2023

Govt. Kamla Nehru Mahila Mahavidyalaya Damoh

- **AISHE ID: C-19132**
- **Established in 1964**
- **First & only Women College in Damoh Region**
- **Affiliated to Maharaja Chhatrasal Bundelkhand University, Chhatrapur**

Criterion 2

Teaching-learning and Evaluation.

2.6 Students Performance and learning outcomes.

2.6.1 Programmed Outcomes (POs) and Course Outcomes (COs) for all Programmed offered by the institution are stated and displayed on website.

2.6.2 Attainment of POs and COs are evaluated. Explain with evidence in a maximum of 500 word.

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Date- 13/06/2023

Declaration

This is to declare that the information, reports, true copies and numerical data etc. Furnished in this file as supporting documents is verified by IQAC and found correct.

Hence this certificate

Dr. P. L. Jain
13/6/23

Dr. G. P. Choudhary
13/6/23

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2.6 Students Performance and learning outcomes.

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LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION

INTERNAL QUALITY ASSURANCE CELL

Govt. Kamla Nehru Mahila Mahavidyalaya, Damoh

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION

SECTION A

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 initiativesarerequiredforinstitutionalizingan outcome-orientedhighereducation 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 researchacrossallhighereducationinstitutions;technologyuseandintegration 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 governitselfthrough coordinated regulatory reform and increasing both public and private sector investment in higher education, with special emphasis on targeted and effective equity-related initiatives.

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 ofknowledge,

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 completingaparticular programme of study areexpected toknow, understandandbeabletodoattheendoftheirprogrammeofstudy.

It may be noted that the learning outcomes-based curriculum framework in this collegenotonlyintend to promote designing of a syllabus for a programme of study or learning contents of courses within each programmeofstudyortoprescribeaset 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 completionoftheprogrammeofstudy;
- 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 programmesandacademicstandards.

Key outcomes underpinning curriculum enrichment and execution

The learning outcomes-based curriculum framework for undergraduate education is aframeworkbasedon theexpectedlearningoutcomesandacademicstandardsthat are expected to be attained by graduates of a programme of study and holder of a qualification.Thekeyoutcomesthatunderpincurriculumenrichment andexecutio

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

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 expectedtobeacquiredbyagraduate throughstudiesattheinstitution.
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 definethecharacteristicsofastudent'suniversitydegreeprogramme anddescribe a set of characteristics/competencies that are transferable beyond study of a particularsubjectarea andprogrammecontextsinwhichtheyhavebeendeveloped. 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 previouslearninglevelsandexperiences,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,includingglobalcompetenciesthatall students in different academic fields of study should acquire/attain and demonstrate. Some of the characteristicattributes thatagraduateshould demonstrate are asfollows:

- ***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, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theoriesbyfollowing 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 lifesituations.
- ***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 orinvestigation.
- ***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 andwork efficiently asa member of a team.
- ***Scientific reasoning:*** Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences fromanopen-mindedandreasonedperspective.
- ***Reflective thinking:*** Critical sensibility to lived experiences, with self awareness and reflexivity of bothselfandsociety.

- ***Information/digital literacy:*** Capability to use ICT in a variety of learning situations, demonstrateabilitytoaccess,evaluate, anduseavarietyofrelevant informationsources;and useappropriatesoftwareforanalysisofdata.
- ***Self-directed learning:*** Ability to work independently, identify appropriate resources requiredforaproject,andmanageaprojectthroughtocompletion.
- ***Multicultural competence:*** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural societyandinteractrespectfullywithdiversegroups.
- ***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 identifyethical issues related toone's work.

avoid unethical behavior such as fabrication, falsification or misrepresentation of dataor committing plagiarism, notadheringtointellectualpropertyrights; 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 ateam who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide peopletothe right destination, in asmooth andefficientway.
- ***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,meetingeconomic,social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

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 attitudesand values that the holders of the qualification are expected to attain and demonstrate. These descriptors also indicate the common academicstandardsforthequalificationandhelpthedegree- awarding bodies in designing, approving, assessing and reviewing academic programmes.Thelearningexperiencesandassessmentprocedures are expected to be designed to provide every student with the opportunity to achieve the intended programme learning outcomes. The qualification descriptors reflect both disciplinaryknowledge andunderstandingaswellasgenericskills,includingglobal competencies that all students in different academic fields of study should acquire/attain anddemonstrate.

