

B.Sc. Part I: Paper I (B-101) Diversity Viruses, Bacteria and Fungi

After completing this paper students will be able to understand and explain:

- History, nature and classification of Viruses
- Genome organization and replication of TMV, Bacteriophages and viroids
- Techniques in plant viruses - purification, serology and electron microscopy
- Economic importance of viruses
- History, nature and classification, bacterial genome and plasmids of Bacteria
- Bacterial reproduction, techniques of sterilization and staining
- Economic importance of Bacteria
- History, nature and classification, thallus organization and reproduction of fungi
- Economic importance of fungi.
- The life cycles of *Albugo*, *Pythium*,; *Saccharomyces*, *Aspergillus*; *Ascobolus*; *Ustilago*, *Puccinia*, *Polyporus*, *Agaricus*; *Fusarium*, *Cercospora*.

B.Sc. Part I: Paper II (B-102) Diversity of Algae, Lichens and Bryophytes

After completing this paper students will be able to understand and explain:

- General characters and range of thallus organization of Algae
- Classification and ultrastructure of eukaryotic algal cell and cyanobacterial cell
- Economic importance of Algae
- The characteristics and life cycles of *Oscillatoria*, *Volvox*, *Hydrodictyon*, *Oedogonium*, *Chara*, *Navicula*, *Vaucheria*, *Ectocarpus*, *Saragassum* and *Polysiphonia*.
- Classification and thallus organization of Lichens
- Reproduction and physiology, ecological and economic importance of lichens.
- General characters, classification, reproduction and affinities of Bryophytes.
- Gametophytic and sporophytic organization of *Riccia*, *Marchantia*, *Anthoceros* and *Pogonatum*.

B.Sc. Part I: Paper III (B-103) Diversity of Pteridophytes, Gymnosperms and Elementary Palaeobotany

After completing this paper students will be able to understand and explain:

- General features, classification, stelar system (with its evolution) of Pteridophytes
- Heterospory and seed habit.
- Comparative study of morphology, anatomy, development, vegetative and reproductive systems of *Lycopodium*, *Selaginella*; *Rhynia Pteridium*, *Equisetum*. *Marsilea*.
- General characters, classification, affinities and relationship and evolutionary significance of Gymnosperms
- Comparative study of morphology, anatomy, development of vegetative and reproductive parts in: *Cycas*, *Pinus* and *Ephedra*.
- Elementary Palaeobotany: general account, types of fossils, methods of fossilization and geological time scale.

B.Sc. Part II: Paper I (B-201) Diversity of Angiosperms: Systematics, Development & Reproduction

After completing this paper students will be able to understand and explain:

- Principles of classification, Binomial nomenclature; comparative study of different classification systems, viz. Linnaeus, Bentham & Hooker, Engler & Prantl, Hutchinson, and Cronquist. Herbarium techniques and important Botanic Gardens.
- Taxonomic study of following families and their economic importance (Dicots): Ranunculaceae, Malvaceae, Brassicaceae, Cucurbitaceae, Rosaceae, Leguminosaceae, Myrtaceae, Rutaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Asteraceae, Rubiaceae, Verbenaceae, Euphorbiaceae, and Amaranthaceae.
- Monocots: Cyperaceae, Poaceae, Arecaceae, Liliaceae.
- External morphology of vegetative and floral parts; modifications – phyllodes, cladodes, and phylloclades.
- Meristems-kinds study of tissue system - epidermal, ground, and vascular.
- Anatomy of roots, stems, and leaves. Cambium - its function and anomalies in roots and stems; root -shoot transition.
- Structure and development of male and female gametophytes – microsporogenesis microgametogenesis, megasporogenesis, and megagametogenesis, embryo sac types.
- Double fertilization development of embryo, endosperm development and its morphological nature, apomixis and polyembryony.

B.Sc. Part II: Paper II (B-202) Cytology, Genetics, Evolution & Ecology

After completing this paper students will be able to understand and explain:

- Cell structure: cell organelles, nucleus, chromosome structure, nucleosome and solenoid model, salivary gland, lampbrush and B chromosomes.
- Cell division: mitosis, meiosis; their significance, chromosomal aberrations, cell cycle.
- Genetics: laws of inheritance; gene interaction; linkage and crossing over;
- Cytoplasmic inheritance; sex determination.
- Mutation: spontaneous, induced mutations, molecular mechanism and evolutionary significance;
- Polyploidy origin, kinds and role in evolution.
- Evidences and theories of evolution.
- Ecology, relation with other disciplines.
- Plant types: Hydrophytes - *Hydrilla*, *Eichhornia*, *Nymphaea*, *Typha*.
- Xerophytes – *Nerium*, *Casuarina*, *Asparagus*, *Calotropis*, *Parkinsonia*.
- Plant succession – xeroseres, hydroseres.
- Ecosystems - concept, basic types, components, & functioning.
- Food chain, food web, energy flow and productivity.

B.Sc. Part II: Paper III (B-203) Plant Physiology and Biochemistry

After completing this paper students will be able to understand and explain:

- Plant and water relationship, colligative properties of water.
- Water uptake, conduction, transpiration, mechanism and its regulation by environmental variables.
- Mineral Nutrition : Macro, and micronutrients, their role, deficiency and toxicity symptoms, plant culture practices, mechanism of ion uptake and translocation.
- Photosynthesis and Chemosynthesis : photosynthetic pigments, O₂ evolution, photophosphorylation, CO₂ fixation – C-3, C-4 and CAM plants.
- Respiration : aerobic and anaerobic respiration, respiratory pathways glycolysis, krebs 'cycle, electron transport, oxidative phosphorylation, pentose phosphate pathway, photorespiration, cyanide resistant respiration.
- Lipid biosynthesis and its oxidation.
- Nitrogen metabolism : atmospheric nitrogen fixation, nitrogen cycle, nitrogen assimilation,
- Growth: general aspects of phytohormones, inhibitors-auxins. kinetin, gibberellins, and ethylene: action and their application; photoperiodism and vernalization.
- Germination, growth movements, abscission and senescence.
- Biomolecules : Classification, properties and biological role of carbohydrates, Protein and lipids
- Chemistry of nucleic acids, vitamins.
- Discovery and nomenclature. Characteristics of enzymes, concepts of holoenzyme, apoenzyme, coenzyme and cofactors.
- Regulation of enzyme activity, Mechanism of action.
- Bioenergetics: Laws of thermodynamics, concept of Gibb's free energy and high energy compounds.

B.Sc. Part III: Paper I (B-301) Plant Resource utilization, Palynology, Plant Pathology and Biostatistics

After completing this paper students will be able to understand and explain:

- Centres of diversity of plants, origin of crop plants.
- Domestication and introduction of crop plants.
- Basic concepts of Plant Breeding, hybridization, heterosis.
- Concepts of sustainable development; cultivation, production and uses of - wheat, rice, legumes, sugarcane
- A general account of plants yielding oils, spices, beverages.
- An account of major fiber, medicinal, petro plants of Uttar Pradesh.
- Etiology of viral, bacterial, fungal and insect-pest diseases: mosaic diseases on tobacco, and cucumber, yellow vein mosaic of bhindi; citrus canker, potato scab, little leaf of brinjal; damping off of seedlings late blight of potato, red rot of sugarcane
- Integrated pest disease management

- An introductory knowledge of palynology, morphology, viability and germination of pollens.
- Classification of data, mean, median and mode. Standard deviation, standard error, variance, co-relation, χ^2 test and experimental designs

B.Sc. Part III: Paper II (B-302) Molecular biology and biotechnology

After completing this paper students will be able to understand and explain:

- Nucleic acid as genetic material, nucleotides, structure of nucleic acids
- Properties of genetic code, codons assignments, chain initiation of codons
- Mechanism of protein synthesis and its regulation
- Replication of DNA in prokaryotes and eukaryotes
- Gene expression and regulation
- Hormonal control and second messengers Ca^{2+} , Cyclic AMP, IP3 etc.
- Introduction to biotechnology, recombinant DNA technology
- Biotechnology and healthcare, IPR issues
- Plant tissue culture, methods of gene transfer, transgenic plants
- Microbial and environmental biotechnology.

