, modification & maintenance, algorithms & flowcharts, Characteristics of a good program - accuracy, simplicity, robustness, portability,	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types. Develop confidence for self education and ability for life-long learning needed for

	minimum resource & time requirement, modularization; Rule V conventions of coding, documentation, naming variables; Top down design; Bottom-up design	Computer language. Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. • Maintain quality assurance through critically evaluating procedures and results.
2	History of C, Structure of a C program, Data types, Constant & Variable, Operators & expressions, Control Constructs - if-else, for, while, do-while, Case statement, Arrays, Formatted & unformatted VO, Type modifiers & Storage classes, Ternary operator, Type	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications.

	conversion & type casting, Priority & associatively of operators.	• Evaluate, select and use office productivity software appropriate to a given situation. Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications
3	Functions, Arguments, return value, Parameter passing - call by value, call by reference, return statement, Scope, visibility and life time rules for various types of variable, static variable, calling a function, Recursion - basics, comparison with iteration, tail recursion, when to avoid recursion examples	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications
4	Special constructs - break, continue, exitQ, goto& labels; pointers - &and * operators, pointer expression, pointer arithmotic, dynamic memory	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage.

	management functions like malloc0, cilloc0, freeQ, String, Pointer to function, Function to parameter, structure - basic, declaration, membership operator, pointer to structure, referential operator, self-referential structures, structure within structure, array in structure, array of structures, Union - basic, declaration: Enumerated data type, Typedef, Command line argument	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation.
5	File handling and related functions: pdntf &scanf family, c preprocessor-basics, # Include, # define, # undef, conditional compilation directive like #if, #else, #endif, #ifdefand	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Upon successful completion of the program, Students will have the skills to:

	#ifndef, Variable argument list functions. File.system_ basics, The file pointer, Opening a file, Closing a file, Writing a character, Reading a character, Using fopen0, getcO,putc0, and fclose0, Using feofO, divorcing with string fputsO and fgetsQ, Standard streams in c, Flushing a stream, using teaog ano dritei;, Direct access file, fseek Q and random access printf Q and fscanfe	• Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications

Class – BCA 2nd year

Paper - Data Structure using C++

Unit	Topic	Outcome
1	Overview of C++: Object oriented programming, Concepts, Advantages, Usage.Classes &Objects: Classes, Structure & classes, Union & Classes, Friend function, Friendclasses, Inline function, Scope resolution operator, Static class members: Static data member,Static member function, passing objects to function, Returning objects, Object assignment.Array, Pointers References & The Dynamic Allocation operators: Anay of objects,Pointers to objecl Type checking C+ pointers,The This pointer, Pointer to derived types, Pointer to class members, C++'s dynamic allocation operators, Initializing allocated memory,Allocating Array, Allocating objects	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types. Develop confidence for self education and ability for life-long learning needed for Computer language. Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications.

		• Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications.
2	Constructor &I)estructor:Introduction, Constructor, Parameterized constructor, Multipleconstructor in a class, Constructor with default argument, Copy constructor, Default Argument, Destructor.Function & Operator Overloading: Function Overloading, Overloading constructor, Operator Overloading, Creating a member operator function, Operator overloading using friend function	• Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. • Maintain quality assurance through critically evaluating procedures and results.
3	Inheritance: Base class Access control, protectedmembers, protected base class inheritance,inheriting multiple base classes, Constructors, destructors &Inheritance,when constructor & destructor function are executed, passing parameters to base class constructors, Grantingaccess. Virtual base classes. Virtual functions &Polymorphism: Virtual function, Pure Virtual functions, Early Vs. late binding.The C+ VO system basics: C#	• Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases.

	streams, The basic stream classes: C** predefined streams, Formatted U0: Formatting using the IOS members, Setting the format flags, Clearing formatflags, An overloaded form of setfQ, Examining the formatted flags, Setting all flags, using widthQ, precision0 and fi110, Using manipulators to format VO, Creating your own	• Maintain quality assurance through critically evaluating procedures and results.
4	The concept ofdata structure, Abstract data t)?e, Concept oflist & array Introduction to stack, Stack as an abstmct data type, primitive operation on stack, Stacks application: Infix, Post fix, Prefix and Recursion, Multiple Stack. Introduction to queues, Primitive Operations on the Queues, Queue as an abstract data type, Circular queue, Dequeue, Priority queue, Applications Of queue. Introduction to the Linked Lis! Basic operations on linked list, Stacks and queues linked lisq Header nodes, Doubly Linked List, Circular Linked List, Application oflinked List.	• Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. • Maintain quality assurance through critically evaluating procedures and results.
5	Analysis of algorithm, complexity using big 'O' notation. Searching; linear search, Binary search, their comparison, Sorting: insertion sort, Selection sort. Quick sort, Bubble sor! Heap sort, Comparison ofsorting methods, Hash Table, Collision resolution Techniques. TREES Basic	• Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions.