Qualification descriptors for a Bachelor's Degree programmed: Thestudentswho complete three years of full-time study of an undergraduate programme of study willbeawardedaBachelor'sDegree.Someof theexpectedlearningoutcomesthata student should be able to demonstrate on completion of a degree-levelprogramme 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'sspecializationandcurrentdevelopmentsintheacademicfieldofstudy.

- 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 andtechniques of the subject(s);
- Meet one's own learning needs, drawing on a range of current research and development workand 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 andemployment opportunities.

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 globalskillsandcompetencies,theachievementofwhichthe 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 ofthe level of competence ofgraduates ofagiven programme of study.

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 aclosely 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 accordingtothe preferencesofindividualstudentthatmaybeverydifferentfromthecoursesof study pursued by anotherstudent ofthesame programme.

Course-level learning outcomes will be aligned to programme learning outcomes. Course-level learning outcomes are specific toacourse of study within agiven programme of study. The achievement by

students of course-level learning outcomesleadtotheattainmentoftheprogrammelearningoutcomes. Atthecourse level, eachcoursemaywell havelinkstosomebut not all graduateattributesas theseare developedthroughthetotalityofstudentlearningexperiencesacrossthe 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 forteaching therein becomes critical. Every programme of study lends itself to well- structured and sequenced acquisition of knowledge and skills. Practical skills, includinganappreciationofthelinkbetweentheoryand experiment,willconstitute animportantaspectoftheteaching-learningprocess.Teachingmethods,guided by such a framework, may include: lectures supported by group tutorial work; practicumandfield-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 tofield sites, and industrial or other research facilities etc.

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.Progresstowardsachievementoflearning outcomesisassessedusing 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 anyother pedagogicapproaches asperthecontext.

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.

	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

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.

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	C) Organo metallic Compounds D) 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
	and Nucleic Acids	• Learn the types and structure of proteins. • Learn the biological functions of proteins. • Understand the composition of nucleic acids and able to distinguish the structural features of RNA and DNA.
Unit IV	Amino Acids, Peptides, Protein	• Understand the essential and non essential amino acids. • Able to apply the knowledge in genetic studies during post graduation and research area. • Understand the stereochemistry of amino acids.

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

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

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

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

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

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

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

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

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

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.

Chemistry I (MCH-402) Paper: Organic

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	Mossbauer 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 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:

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.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

FOR UNDERGRADUATE EDUCATION

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION
SECTION A

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 highereducation.

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.

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:

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.

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 andarguments;
- 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 thesubject(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.

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.

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 course,s 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.

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 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

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 andunderstand-
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 importantfamilies.
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 Prochlorophyte, Charophyta, Chlorophyta, Xanthophyte, 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	Pteridophyte	Morphology, structure, reproduction and life history of pteridophyte. Distribution & classification. Evolution of stele, Heterospory & origin of seed habit.
Unit-V	Pteridophyte	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 methane 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 ofworms, 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

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.

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 andstart 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) fordata collection.

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:

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 shoulddemonstrate 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 diseasesetc.).
- **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 orinvestigation.

- **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 ofdata.
- **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 diversegroups.
- **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 ofwork.
- **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.

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 andunderstanding 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 professionalmaterials;
- 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

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 andprovide a broad picture of the level of competence of graduates of a given programme of study.

Course learning outcomes:

The programme learning outcomes are attained by learners through the essential learnings acquiredon 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.

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 andexperiment, 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.

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. Kamla Nehru Mahila Mahavidyalaya Damoh M.P.

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 celldivision

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 offrog
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 Protochordateanimals. ● 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 ofplacenta.

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.