B.Sc. Part III: Paper III (B-303) Environmental Botany

After completing this paper students will be able to understand and explain:

- Mineral resources of planet earth and conservation of mineral resources.
- Soils: types, properties and various problem soils;
- Water: the source of water, physico-chemical and biological properties of water.
- Sustainable management of water;
- Energy resources in India;
- Forests: global forest wealth, importance of forests, deforestation.
- Environmental pollution: air, water, soil, radioactive, thermal and noise pollutions, their sources, effects and control.
- Greenhouse effect, ozone depletion and acid rain.
- CO₂ enrichment and climate change.
- Biodiversity: biotic communities and populations, their characteristics and population dynamics.
- Phytogeography: Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, endemism.
- Conservation of plants resources for agriculture and forestry.
- *In situ* conservation sanctuaries, national parks, biosphere reserves, wetlands, mangroves.
- *Ex situ* conservation; botanical gardens, field gene banks, seed banks, cryobanks.

COURSE OUTCOME OF STATISTICS

Programme Outcomes (POs)-

Students having Degree in B.Sc. (with Statistics) should have knowledge of different concepts and fundamentals of Statistics and ability to apply this knowledge in various fields of industry. They may pursue their future career in the field of Statistics and Research.

Programme Specific Outcomes (PSOs)-

After completing B.Sc. (with Statistics) the student should have

- Knowledge of different concepts, principles, methodologies and tools (skills) of statistics.
- Ability to collect, tabulate, represent graphically, analyze and interpret data/information by using appropriate statistical tools.
- Ability to identify and solve a wide range of problems in real life/industry related to Statistics.
- Familiarity with computational techniques and statistical software including programming language (e.g. R) for mathematical and statistical computation.
- Capability to use appropriate statistical skills in interdisciplinary areas such as finance, health, agriculture, government, business, industry, telecommunication and bio-statistics.
- Ability to compete with industrial/private sector demand in the field of data analysis, marketing survey, etc. in professional manner and pursue their future career in the field of Statistics.
- Ability to develop original thinking for formulating new problems and providing their solutions. As a result, they will be able to pursue higher studies or research in the field of Statistics.

Course outcomes:

Course Code: -B060101T Year: First Semester: First

Course Title: Descriptive Statistics (Univariate) and Theory of Probability

After completing this course a student will have:

- Knowledge of Statistics, its scope and importance in various fields.
- Ability to understand concepts of sample vs. population and difference between different types of data.
- Knowledge of methods for summarising data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.
- Ability to describe data with measures of central tendency and measures of dispersion.
- Ability to understand measures of skewness and kurtosis and their utility and significance.
- Ability to understand the concept of probability along with basic laws and axioms of probability.
- Ability to understand the terms mutually exclusive and independence and their relevance.

- Ability to identify the appropriate method (i.e. union, intersection, conditional, etc.) for solving a problem.
- Ability to apply basic probability principles to solve real life problems.
- Ability to understand the concept of random variable (discrete and continuous), concept of probability distribution.

Year: First Semester: First

Course Code: -B060102P Course Title: Descriptive Data Analysis Lab (Univariate)

Course outcomes:

After completing this course a student will have:

- Ability to represent/summarise the data/information using appropriate Graphical methods including common graphical tools (such as boxplots, histograms and stem plots) and also to draw inferences from these graphs
- Acquire the knowledge to identify the situation to apply appropriate measure of central tendency as per the nature and need of the data and draw meaningful conclusions regarding behavior of the data.
- Acquire the knowledge to identify the situation to apply appropriate measure of dispersion as per the nature and need of the data and draw meaningful conclusions regarding heterogeneity of the data.
- Ability to measure skewness and kurtosis of data and define their significance.
- Acquire the knowledge to compute conditional probabilities based on Bayes Theorem.

Year: First Semester: Second

Course Code: -B060201T Course Title: Descriptive Statistics (Bivariate) and Probability Distributions

Course outcomes:

After completing this course a student will have:

- Knowledge of the method of least squares for curve fitting to theoretically describe experimental data with a function or equation and to find the parameter s associated with the model.
- Knowledge of the concepts of correlation and simple linear regression and Perform correlation and regression analysis.
- Ability to interpret results from correlation and regression.
- Ability to compute and interpret rank correlation. .
- Ability to understand concept of qualitative data and its analysis.
- Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Poisson, etc. with their properties and application of discrete distribution models to solve problems.
- Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.

- Knowledge of the formal definition of order statistics.
- Ability to identify the application of theory of order statistics in real life problems.

Year: First Semester: Second

Course Code: -B060202P Course Title: Descriptive Data Analysis Lab (Bivariate)

Course outcomes:

After completing this course a student will have:

- Ability to deal with the problems based on fitting of curves by Method of least squares e.g. fitting of straight line, second degree polynomial, power curve, exponential curve etc.
- Ability to deal with problems based on determination of Regression lines and calculation of Correlation coefficient – grouped and ungrouped data.
- Ability to deal with the problems based on determination of Rank correlation.
- Ability to fit Binomial and Poisson distribution for given data.

Year: Second Semester: Third

Course Code: -B060301T Course Title: Theory of Estimation and Sampling Survey

Course outcomes:

After completing this course a student will have:

- Knowledge of the concept of Sampling distributions.
- Ability to understand the difference between parameter & statistic and standard error & standard deviation.
- Knowledge of the sampling distribution of the sum and mean.
- Ability to understand the t, f and chi-square distribution and to identify the main characteristics of these distributions.
- Knowledge of the concept of Point and Interval Estimation and discuss characteristics of a good estimator.
- Ability to understand and practice various methods of estimations of parameters.
- Ability to understand the concept of sampling and how it is different from complete enumeration.
- Knowledge of various probability and non-probability sampling methods along with estimates of population parameters
- Ability to identify the situations where the various sampling techniques shall be used.
- Knowledge of sampling and non-sampling errors.

Year: Second Semester: Third

Course Code: -B060302P Course Title: Sampling Techniques Lab

Course outcomes:

After completing this course a student will have:

- Ability to draw a simple random sample with the help of table of random numbers.

- Ability to estimate population means and variance in simple random sampling.
- Ability to deal with problems based on Stratified random sampling for population means (proportional and optimum allocation).
- Ability to deal with problems based on Systematic random sampling

Year: Second Semester: Fourth

Course Code: -B060401T Course Title: Testing of Hypothesis and Applied Statistics

Course outcomes:

After completing this course a student will have:

- Knowledge of the terms like null and alternative hypotheses, two-tailed and onetailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
- Ability to understand the concept of MP, UMP and UMPU tests
- Ability to understand under what situations one would conduct the small sample and large sample tests (in case of one sample and two sample tests).
- Familiarity with different aspects of Applied Statistics and their use in real life situations.
- Ability to understand the concept of Time series along with its different components.
- Knowledge of Index numbers and their applications along with different types of Index numbers.
- Familiarity with various demographic methods and different measures of mortality and fertility.
- Ability to understand the concept of life table and its construction.
- Knowledge to understand the concept of statistical quality control and different control charts for variables and attributes.

Year: Second Semester: Fourth

Course Code: -B060402P Course Title: Tests of Significance and Applied Statistics Lab

Course outcomes:

After completing this course a student will have:

- Ability to conduct test of significance based on t , F tests and Chi-square test.
- Ability to deal with problems based on large sample tests.
- Ability to deal with problems based on time series and calculation of its different components for forecasting.
- Ability to deal with problems based on Index number.
- Acquire knowledge about measurement of mortality and fertility.
- Ability to deal with problems based on life table.
- Ability to work with control charts for variables and attributes and draw inferences.

Year: Third, Semester: Fifth

Course Code:-B060501T Course Title: Multivariate Analysis and Non-parametric Methods

Course outcomes:

After completing this course a student will have:

- Ability to understand the basic concepts of matrices in order to study multivariate distribution.
- Ability to understand bivariate normal distribution and its applications
- Knowledge of the applications of multivariate normal distribution and Maximum Likelihood estimates of mean vector and dispersion matrix.
- Ability to apply distribution free tests (Non-parametric methods) for one and two sample cases.

Year: Third Semester: Fifth

Course Code: -B060502T Course Title: Analysis of Variance and Design of Experiment

Course outcomes:

After completing this course a student will have:

- Knowledge of the concept of Analysis of Variance (ANOVA).
- Ability to carry out the ANOVA for One way and Two way Classification.
- Ability to carry out the post-hoc analysis.
- Knowledge of the concept of Design of experiment and its basic principles.
- Ability to perform the basic symmetric designs CRD, RBD and LSD with and without missing observations.
- Knowledge of the concept of factorial experiments and their practical applications.