	Terminology, Binary Trees, Tree Representations using Anay & Linked Lis! Basic op€ration on Binary Trees Traversal of binary trees: - In order, Preorder &Post order, Application of Binary tree, Binary tree representation of trees. Introduction to graphs, Definition, Terminology, Directed, Undirected & Weighted graph, Representation of graphs, Graph Traversal-Depth first & Breadth first search. Spanning Trees	• Solve a range of problems using office productivity applications, and adapt quickly to new software releases. • Maintain quality assurance through critically evaluating procedures and results.

Class – BCA 2nd year

Paper - DBMS & RDBMS

Unit	Topic	Outcome
1	DBMS Concepts and architecture Introduction, Review of file organization techniques, Database approach v/s Traditional file accessing approach, Advantages of database systems, Data models, Schemas and instances, Data independence, Functions of DBA and designer. Entities and attributes, Entity types, Value, Sets, Key attributes, Relationships, Defining the E-	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications.

	R diagram of database, Various data models: Basic concepts of Hierarchical data model. Network data model, and Relational data model, Comparison between the three types of models	• Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
2	Relational Data models: Domains, Tupleq Attributes, Relations, Characteristics of relations, Keys, Key attributes ofrelation, Relational database, Schemas, Integrity constraints, Intension and Extension, Relational Query languages: Relational algebra and relational calculus, Relational algebra operations like select, Project, Join, Division, outer union et	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

3	SQL: Data definition in SQL, Brief History and overview of Sql, Sql Basic: Creating a Database, Adding Tables, Adding Records, Removing and Modifing records, executing queries, Data types: Numeric, String, Date & Time, Operators: Arithmetic, Comparison, Logical, Functions: Math Function, Aggregate, String, Date & Time	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
4	Data Base Design: Introduction to normalization, Normal forms, Functional dependency, Decomposition, Dependency preservation and losslessjoin, problems with null valued and dangling tuples, multivalued dependencies. Distributed databases, protection, security and	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and

	integrity constraints, concurrent operation on databases, recovery, transaction processing, basic concepts ofobject oriented data base system and design, CODD's rule	presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications, and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results
5	Relational Database Design: pitfalls in relational database design, subqueries, overview of subqueries, types ofsub- query: Where/Having Clause, subqueries and from clause, Subqueries and Joins. Security, Access Control and Privilege: Granting, Revoking & Viewing user privileges, commit and roll back. Transaction, Acid Properties of Transaction	Upon successful completion of the program, Students will have the skills to: • Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • Solve a range of problems using office productivity applications,

		and adapt quickly to new software releases. Maintain quality assurance through critically evaluating procedures and results

BCA 3rd year

Paper- java

Unit	Topic	Outcome
1	C++ Vs JAVA, JAVA and Interne€t and WWW, JAVA support systems, JAVA environment, JAVA program structure, Tokens, Statements, JAVA virtual machine, Constant & Variables, Da ta Types, Declaration of Variables, Scope of Variables, Symbolic Constants, Type Casting. Operators: fuithmetic, Relational, Logical Assignments, Increment and Decrement, Conditional, Bitwise, Special, Expressions & its evaluation. If statemen! If...Else… statement Nesting of If. . .else. . . statements, else.. .if Ladder, Switch, ? operators, Loops- While, Do, For, Jumps in Loops, Labelled Loops.	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types.

		Develop confidence for self education and ability for life-long learning needed for Computer language.
2	Defining a Class, Adding Variables and Methods, creating objects, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting ofMethods. Inheritance: Extending a Clasg Overriding Methods, Final Variables and Methods, Final Classes, Finalize Methods, Abstract methods and Visibility Conhol	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able

		to define union and enumeration user defined data types. Develop confidence for self education and ability for life-long learning needed for Computer language.
3	Arrays: One Dimensional & two-Dimensional strings, Vectors, wrappe Classes, Defining Interface Extending Implementing Interface, Accessing Interface Variable, System packages, Using System Package, adding a Class to aPackage, Hiding Class	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Able to define data types and use them in simple data processing applications also

		he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types. Develop confidence for self education and ability for life-long learning needed for Computer language.
4	Creating Threads, Extending the Threads Class, Stopping and Blocking a Thread, Life Cycle of a Thread, Using Thread Methods, Thread Exceptions, Thread priority, Synchronization, Implementing the Runnable Interface	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. Able to define data types and use them in simple data processing applications also

		he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types. Develop confidence for self education and ability for life-long learning needed for Computer language.
5	Local and Remote Applets Vs Applications, Writing Applets, Applets Life Cycles,creating an Executable Applet, designing a Web Page, Applet Tag, Adding Applet to HTML File. Running the Applet, Passing Parameters to Applets, Aligning the Display, HTML Tags & App	Upon completion of this course, students will acquire knowledge about: Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems. Demonstrate an understanding of computer programming language concepts. To be able to develop C programs on linux platform. Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage.

		Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types. Develop confidence for self education and ability for life-long learning needed for Computer language.