DEPARTMENT OF PHYSICS

Course/Learning outcomes

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 offorces.
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 ofthermodynamics. • 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 changethe entropy of the universe in a reversible and irreversible process. • The second law of thermodynamics in terms ofentropy. • 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'sconstant • 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-perotinterferometer.
Unit III	Diffraction	• Understand that how to determine the resolving power of Telescope and microscope • Differentiate between Fresnel's and Fraunhoferdiffraction. • 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 useCapacitors. • 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 boundaryconditions. • wave function for ground state. • Know about Rigid rotator.
Unit III	Atomic Spectroscopy	• Understand the concepts ofSpectra. • 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 ofnucleus. • 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 ofSemiconductors • 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 Barkhausencriterion • 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.

हिन्दी भाषा एवं नैतिक मूल्य

प्रस्तावना

1.1 समय सूचना क्रांति आधुनिक समय में विद्यार्थी मातृभूमि, अपनी मातृभाषा से रहे– यह महत्वपूर्ण है। हिन्दी नैतिक मूल्य का स्नातक स्तर अधिगम आधारित पाठ्यक्रम कुछ उददेश्यों 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 निर्माण की सार्थकता इसी बात में है कि विद्यार्थी विज्ञान विषय के होकर 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।

Learning outcomes
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

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 शैलियों 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 पद्धतियाँ)

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 यहाँ 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 :
इकाई 1 हिन्दी भाषा	पाठ 1 : स्वतत्रता 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 सरचना और अशुद्धियॉ (संकलित)	1. वाक्य, अवयव, वाक्य के प्राकर एव 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 दीपो 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 शब्दों का अर्थ एव 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 2. बौद्ध धर्म का वैशिष्ट्य एवं पाठ का मूल उद्देश्य
	पाठ 2 : कछुआ धरम (निबंध)	1. पाठ का **साराश** एव 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 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**
	पाठ 2 : भारत एक है (निबंध)	1. लेखक श्री रामधारी सिंह 'दिनकर' का परिचय 2. की सांस्कृतिक जानकारी 3. **सारांश**
	पाठ 3 : **सक्षेपण (सकलित)**	1. **सक्षेपण** का अर्थ एव 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
	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

	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 (सकलित)	1. संधि की परिभाषा, 2. उदाहरण
इकाई 4	पाठ 1 : सपनों की उड़ान (प्रेरक निबंध)	1. ए.पी.जे अब्दुल कलाम के उत्प्रेरक विचार 2. श्री कलाम की
	पाठ 2 : हमारा सौरमण्डल (संकलित)	1. सौरमण्डल की अवधारणा 2. सौरमण्डल के सभी ग्रहों का (वैज्ञानिक नामों सहित) 3. उल्कापिंड, आकाश गंगा के निर्माण की जानकारी
	पाठ 3 : प्रमुख वैज्ञानिक आविष्कार (संकलित)	1. आदिमकाल के आविष्कार 2. आधुनिक काल के विभिन्न आविष्कार 3. वैज्ञानिक आविष्कारों की प्रासंगिकता
	पाठ 4 : समास (सकलित)	1. समास का अर्थ, परिभाषाएँ उसके उदाहरण 2. समास के विभिन्न भेद एव उनसे संबंधित उदाहरण
इकाई 5	पाठ 1 शिकागो व्याख्यान (व्याख्यान)	1. पाठ की पूर्व पीठिका एव 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 जहाँ भयशून्य (कविता)	1. श्री रवीन्द्रनाथ टैगोर का जीवन परिचय 2. पराधीन भारत की युग चेतना 3. स्वतंत्रता प्राप्ति के प्रयास एव 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 :
इकाई 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 : लोकोवितियाँ एव मुहावरे (संकलित)	1. लोकोक्तियो का अर्थ एव विभिन्न उदाहरण 2. मुहावरें का अर्थ, परिभाषा एवं संबंधित उदाहरण 3. लोकोक्तियों एवं मुहावरों में अंतर
इकाई 2	पाठ 1 : जनसचार 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 : सक्षिप्तियाँ (सकलित)	1. संक्षिप्ति का अर्थ, कोशगत परिभाषाएँ एव 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 एव वर्गीकरण 2. म.प्र. की मालवी, बुंदेली, निमाड़ी आदि लोक साहित्य से संबंधित जानकारी 3.