Year: Third Semester: Fifth

Course Code: -B060503P Course Title: Non-parametric Methods and DOE Lab

Course outcomes:

After completing this course a student will have:

- Ability to conduct test of significance based non-parametric tests.
- Ability to deal with multivariate data.
- Ability to perform ANOVA for one way and two classification.
- Ability to perform post-hoc analysis.
- Ability to conduct analysis of CRD, RBD and LSD with and without missing observations.

Year: Third Semester: Sixth

Course Code: -B060601T Course Title: Statistical Computing and Introduction to Statistical Software

Course outcomes:

After completing this course a student will have:

- Basic Knowledge of Excel and R programming with some basic notions for developing their own simple programs and visualizing graphics in R and Excel.
- Ability to perform data analysis for both univariate and multivariate data sets using R as well as Excel.

Year: Third Semester: Sixth

Course Code: -B060602T Course Title: Operations Research

Course outcomes:

After completing this course a student will have:

- An idea about the historical background and need of Operations research.
- Ability to identify and develop operational research models from the verbal description of the real life problems.
- Knowledge of the mathematical tools that are needed to solve optimization problems.
- Ability of solving Linear programming problem, Transportation and Assignment problems, Job sequencing, etc.
- Ability to solve the problems based on Game Theory.

Year: Third Semester: Sixth

Course Code: -B060603P Course Title: Operations Research and Statistical Computing Lab

Course outcomes:

After completing this course a student will have:

- Knowledge of mathematical formulation of L.P.P
- Ability of solving LPP using different methods.
- Ability to solve Allocation Problem based on Transportation and Assignment models.
- Ability to solve problems based on Game Theory.
- Ability to use programming language R as Calculator.
- Knowledge of using R in simple data analysis.
- Able to perform statistical functions, creating graphs and statistical analysis by using Excel.

RK (PG) College Shamli UP
Department of Chemistry

Programme outcomes: B.Sc Chemistry

Department of Chemistry	After successful completion of three year degree programme in Chemistry, a student should be able to;
Programme outcomes	<ul style="list-style-type: none">● Gain sound knowledge about basic fundamentals of Chemistry● Understand applications of chemistry in daily life● Broadly understand about the different branches of chemistry like organic, inorganic, physical, environment and analytical chemistry● Understand about different type of environment pollution and can open up new methods for environmental pollution control● Develop problem solving skills which is required to solve various problems related to chemistry● Develop analytical skills which is required to handle various instruments and apparatus in chemistry laboratory● Apply different techniques for the quantitative and qualitative analysis of chemicals in laboratories● Gain factual chemical knowledge concerning the properties of substance, molecules and atoms● Work independently as well as in team● Effectively use technologies and instrumentation to gather and analyse data

Course outcomes: B.Sc Chemistry
Year- I

Course	Outcomes
	After completion of these courses, students will be able to;
Inorganic chemistry	<ul style="list-style-type: none">● Understand about basic atomic structure● Easily understand about chemical bonding and periodic properties● Understand about basic features of S-block, P-block and noble gases
Organic chemistry	<ul style="list-style-type: none">● Understand about basic structure and bonding in

	<p>organic molecules</p> <ul style="list-style-type: none"> • Understand stereochemistry and mechanism of organic reactions • Understand about the reactions and properties of aromatic compounds • Understand about the properties and chemical reactions of alkenes, cycloalkenes, alkynes, alkyl and aryl halide
Physical chemistry	<ul style="list-style-type: none"> • Understand the application of mathematics and computers in chemistry • Easily understand the concepts of solid, liquid, gaseous and colloidal state • Understand the kinetics of chemical reactions and different types of catalysed reactions
Practical chemistry	<ul style="list-style-type: none"> • Understand about basic laboratory techniques • Understand about semi-micro analysis • Easily determine the viscosity and surface tension of given solution

Course outcomes: B.Sc Chemistry
Year- II

Course	Outcomes
	After completion of these courses, students will be able to;
Inorganic chemistry	<ul style="list-style-type: none"> • Understand about coordination chemistry • Understand about basic properties of transition, lanthanide and actinide elements • Understand acid-bases and non-aqueous solvents • Understand about oxidation and reduction reactions
Organic chemistry	<ul style="list-style-type: none"> • Understand about UV and IR spectroscopy • Understand the properties and chemical reactions of alcohol, phenol, ether, epoxides, aldehydes, ketones, carboxylic acids and nitrogen containing compounds
Physical chemistry	<ul style="list-style-type: none"> • Understand about the principles of thermodynamics and thermochemistry • Understand about the basics of electrochemistry • Understand the concept of chemical and phase equilibria
Practical chemistry	<ul style="list-style-type: none"> • Learn about volumetric and gravimetric analysis

	<ul style="list-style-type: none"> • Understand about different types of chromatography experiments and their applications • Identify the unknown organic compound and prepare their suitable derivatives • Construct the phase diagram of two component system • Determine enthalpy of different solutions
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Course outcomes: B.Sc Chemistry
Year- III

Course	Outcomes
	After completion of these courses, students will be able to;
Inorganic chemistry	<ul style="list-style-type: none"> • Understand metal-ligand Bonding in transition metal complexes • Understand magnetic and optical properties of transition metal complexes • Understand basic bio-inorganic and organometallic chemistry • Learn about silicones, phosphazenes, hard and soft bases
Organic chemistry	<ul style="list-style-type: none"> • Understand about the nuclear magnetic resonance spectroscopy (NMR) • Understand about organometallic, organosulphur and heterocyclic compounds • Learn about carbohydrates, amino acids, nucleic acids, fats, oils, detergents, synthetic polymers and synthetic dyes • Learn about organic synthesis via enolate formation
Physical chemistry	<ul style="list-style-type: none"> • Understand about quantum mechanics and different types of spectroscopy • Understand the concept of photochemistry, solutions and colligative properties
Practical chemistry	<ul style="list-style-type: none"> • Synthesis and analysis of transition metal complexes • Understand and handle different laboratory techniques like steam distillation and column chromatography • Analysis of binary organic mixture • Understand the principle of using conductometer and handle various experiments on conductomete • Find out molecular weight of a non-volatile solute by Rast camphor method

Programme Outcome/ Programme Specific Outcome and Course Outcome of B.Sc., Mathematics:

Programme Outcome

- PO1:** It is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for the same.
- PO2:** It is to develop enhanced quantitative skills and pursuing higher mathematics and research as well.
- PO3:** Students will be able to develop solution-oriented approach towards various issues related to their environment.
- PO4:** Students will become employable in various govt. and private sectors
- PO5:** Scientific temper in general and mathematical temper in particular will be developed in students.
- PO6:** Think in a critical manner.
- PO7:** Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.
- PO8:** Formulate and develop mathematical arguments in a logical manner.
- PO9:** Acquire good knowledge and understanding in advanced areas of mathematics and statistics, chosen by the student from the given courses.
- PO10:** Understand, formulate and use quantitative models arising in social science, business and other contexts.

Programme Specific Outcome

- PSO1:** Student should be able to possess recall basic idea about mathematics which can be displayed by them.
- PSO2:** Student should have adequate exposure to many aspects of mathematical sciences.
- PSO3:** Student is equipped with mathematical modelling ability, critical mathematical thinking, and problem-solving skills etc.
- PSO4:** Student should be able to apply their skills and knowledge in various fields of studies including, science, engineering, commerce and management etc.

Course Outcome of B. Sc. Mathematics

Course Code: B030101T

Course Title: Differential Calculus & Integral Calculus

Course outcomes:

- CO1:** The Programme outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for developing enhanced quantitative skills and pursuing higher mathematics and research as well.
- CO2:** By the time students complete the course they will have wide ranging application of the subject and have the knowledge of real valued functions such as sequence and series. They will also be able to know about convergence of sequence and series. Also, they have knowledge about curvature, envelope and evolutes and trace curve in polar, Cartesian as well as parametric curves.

CO3: The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of integral he learns to solve a variety of practical problems in science and engineering.

CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking more advance level course in mathematics.

Course Code: B030102P

Course Title: Practical

Course outcomes:

CO1: The main objective of the course is to equip the student to plot the different graph and solve the different types of equations by plotting the graph using different computer software such as Mathematica /MATLAB /Maple /Scilab/Maxima etc.

CO2. After completion of this course student would be able to know the convergence of sequences through plotting, verify Bolzano-Weierstrass theorem through plotting the sequence, Cauchy's root test by plotting n th roots and Ratio test by plotting the ratio of n th and $(n + 1)$ th term.

CO3. Student would be able to plot Complex numbers and their representations, Operations like addition, subtraction, Multiplication, Division, Modulus and Graphical representation of polar form.