	पाठ 3 : पत्र लेखन (सकलित)	1. पत्र के विभिनन प्रकारों जानकारी व आवेदन करना 2. प्रारूपण, आदेश, परिपत्र, ज्ञापन, अनुस्मारक सूचना आदि के प्रारूप
इकाई 4	पाठ 1 : राजभाषा हिन्दी (संकलित)	1. हिन्दी की संवैधानिक एवं व्यावहारिक स्थिति संविधान में
	पाठ 2 : हिन्दी की शब्द संपादा (संकलित)	1. हिन्दी की शब्द सपदा के उदाहरण प्रस्तुत करना 2. तत्सम, तद्भव शब्द परिचय 3. देशज, विदेशज शब्द वर्गीकरण
	पाठ 3 : अनुवाद (सकलित)	1. अनुवाद का अर्थ, उदाहरण 2. अनुवाद के विभिन्न प्रकार 3. अनुवाद : विभिन्न उदाहरण
इकाई 5	पाठ 1 : विश्व के प्रमुख धर्म 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 आत्मकथा का संक्षिप्त संस्करण)	1. महात्मा गाधी 2. विवाह एवं वकालत 3. विदेश जाना एवं प्रतिज्ञा 4. शाकाहार संबंधीप्रयोग 5. धर्म की झाँकी 6. असहयोग आदोलन 7. उपसंहार

2.6.2 Attainment of POs and COs are evaluated. Explain with evidence in a maximum of 500 word.

The process for the evaluation of the students in different subjects is followed as per the rules and regulations of the University and Department of Higher Education M.P. The implementation of the syllabus with changes and the process of evaluation of the learners are monitored by the University, Management of the college and the principal. Programs run by institution have been framed by the University thus course objectives, course outcomes, and mainly depend upon the intentions of the university. In relation with these outcomes the institute have framed some on the basis of overall experience of the university and tried to follow it in the favor of the students. The program outcome is analyzed on basis of university result which is recorded in the college. Some of the steps taken by the institution for the attainment of Course Outcomes (CO) are as follows:

Remedial classes/Extra classes , Group Based Learning (GBL), WhatsApp study groups for providing notes/guidance/home work, Educational tours/Site visits/field visits, etc. Guest lectures.

At the institution level evaluation of attainment of Program Outcomes and Course Outcomes is done through:

1) **Direct method**
   - **Internal (CCE through different modes)**

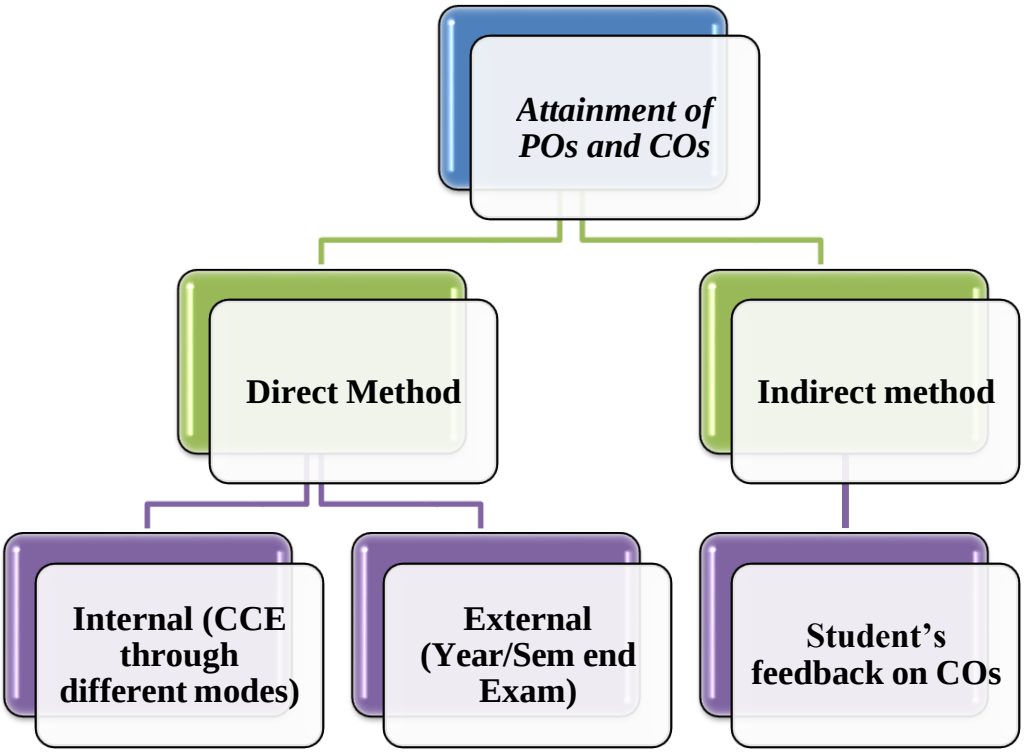
   The Continuous Comprehensive Evaluation (CCE) of the students are done keeping in mind the Cos Varying methods such as Class Tests, Presentations, Group Discussions, Quizzes, Role plays, etc. are used for evaluation.
   - **External (Year/Sem end Exam)**

   The attainment of COs is measured in the Year/Sem end exam through Practical / written examinations based on the questions framed as per the Cos 2)
2) **Indirect method**
   - **Student's feedback on COs**

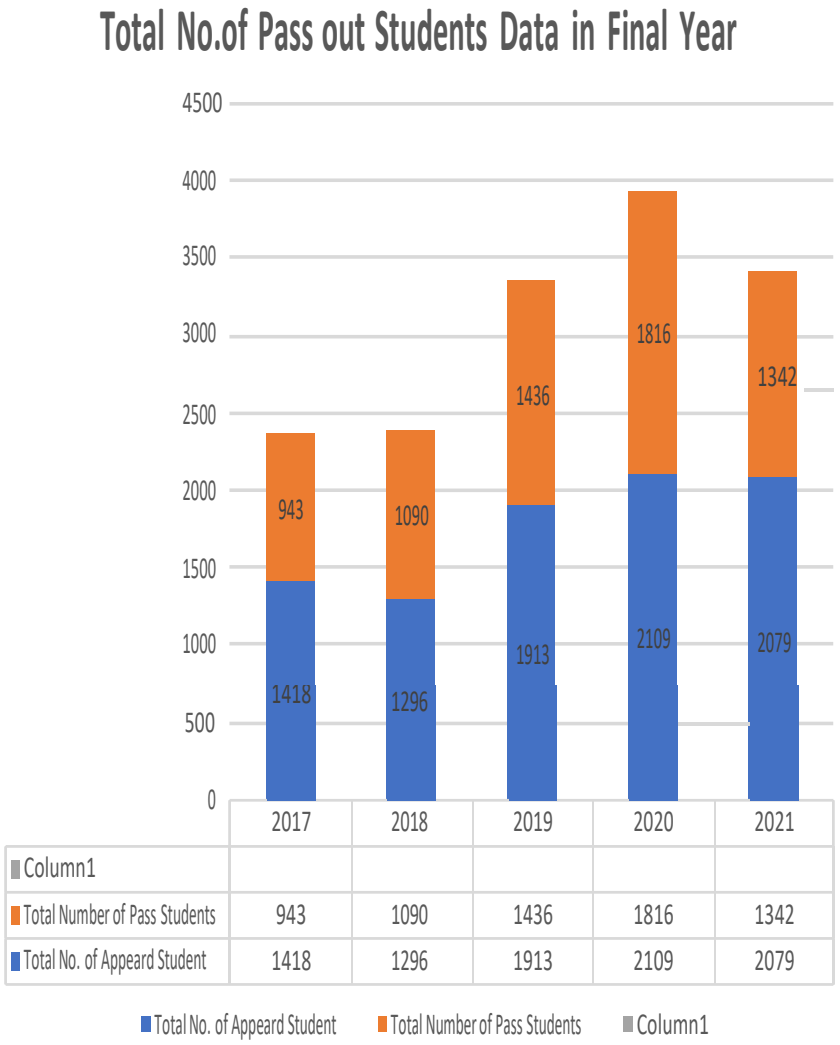
     The Feedback Review on the attainment of Cos

The attainment of POs and COs are gathered for different courses, and then calculations are