CO4: Student would be able to perform following task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant, Rank, Eigenvectors, Eigenvalues, Characteristic equation and verification of the Cayley-Hamilton theorem, Solving the systems of linear equations.

Course Code: B030201T

Course Title: Matrices and Differential Equations & Geometry

Course outcomes:

CO1: The subjects of the course are designed in such a way that they focus on developing mathematical skills in algebra, calculus and analysis and give in depth knowledge of geometry, calculus, algebra and other theories.

CO2: The student will be able to find the rank, eigen values of matrices and study the linear homogeneous and non-homogeneous equations. The course in differential equation intends to develop problem solving skills for solving various types of differential equation and geometrical meaning of differential equation.

CO3: The subjects learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surface by using analytical geometry.

CO4: On successful completion of the course students have gained knowledge about regular geometrical figures and their properties. They have the foundation for higher course in Geometry.

Course Code: B030301T
Course Title: Algebra & Mathematical Methods

Course outcomes:

- CO1:** Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of Group, Ring theory and their properties.
- CO2:** A student learning this course gets a concept of Group, Ring, Integral Domain and their properties. This course will lead the student to basic course in advanced mathematics and Algebra.
- CO3:** The course gives emphasis to enhance students' knowledge of functions of two variables, Laplace Transforms, Fourier Series.
- CO4:** On successful completion of the course students should have knowledge about higher different mathematical methods and will help him in going for higher studies and research.

Course Code: B030401T
Course Title: Differential Equations & Mechanics

Course outcomes:

- CO1:** The objective of this course is to familiarize the students with various methods of solving differential equations, partial differential equations of first order and second order and to have qualitative applications.
- CO2:** A student doing this course is able to solve differential equations and is able to model problems in nature using ordinary differential equations. After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, nonlinear evolution equation etc. These entire courses are important in engineering and industrial applications for solving boundary value problem.
- CO3:** The object of the paper is to give students knowledge of basic mechanics such as simple harmonic motion, motion under other laws and forces.
- CO4:** The student, after completing the course can go for higher problems in mechanic such as hydrodynamics, this will be helpful in getting employment in industry.

Course Code: B030501T
Course Title: Group and Ring Theory & Linear Algebra

Course outcomes:

- CO1:** Linear algebra is a basic course in almost all branches of science. The objective of this course is to introduce a student to the basics of linear algebra and some of its applications.
- CO2:** Students will be able to know the concepts of group, ring and other related properties which will prepare the students to take up further applications in the relevant fields.
- CO3:** The student will use this knowledge in computer science, finance mathematics, industrial mathematics and bio mathematics. After completion of this course students appreciate its interdisciplinary nature.

Course Code: B030502T

Course Title: Number Theory & Game Theory

Course outcomes:

- CO1:** Upon successful completion, students will have the knowledge and skills to solve problems in elementary number theory and also apply elementary number theory to cryptography.
- CO2:** This course provides an introduction to Game Theory. Game Theory is a mathematical framework which makes possible the analysis of the decision-making process of interdependent subjects. It is aimed at explaining and predicting how individuals behave in a specific strategic situation, and therefore help improve decision making.
- CO3:** A situation is strategic if the outcome of a decision problem depends on the choices of more than one person. Most decision problems in real life are strategic.
- CO4:** To illustrate the concepts, real-world examples, case studies, and classroom experiments might be used.

Course Code: B030502T

Course Title: Graph Theory & Discrete Mathematics

Course outcomes:

- CO1:** Upon successful completion, students will have the knowledge of various types of graphs, their terminology and applications.
- CO2:** After Successful completion of this course students will be able to understand the isomorphism and homomorphism of graphs. This course covers the basic concepts of graphs used in computer science and other disciplines. The topics include path, circuits, adjacency matrix, tree, coloring. After successful completion of this course the student will have the knowledge graph coloring, color problem, vertex coloring.
- CO3:** After successful completion, students will have the knowledge of Logic gates, Karnaugh maps and skills to proof by using truth tables. After Successful completion of this course students will be able to apply the basics of the automation theory, transition function and table.
- CO4:** This course covers the basic concepts of discrete mathematics used in computer science and other disciplines that involve formal reasoning. The topics include logic, counting, relations, Hasse diagram and Boolean algebra. After successful completion of this course the student will have the knowledge in Mathematical reasoning, combinatorial analysis, discrete structures and Applications.

Course Code: B030502T

Course Title: Differential Geometry & Tensor Analysis

Course outcomes:

- CO1:** After Successful completion of this course, students should be able to determine and calculate curvature of curves in different coordinate systems.
- CO2:** This course covers the Local theory of Curves, Local theory of surfaces, Geodesics, Geodesics curvature, Geodesic polars, Curvature of curves on surfaces, Gaussian curvature, Normal curvature etc.

CO3: After Successful completion of this course, students should have the knowledge of tensor algebra, different types of tensors, Riemannian space, Ricci tensor, Einstein space and Einstein tensor etc.

Course Code: B030601T

Course Title: METRIC SPACES & COMPLEX ANALYSIS

Course outcomes:

CO1: The course is aimed at exposing the students to foundations of analysis which will be useful in understanding various physical phenomena and gives the student the foundation in mathematics.

CO2: After completion of this course the student will have rigorous and deeper understanding of fundamental concepts in Mathematics. This will be helpful to the student in understanding pure mathematics and in research.

CO3: Students will be able to know the concepts of metric space, basic concepts and developments of complex analysis which will prepare the students to take up further applications in the relevant fields.

Course Code: B030602T

Course Title: Numerical Analysis & Operations Research

Course outcomes:

CO1: The aim of this course is to teach the student the application of various numerical technique for variety of problems occurring in daily life. At the end of the course the student will be able to understand the basic concept of Numerical Analysis and to solve algebraic and differential equation.

CO2: The main outcome will be that students will be able to handle problems and finding approximated solution. Later he can opt for advance course in Numerical Analysis in higher Mathematics.

CO3: The student will be able to solve various problems based on convex sets and linear programming. After successful completion of this paper will enable the students to apply the basic concepts of transportation problems and its related problems to apply in further concepts and application of operations research.

Course Code: B030602T

Course Title: Numerical Analysis & Operations Research

Course outcomes:

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CO2: The main outcome will be that students will be able to handle problems and finding approximated solution. Later he can opt for advance course in Numerical Analysis in higher Mathematics.

CO3: The student will be able to solve various problems based on convex sets and linear programming. After successful completion of this paper will enable the students to apply the basic concepts of transportation problems and its related problems to apply in further concepts and application of operations research.

Department of Physics

Course Outcomes

B.Sc. I Sem

B010101T- Mathematical Physics & Newtonian Mechanics

Recognize the difference between scalars, vectors, pseudo-scalars and pseudo-vectors. Understand the physical interpretation of gradient, divergence and curl. Comprehend the difference and connection between Cartesian, spherical and cylindrical coordinate systems. Know the meaning of 4-vectors, Kronecker delta and Epsilon (Levi Civita) tensors. Study the origin of pseudo forces in rotating frame.

Study the response of the classical systems to external forces and their elastic deformation. Understand the dynamics of planetary motion and the working of Global Positioning System (GPS). Comprehend the different features of Simple Harmonic Motion (SHM) and wave propagation.

Practical

B010102P – Mechanical Properties of Matter

Determine the mechanical properties. Achieve the measurement precision and perfection.

B.Sc. II Sem

B010201T- Thermal Physics & Semiconductor Devices

Recognize the difference between reversible and irreversible processes. Understand the physical significance of thermodynamical potentials. Comprehend the kinetic model of gases w.r.t. various gas laws. Study the implementations and limitations of fundamental radiation laws. Utility of AC bridges. Recognize the basic components of electronic devices. Design simple electronic circuits. Understand the applications of various electronic instruments.

Practical

B010202P- Thermal Properties of Matter & Electronic Circuits

Determine the thermal and electronic properties. Achieve the measurement precision and perfection.

B.Sc. I Year (Old)

(B-116) Mechanics & Wave Motion

Inertial reference frame, Newton's laws of motion, Dynamics of particle in rectilinear and circular motion, Conservative and Non-conservative forces, Conservation of energy, linear momentum and angular momentum, Collision in one and two dimensions, cross-section. Rotational energy and rotational inertia for simple bodies, the combined translation and rotational motion of a rigid body on horizontal and inclined planes, Simple treatment of the motions of a top. Relations between elastic constants, bending of Beams and Torsion of Cylinder. Central forces, two particle central force problem, reduced mass, relative and centre of mass motion, Law of gravitation, Kepler's laws, motions of planets and satellites, geo-stationary satellites. Simple harmonic motion, differential equation of S.H.M. and its solution, uses of complex notation, damped and forced vibrations, composition of simple harmonic motion. Differential equation of wave motion, plane progressive waves in fluid media, reflection of waves, phase change on reflection, superposition, stationary waves, pressure and energy distribution, phase and group velocity.