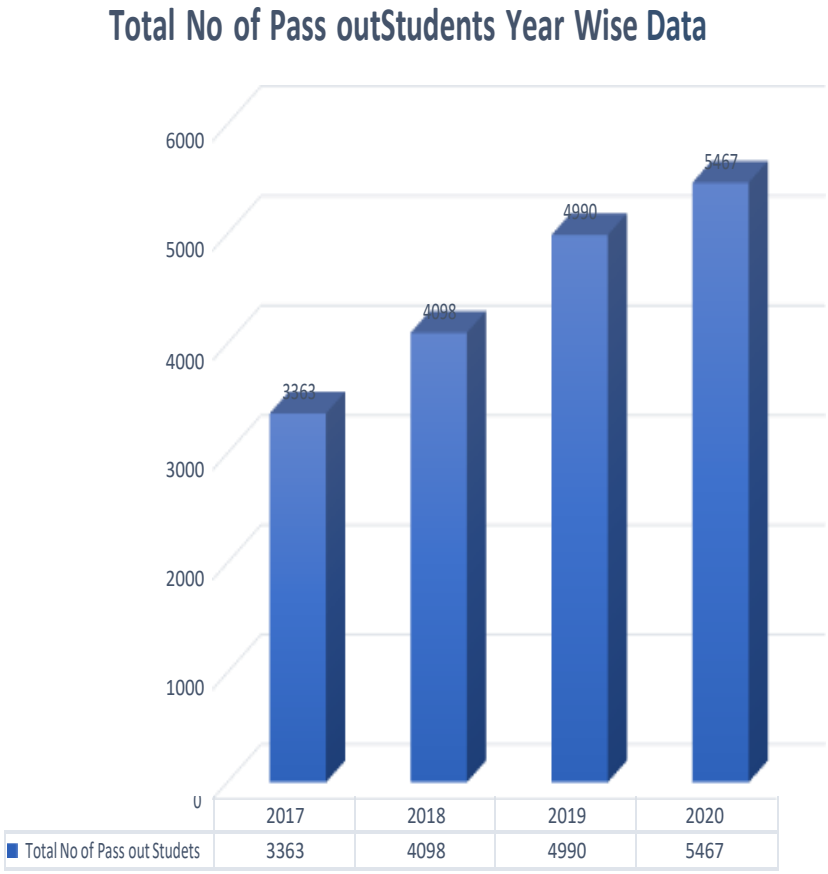
done for measuring the level of attainment of the outcomes.



Total No. of Appeared students and total number of pass out students in UG final year and PG final Year.



Total Number pass out students Year wise results , Its results also available on the Maharaja Chhatrasal Bundelkhand university Chhatarpur.



Policy

The institution has an efficient mechanism of internal and external assessment which is transparent in the conduct and also in the rectification of grievances. The grievances are solved with utmost priority in a time-bound manner. The institution strictly follows the guidelines of the affiliated university while conducting the internal assessment and end-semester examinations.

If the girl students studying in the college have problems related to the examination, such as absent in the theory or practical examination, then the student comes to the college with his problem. If the student is absent in the theory examination, and then they contacts the exam centre, in-charge of the examination centre. They send the information of the above candidate to the registrar of the university. They resolved the problem of the students.

Similarly, if the student is absent in the practical examination, and then he contacts the head of the department, the head of the department sends the information of the above student to the university within three days. From there his problem is solved. If the student is absent in the practical examination, the college with a fee of Rs 1500 it is conducted in the college. Students also can give the exam in any college of the district where the examination is not conducted with a fee of Rs. 1000 can be included.

GOPAL PRASAD CHAUDHARI

Digitally signed by GOPAL PRASAD CHAUDHARI
DN: c=IN, postalCode=470661, st=MADHYA PRADESH, street=DAMOH,SHAKTI NAGAR COLONY ,470661, l=DAMOH, o=Personal, serialNumber=0edc34c85ca0a3e50f3bd468779a974c8853bfae13d292f510d141b9a31801cc, pseudonym=29793a41afde4cd380b1a9ad1dedc48f, 2.5.4.20=ced6a32ff8f92e3b8641da0d0358bb6229b679cea1dbfededf73eea3ad08e7a82, email=PRINCIPALKNMM@GMAIL.COM, cn=GOPAL PRASAD CHAUDHARI
Date: 2023.06.30 15:44:59 +05'30'

Signature Principal