(B-117) Kinetic Theory and Thermodynamics

Recognize the difference between reversible and irreversible processes. Understand the physical significance of thermodynamical potentials. Comprehend the kinetic model of gases w.r.t. various gas laws. Study the implementations and limitations of fundamental radiation laws.

(B-118) Circuit Fundamentals and Basic Electronics

Utility of AC bridges. Recognize the basic components of electronic devices. Design simple electronic circuits. Understand the applications of various electronic instruments.

Practical (B-416)

Instruments are used to study and determine the mechanical properties. Measurement precision and perfection is achieved through Lab Experiments.

BSc II Year

(B-216) Physical Optics & Lasers

Interference of a light: The principle of superposition, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications. Localized fringes; thin films, applications for precision measurements for displacements. Haidinger fringes: Fringes of equal inclination. Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Twyman Green interferometer and its uses. Intensity distribution in multiple beam interference, Tolansky fringes, Fabry- Perrot interferometer and etalon. Fresnel diffraction: Fresnel half-period zones, plates, straight edge, rectilinear propagation. Fraunhofer diffraction: Diffraction at a slit, half-period zones, phasor diagram and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscopic systems, outline of phase contrast microscopy. Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating and comparison with resolving powers of prism and of a Fabry-Perrot etalon.

Polarization, Double refraction in uniaxial crystals, Nicol prism, polaroid and retardation plates, Babinet's compensator. Analysis of polarized light. Optical activity and Fresnel's explanation, Half shade and Biquartz palatinates. Matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators, Application to simple systems. Laser system: Purity of a spectral line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, population inversion. Application of Lasers: Pulsed lasers and tunable lasers, spatial coherence and directionality, estimates of beam intensity; temporal coherence and spectral energy density.

(B-217) Electromagnetics

Better understanding of electrical and magnetic phenomenon. To troubleshoot simple problems related to electrical devices. Comprehend the powerful applications of ballistic galvanometer. Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).

(B-218) Elements of Quantum Mechanics, Atomic and Molecular Spectra

Be familiar with the main aspects of the historical development of quantum mechanics of quantum mechanics, wave properties of matter. Concept of Wave Function, Wave Packet, Expectation Values. Able to correlate the classical mechanics with quantum mechanics. Able to solve Schrodinger equation in one to three dimensions and their physical interpretation. Able to solve the problems such as particle in a Box, Harmonic Oscillator, Potential Well etc. by using Schrodinger equations. Able to understand the different theories of atomic model, different quantum numbers. Also, able to studies, how the momentums and magnetic moments associated with different motion of electron are oriented and their interaction with each other and Spectroscopies.

Practical (B-516)

Able to understanding the characteristics of PN and Zener diodes, NPN and PNP transistors. Able to understand Heat conduction, convection and radiation through several experiments. Able to understand the Optics phenomena such as refraction, reflection, interference, polarization and

refractive index of materials of a prism i.e., Glass. Able to understand the Active and passive components of electronics.

B.Sc. Part III:

(B-316) Relativity & Statistical Physics

Reference systems, inertial frames, Galilean invariance and conservation laws, propagation of light, Michelson-Morley experiment; search for ether. Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence, particle with a zero-rest mass. The statistical basis of thermodynamics: Probability and thermodynamic probability, principle of equal a priori probability, probability distribution and its narrowing with increase in number of particles. The expressions for average properties. Constraints; accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states. The j_i -space representation, division of i -space into energy sheets and into phase cells of arbitrary size, applications to one-dimensional harmonic oscillator and free particles. Equilibrium between two systems in thermal contact, bridge with macroscopic physics. Probability and entropy, Boltzmann entropy relation. Statistical interpretation of second law of thermodynamics. Boltzmann canonical distribution law and its applications; rigorous form of equipartition of energy. Maxwellian distribution of speeds in an ideal gas: Distribution of speeds and of velocities, experimental verification, distinction between mean, r.m.s. and most probable speed values. Doppler broadening of spectral lines. 'h' as a natural constant and its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator, Indistinguishability of particles and its implications cases of particle in a one-dimensional box and one-dimensional harmonic oscillator, Indistinguishability of particles and its consequences, Bose-Einstein, and Fermi-Dirac distributions, photons in black body chamber, free electrons in a metal, Fermi level and Fermi energy.

(B-317) Solid State & Nuclear Physics

Understand the crystal geometry w.r.t. symmetry operations. Comprehend the power of X-ray diffraction and the concept of reciprocal lattice. Study various properties based on crystal bindings. Recognize the importance of Free Electron & Band theories in understanding the crystal properties. Study the salient features of nuclear forces & radioactive decays. Understand the importance of nuclear models & nuclear reactions. Comprehend the working and applications of nuclear accelerators and detectors. Understand the classification and properties of basic building blocks of nature.

(B-318) Solid State Electronics

The course is an introduction to semiconductor fundamentals and applications to the electronic devices. Course creates the background in the physics of the compound semiconductor-based electronic devices and also prepare students to advanced courses. The course provides an opportunity for students to continue education in undertaking advanced study and research in the variety of different branches of semiconductor device applications. Topics include the background solid state and semiconductor physics, and basic principles of electronic devices operation. The course enables the students to gain insights on basics of power supply.

Practical (B-616)

Analog & digital circuits have the most striking impact on the industry wherever the electronics instruments are used to study and determine the electronic properties. Measurement precision and perfection is achieved through Lab Experiments.

B.Sc. ZOOLOGY

Zoology Program Outcomes, Program Specific Outcomes and Course Outcomes

Zoology Program Outcomes:

PO1 - Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms.

PO2 – Analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.

PO3 – Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.

PO4 – Understands the complex evolutionary processes and behaviour of animals.

PO5 – Correlates the physiological processes of animals and relationship of organ systems.

PO6 – Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species.

PO7 – Gain knowledge of Agro based Small Scale industries like sericulture, fish farming, and Apiculture and vermicompost preparation.

PO8 – Understands about various concepts of genetics and its importance in human health.

PO9 - Apply ethical principles and commit to professional ethics and responsibilities in delivering his duties.

PO10 – Apply the knowledge and understanding of Zoology to one's own life and work.

PO11 – Develops empathy and love towards the animals

Program Specific Outcomes:

- (a) PSO1. Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied Zoology.
- (b) PSO2. Analyse the relationships among animals, plants and microbes.
- (c) PSO3. Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology, Nematology, Sericulture, Biochemistry, Fish biology, Animal biotechnology, Immunology and research methodology.
- (d) PSO4. Understand the applications of biological sciences in Apiculture, Aquaculture, Agriculture and Medicine.
- (e) PSO5. Gains knowledge about research methodologies, effective communication and skills of problem solving methods.
- (f) PSO6. Contributes the knowledge for Nation building.

COURSE OUTCOMES

BSC I

Paper I- Non Chordata-I (Protozoa to Helminths)

CO1- Understand the habits, morphology, physiology, reproduction and development of the following animals.

Euglena, Monocystis, Paramecium, Sycon Obelia, Aurelia Fasciola (liver fluke), *Taenia* (tape worm) and *Ancylostoma* (hook worm)

CO2 - Classify Phylum Protozoa to Helminths with taxonomic keys

Paper II- Non Chordata-II (Annelida to Echinodermata)

CO1- Understand the habits, morphology, physiology, reproduction and development of the following animals.

Nereis, Hirudinaria (leech), Palaemon (prawn) *Apis* (honeybee), *Lamellidens* (fresh water mussel), *Pila* (apple-snail) and *Pentaceros*.

CO2 - Classify Phylum annelida to echinodermata with taxonomic keys

Paper III- Cell Biology & Genetics

CO1: Describe the Structure and function of cell, membrane, Nucleus, Mitosis and Meiosis.

CO2: Describe the Structure and function of cell organelles with special emphasis on mitochondria, golgi bodies, ribosome and endoplasmic reticulum.

CO3 Understand the concept of Mendelian and non Mendelian inheritance

CO4 Concept behind genetic disorder, gene mutations- various causes associated with inborn errors of metabolites.

B.SC. Part II

Paper I: Chordata

CO1- Understand the habits, morphology, physiology, reproduction and development of the following animals.

Balanoglossus Branchiostoma (Amphioxus). Herdmania.

CO2 Classify Phylum Hemicordata, Cephalochordata and Urochordata .

CO3 Classify different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves and Mammalia).

CO4 Compare the anatomy of vertebrates like Histology (types of tissues). integument, skeleton, digestive, respiratory, circulatory, nervous, receptor and urinogenital system.

Paper II: Animal distribution, Evolution and Developmental Biology

CO1 Students understands the Distribution of fauna in different realms interaction.

CO2 Theories of Evolution and Knowledge of eras and evolution of species.

CO4 Aims and scope of Developmental Biology. Gametogenesis, Fertilization,

Egg: structure and types. Types & patterns of cleavage.

CO5 Understand the process of Blastulation & Gastrulation, Fate Map, development of Chick up to formation of Primitive streak , extra embryonic membranes of chick and placentation and types of Placenta.

Paper III: Physiology and Biochemistry

CO1 Students are taught the detailed concepts of digestion respiration excretion the functioning of nerves and muscles.

CO2 Students gain fundamental knowledge of animal physiology.

CO3 Students will gain skill to execute the roles of a biology teacher or medical lab technicians with training as they have basic fundamentals.

CO4 Interactions and interdependence of physiological and biochemical processes.

CO5 The paper imparts thorough knowledge in the fundamentals of biochemistry of all the biomolecules like the carbohydrates ,proteins,lipids,nucleic acids,their classification structure and metabolism.

B. Sc. Part III

PAPER-I Applied and Economic Zoology

CO1 Student gains knowledge regarding vector born diseases their pathology, control measures, thus aiming at 'Swach and Swasth Bharat'.

CO2 Understand the nature of damage and control measures of pant nematodes.

CO3 Understand the concept of the following career oriented programme like Aquaculture, Pisciculture, Poultry, Sericulture, Apiculture and Lac-culture.

CO4 Biodiversity and conservation explore natural landscapes, species and ecosystems and acquires theories and practical methods in preserving environments and organisms.

CO5 Key threats to biodiversity, including habitat modification and loss, unsustainable resource use, introduced species and climate change.

CO6 Management actions that are used to mitigate threats to biodiversity, including selecting nature reserves, connectivity and wildlife corridors, ecosystem restoration and control of pest plants and animals.

PAPER-II Biotechnology, Immunology, Biological Tools and Techniques and Biostatistics

CO1 Use in recombinant DNA technology, genetic manipulations and in a variety of industrial processes.

CO2 Gains skills in medical, environmental biotechnology, biopesticides, Biotechnology of aquaculture and use of animals as bioreactors.

CO3 Provides basics knowledge about immune system and allows the student to create insight as how to improve their immune system and good health.

CO4 Describe the Types of immunity, antigens-antibodies and their properties, Complement system, MHC's and immune response.

CO5 Understanding of immune mechanisms in disease control, vaccination, process of immune interactions.

CO6 Students gain knowledge about various tools & techniques used in biological systems and gives them insight about their use in research. are following. pH Meter, Colorimeter, Microtome, Spectrophotometer & Centrifuge. Microscopy (light, transmission and scanning electron microscopy), Chromatography and Electrophoresis.

CO7 Biostatistics teaches them to use the best data analysis methods in their research projects.

CO8 Students gains knowledge about statistical methods like measures of central tendencies, Probability, hypothesis and correlation.

PAPER-III Ecology, Microbiology Animal Behavior and Pollution and Toxicology.

CO1 Imparts knowledge to the student regarding environment and conservation biology.

CO2 Gains knowledge in the areas of responses to Laws of limiting factor, Laws of minimum, Laws of Tolerance ,types of ecosystem, Population characteristics and dynamics, ecological succession.

CO3 Understanding the various kinds of Animal adaptations.

CO4 Understanding of pathology of diseases caused by various microorganisms such as bacteria, virus, parasites and fungus

CO5 Understand Animal behaviour and response of animals to different instincts.

CO6 understanding the different types of pollution and their effects on environment.

CO7 It is a discipline overlapping with biology, chemistry, medicine that involves the study of toxic ants, their mechanism of action.

CO8 It involves the study of the adverse effects of chemical substances on living organisms.

Programme Outcome/ Programme Specific Outcome and Course Outcome of B.Sc., Mathematics:

Programme Outcome

- PO1:** It is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for the same.
- PO2:** It is to develop enhanced quantitative skills and pursuing higher mathematics and research as well.
- PO3:** Students will be able to develop solution-oriented approach towards various issues related to their environment.
- PO4:** Students will become employable in various govt. and private sectors
- PO5:** Scientific temper in general and mathematical temper in particular will be developed in students.
- PO6:** Think in a critical manner.
- PO7:** Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.
- PO8:** Formulate and develop mathematical arguments in a logical manner.
- PO9:** Acquire good knowledge and understanding in advanced areas of mathematics and statistics, chosen by the student from the given courses.
- PO10:** Understand, formulate and use quantitative models arising in social science, business and other contexts.

Programme Specific Outcome

- PSO1:** Student should be able to possess recall basic idea about mathematics which can be displayed by them.
- PSO2:** Student should have adequate exposure to many aspects of mathematical sciences.
- PSO3:** Student is equipped with mathematical modelling ability, critical mathematical thinking, and problem-solving skills etc.
- PSO4:** Student should be able to apply their skills and knowledge in various fields of studies including, science, engineering, commerce and management etc.

Course Outcome of B. Sc. Mathematics

Course Code: B030101T

Course Title: Differential Calculus & Integral Calculus

Course outcomes:

- CO1:** The Programme outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for developing enhanced quantitative skills and pursuing higher mathematics and research as well.
- CO2:** By the time students complete the course they will have wide ranging application of the subject and have the knowledge of real valued functions such as sequence and series. They will also be able to know about convergence of sequence and series. Also, they have knowledge about curvature, envelope and evolutes and trace curve in polar, Cartesian as well as parametric curves.

CO3: The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of integral he learns to solve a variety of practical problems in science and engineering.

CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking more advance level course in mathematics.

Course Code: B030102P

Course Title: Practical

Course outcomes:

CO1: The main objective of the course is to equip the student to plot the different graph and solve the different types of equations by plotting the graph using different computer software such as Mathematica /MATLAB /Maple /Scilab/Maxima etc.

CO2. After completion of this course student would be able to know the convergence of sequences through plotting, verify Bolzano-Weierstrass theorem through plotting the sequence, Cauchy's root test by plotting n th roots and Ratio test by plotting the ratio of n th and $(n + 1)$ th term.

CO3. Student would be able to plot Complex numbers and their representations, Operations like addition, subtraction, Multiplication, Division, Modulus and Graphical representation of polar form.

CO4: Student would be able to perform following task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant, Rank, Eigenvectors, Eigenvalues, Characteristic equation and verification of the Cayley-Hamilton theorem, Solving the systems of linear equations.

Course Code: B030201T

Course Title: Matrices and Differential Equations & Geometry

Course outcomes:

CO1: The subjects of the course are designed in such a way that they focus on developing mathematical skills in algebra, calculus and analysis and give in depth knowledge of geometry, calculus, algebra and other theories.

CO2: The student will be able to find the rank, eigen values of matrices and study the linear homogeneous and non-homogeneous equations. The course in differential equation intends to develop problem solving skills for solving various types of differential equation and geometrical meaning of differential equation.

CO3: The subjects learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surface by using analytical geometry.

CO4: On successful completion of the course students have gained knowledge about regular geometrical figures and their properties. They have the foundation for higher course in Geometry.

Course Code: B030301T
Course Title: Algebra & Mathematical Methods

Course outcomes:

- CO1:** Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of Group, Ring theory and their properties.
- CO2:** A student learning this course gets a concept of Group, Ring, Integral Domain and their properties. This course will lead the student to basic course in advanced mathematics and Algebra.
- CO3:** The course gives emphasis to enhance students' knowledge of functions of two variables, Laplace Transforms, Fourier Series.
- CO4:** On successful completion of the course students should have knowledge about higher different mathematical methods and will help him in going for higher studies and research.

Course Code: B030401T
Course Title: Differential Equations & Mechanics

Course outcomes:

- CO1:** The objective of this course is to familiarize the students with various methods of solving differential equations, partial differential equations of first order and second order and to have qualitative applications.
- CO2:** A student doing this course is able to solve differential equations and is able to model problems in nature using ordinary differential equations. After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, nonlinear evolution equation etc. These entire courses are important in engineering and industrial applications for solving boundary value problem.
- CO3:** The object of the paper is to give students knowledge of basic mechanics such as simple harmonic motion, motion under other laws and forces.
- CO4:** The student, after completing the course can go for higher problems in mechanic such as hydrodynamics, this will be helpful in getting employment in industry.

Course Code: B030501T
Course Title: Group and Ring Theory & Linear Algebra

Course outcomes:

- CO1:** Linear algebra is a basic course in almost all branches of science. The objective of this course is to introduce a student to the basics of linear algebra and some of its applications.
- CO2:** Students will be able to know the concepts of group, ring and other related properties which will prepare the students to take up further applications in the relevant fields.
- CO3:** The student will use this knowledge in computer science, finance mathematics, industrial mathematics and bio mathematics. After completion of this course students appreciate its interdisciplinary nature.

Course Code: B030502T

Course Title: Number Theory & Game Theory

Course outcomes:

- CO1:** Upon successful completion, students will have the knowledge and skills to solve problems in elementary number theory and also apply elementary number theory to cryptography.
- CO2:** This course provides an introduction to Game Theory. Game Theory is a mathematical framework which makes possible the analysis of the decision-making process of interdependent subjects. It is aimed at explaining and predicting how individuals behave in a specific strategic situation, and therefore help improve decision making.
- CO3:** A situation is strategic if the outcome of a decision problem depends on the choices of more than one person. Most decision problems in real life are strategic.
- CO4:** To illustrate the concepts, real-world examples, case studies, and classroom experiments might be used.

Course Code: B030502T

Course Title: Graph Theory & Discrete Mathematics

Course outcomes:

- CO1:** Upon successful completion, students will have the knowledge of various types of graphs, their terminology and applications.
- CO2:** After Successful completion of this course students will be able to understand the isomorphism and homomorphism of graphs. This course covers the basic concepts of graphs used in computer science and other disciplines. The topics include path, circuits, adjacency matrix, tree, coloring. After successful completion of this course the student will have the knowledge graph coloring, color problem, vertex coloring.
- CO3:** After successful completion, students will have the knowledge of Logic gates, Karnaugh maps and skills to proof by using truth tables. After Successful completion of this course students will be able to apply the basics of the automation theory, transition function and table.
- CO4:** This course covers the basic concepts of discrete mathematics used in computer science and other disciplines that involve formal reasoning. The topics include logic, counting, relations, Hasse diagram and Boolean algebra. After successful completion of this course the student will have the knowledge in Mathematical reasoning, combinatorial analysis, discrete structures and Applications.

Course Code: B030502T

Course Title: Differential Geometry & Tensor Analysis

Course outcomes:

- CO1:** After Successful completion of this course, students should be able to determine and calculate curvature of curves in different coordinate systems.
- CO2:** This course covers the Local theory of Curves, Local theory of surfaces, Geodesics, Geodesics curvature, Geodesic polars, Curvature of curves on surfaces, Gaussian curvature, Normal curvature etc.

CO3: After Successful completion of this course, students should have the knowledge of tensor algebra, different types of tensors, Riemannian space, Ricci tensor, Einstein space and Einstein tensor etc.

Course Code: B030601T

Course Title: METRIC SPACES & COMPLEX ANALYSIS

Course outcomes:

CO1: The course is aimed at exposing the students to foundations of analysis which will be useful in understanding various physical phenomena and gives the student the foundation in mathematics.

CO2: After completion of this course the student will have rigorous and deeper understanding of fundamental concepts in Mathematics. This will be helpful to the student in understanding pure mathematics and in research.

CO3: Students will be able to know the concepts of metric space, basic concepts and developments of complex analysis which will prepare the students to take up further applications in the relevant fields.

Course Code: B030602T

Course Title: Numerical Analysis & Operations Research

Course outcomes:

CO1: The aim of this course is to teach the student the application of various numerical technique for variety of problems occurring in daily life. At the end of the course the student will be able to understand the basic concept of Numerical Analysis and to solve algebraic and differential equation.

CO2: The main outcome will be that students will be able to handle problems and finding approximated solution. Later he can opt for advance course in Numerical Analysis in higher Mathematics.

CO3: The student will be able to solve various problems based on convex sets and linear programming. After successful completion of this paper will enable the students to apply the basic concepts of transportation problems and its related problems to apply in further concepts and application of operations research.

Course Code: B030602T

Course Title: Numerical Analysis & Operations Research

Course outcomes:

CO1: The aim of this course is to teach the student the application of various numerical technique for variety of problems occurring in daily life. At the end of the course the student will be able to understand the basic concept of Numerical Analysis and to solve algebraic and differential equation.

CO2: The main outcome will be that students will be able to handle problems and finding approximated solution. Later he can opt for advance course in Numerical Analysis in higher Mathematics.

CO3: The student will be able to solve various problems based on convex sets and linear programming. After successful completion of this paper will enable the students to apply the basic concepts of transportation problems and its related problems to apply in further concepts and application of operations research.

COURSE OUTCOME OF STATISTICS

Programme Outcomes (POs)-

Students having Degree in B.Sc. (with Statistics) should have knowledge of different concepts and fundamentals of Statistics and ability to apply this knowledge in various fields of industry. They may pursue their future career in the field of Statistics and Research.

Programme Specific Outcomes (PSOs)-

After completing B.Sc. (with Statistics) the student should have

- Knowledge of different concepts, principles, methodologies and tools (skills) of statistics.
- Ability to collect, tabulate, represent graphically, analyze and interpret data/information by using appropriate statistical tools.
- Ability to identify and solve a wide range of problems in real life/industry related to Statistics.
- Familiarity with computational techniques and statistical software including programming language (e.g. R) for mathematical and statistical computation.
- Capability to use appropriate statistical skills in interdisciplinary areas such as finance, health, agriculture, government, business, industry, telecommunication and bio-statistics.
- Ability to compete with industrial/private sector demand in the field of data analysis, marketing survey, etc. in professional manner and pursue their future career in the field of Statistics.
- Ability to develop original thinking for formulating new problems and providing their solutions. As a result, they will be able to pursue higher studies or research in the field of Statistics.

Course outcomes:

Course Code: -B060101T Year: First Semester: First

Course Title: Descriptive Statistics (Univariate) and Theory of Probability

After completing this course a student will have:

- Knowledge of Statistics, its scope and importance in various fields.
- Ability to understand concepts of sample vs. population and difference between different types of data.
- Knowledge of methods for summarising data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.
- Ability to describe data with measures of central tendency and measures of dispersion.
- Ability to understand measures of skewness and kurtosis and their utility and significance.
- Ability to understand the concept of probability along with basic laws and axioms of probability.
- Ability to understand the terms mutually exclusive and independence and their relevance.

- Ability to identify the appropriate method (i.e. union, intersection, conditional, etc.) for solving a problem.
- Ability to apply basic probability principles to solve real life problems.
- Ability to understand the concept of random variable (discrete and continuous), concept of probability distribution.

Year: First Semester: First

Course Code: -B060102P Course Title: Descriptive Data Analysis Lab (Univariate)

Course outcomes:

After completing this course a student will have:

- Ability to represent/summarise the data/information using appropriate Graphical methods including common graphical tools (such as boxplots, histograms and stem plots) and also to draw inferences from these graphs
- Acquire the knowledge to identify the situation to apply appropriate measure of central tendency as per the nature and need of the data and draw meaningful conclusions regarding behavior of the data.
- Acquire the knowledge to identify the situation to apply appropriate measure of dispersion as per the nature and need of the data and draw meaningful conclusions regarding heterogeneity of the data.
- Ability to measure skewness and kurtosis of data and define their significance.
- Acquire the knowledge to compute conditional probabilities based on Bayes Theorem.

Year: First Semester: Second

Course Code: -B060201T Course Title: Descriptive Statistics (Bivariate) and Probability Distributions

Course outcomes:

After completing this course a student will have:

- Knowledge of the method of least squares for curve fitting to theoretically describe experimental data with a function or equation and to find the parameter s associated with the model.
- Knowledge of the concepts of correlation and simple linear regression and Perform correlation and regression analysis.
- Ability to interpret results from correlation and regression.
- Ability to compute and interpret rank correlation. .
- Ability to understand concept of qualitative data and its analysis.
- Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Poisson, etc. with their properties and application of discrete distribution models to solve problems.
- Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.

- Knowledge of the formal definition of order statistics.
- Ability to identify the application of theory of order statistics in real life problems.

Year: First Semester: Second

Course Code: -B060202P Course Title: Descriptive Data Analysis Lab (Bivariate)

Course outcomes:

After completing this course a student will have:

- Ability to deal with the problems based on fitting of curves by Method of least squares e.g. fitting of straight line, second degree polynomial, power curve, exponential curve etc.
- Ability to deal with problems based on determination of Regression lines and calculation of Correlation coefficient – grouped and ungrouped data.
- Ability to deal with the problems based on determination of Rank correlation.
- Ability to fit Binomial and Poisson distribution for given data.

Year: Second Semester: Third

Course Code: -B060301T Course Title: Theory of Estimation and Sampling Survey

Course outcomes:

After completing this course a student will have:

- Knowledge of the concept of Sampling distributions.
- Ability to understand the difference between parameter & statistic and standard error & standard deviation.
- Knowledge of the sampling distribution of the sum and mean.
- Ability to understand the t, f and chi-square distribution and to identify the main characteristics of these distributions.
- Knowledge of the concept of Point and Interval Estimation and discuss characteristics of a good estimator.
- Ability to understand and practice various methods of estimations of parameters.
- Ability to understand the concept of sampling and how it is different from complete enumeration.
- Knowledge of various probability and non-probability sampling methods along with estimates of population parameters
- Ability to identify the situations where the various sampling techniques shall be used.
- Knowledge of sampling and non-sampling errors.

Year: Second Semester: Third

Course Code: -B060302P Course Title: Sampling Techniques Lab

Course outcomes:

After completing this course a student will have:

- Ability to draw a simple random sample with the help of table of random numbers.

- Ability to estimate population means and variance in simple random sampling.
- Ability to deal with problems based on Stratified random sampling for population means (proportional and optimum allocation).
- Ability to deal with problems based on Systematic random sampling

Year: Second Semester: Fourth

Course Code: -B060401T Course Title: Testing of Hypothesis and Applied Statistics

Course outcomes:

After completing this course a student will have:

- Knowledge of the terms like null and alternative hypotheses, two-tailed and onetailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
- Ability to understand the concept of MP, UMP and UMPU tests
- Ability to understand under what situations one would conduct the small sample and large sample tests (in case of one sample and two sample tests).
- Familiarity with different aspects of Applied Statistics and their use in real life situations.
- Ability to understand the concept of Time series along with its different components.
- Knowledge of Index numbers and their applications along with different types of Index numbers.
- Familiarity with various demographic methods and different measures of mortality and fertility.
- Ability to understand the concept of life table and its construction.
- Knowledge to understand the concept of statistical quality control and different control charts for variables and attributes.

Year: Second Semester: Fourth

Course Code: -B060402P Course Title: Tests of Significance and Applied Statistics Lab

Course outcomes:

After completing this course a student will have:

- Ability to conduct test of significance based on t , F tests and Chi-square test.
- Ability to deal with problems based on large sample tests.
- Ability to deal with problems based on time series and calculation of its different components for forecasting.
- Ability to deal with problems based on Index number.
- Acquire knowledge about measurement of mortality and fertility.
- Ability to deal with problems based on life table.
- Ability to work with control charts for variables and attributes and draw inferences.

Year: Third, Semester: Fifth

Course Code:-B060501T Course Title: Multivariate Analysis and Non-parametric Methods

Course outcomes:

After completing this course a student will have:

- Ability to understand the basic concepts of matrices in order to study multivariate distribution.
- Ability to understand bivariate normal distribution and its applications
- Knowledge of the applications of multivariate normal distribution and Maximum Likelihood estimates of mean vector and dispersion matrix.
- Ability to apply distribution free tests (Non-parametric methods) for one and two sample cases.

Year: Third Semester: Fifth

Course Code: -B060502T Course Title: Analysis of Variance and Design of Experiment

Course outcomes:

After completing this course a student will have:

- Knowledge of the concept of Analysis of Variance (ANOVA).
- Ability to carry out the ANOVA for One way and Two way Classification.
- Ability to carry out the post-hoc analysis.
- Knowledge of the concept of Design of experiment and its basic principles.
- Ability to perform the basic symmetric designs CRD, RBD and LSD with and without missing observations.
- Knowledge of the concept of factorial experiments and their practical applications.

Year: Third Semester: Fifth

Course Code: -B060503P Course Title: Non-parametric Methods and DOE Lab

Course outcomes:

After completing this course a student will have:

- Ability to conduct test of significance based non-parametric tests.
- Ability to deal with multivariate data.
- Ability to perform ANOVA for one way and two classification.
- Ability to perform post-hoc analysis.
- Ability to conduct analysis of CRD, RBD and LSD with and without missing observations.

Year: Third Semester: Sixth

Course Code: -B060601T Course Title: Statistical Computing and Introduction to Statistical Software

Course outcomes:

After completing this course a student will have:

- Basic Knowledge of Excel and R programming with some basic notions for developing their own simple programs and visualizing graphics in R and Excel.
- Ability to perform data analysis for both univariate and multivariate data sets using R as well as Excel.

Year: Third Semester: Sixth

Course Code: -B060602T Course Title: Operations Research

Course outcomes:

After completing this course a student will have:

- An idea about the historical background and need of Operations research.
- Ability to identify and develop operational research models from the verbal description of the real life problems.
- Knowledge of the mathematical tools that are needed to solve optimization problems.
- Ability of solving Linear programming problem, Transportation and Assignment problems, Job sequencing, etc.
- Ability to solve the problems based on Game Theory.

Year: Third Semester: Sixth

Course Code: -B060603P Course Title: Operations Research and Statistical Computing Lab

Course outcomes:

After completing this course a student will have:

- Knowledge of mathematical formulation of L.P.P
- Ability of solving LPP using different methods.
- Ability to solve Allocation Problem based on Transportation and Assignment models.
- Ability to solve problems based on Game Theory.
- Ability to use programming language R as Calculator.
- Knowledge of using R in simple data analysis.
- Able to perform statistical functions, creating graphs and statistical analysis by using Excel.

Course outcomes and mechanism of communication of B.Sc. physical education

Our college adopts outcome based education of learning. The physical education programs include theory and practical classes of subject. It improves the student's physical, mental, social, emotional and spiritual ability to cope up with the day-to-day problems of life. The following mechanism is followed by the college to communicate the learning outcomes to the teachers and students.

1. **Prospectus:-** Prospectus is used for admission process. The prospectus of the college is made available to the students before the admission process starts. In every academic session new prospectus is printed and all information about the college, admission, admission fees and new curriculum is included in it.
2. **Institutional website:-** Institutional website is available and all the information about the academic courses available in it and is utilized for admission process by students. The students are also communicated about the course outcomes through website and daily classes. Soft copies of curriculum and courses outcomes are uploaded on the college website.
3. **Meeting:-** Through regular meetings of principal teachers are acquainted about the stated program and course outcomes and also guided for effective implementation. Course outcomes are observed and measured time to time and the importance of courses outcomes has been communicated to the teachers periodically in every IQAC meeting and staff meeting.
4. **Personal Counseling:-** Personal counseling of the subject is done as per the need of the subjects. At the beginning of session, graduate attributes are described to the first year students. Teachers introduce the subject to the students. Every student actively involved in practical classes of physical education and sports.

Course outcome of B.Sc. I year physical education and sports

(Paper code - B -001)

This course will enable the students to:

1. Know the meaning and definition of education and physical education.
2. Learn about the aims, objectives, scope, need and importance of physical education.
3. Understand the meaning, definition and dimension of health.

4. Learn about meaning, definition, objectives and principles of health education.
5. Know the balance diet, its elements and sources, malnutrition and adulterations.
6. Know the meaning of growth and development, factors affecting growth and development.
7. Learn about the heredity and environment, effect of heredity and environment on growth and development.
8. Understand the meaning and definition of psychology and sports psychology.
9. Know about the meaning and definition of personality, psychological factors effecting physical performance.
10. Learn about Olympic Games, Asian games, Afro-Asian games and commonwealth games.

Course outcome of B.Sc.-II year physical education and sports

(Paper code - B -002)

This course will enable the students to:

1. Know the meaning of anatomy and physiology.
2. Learn about structure and functions of cell.
3. Learn about structure and functions of cell understand the different systems (muscular , skeletal, circulatory, respiratory, digestive and nervous system)and effect of exercise on various systems .
4. Know the concept of society and sports social institutions.
5. Learn about games and sports as men's cultural heritage.
6. Understand national and international integration.
7. Know about yoga, Asanas– lying, sitting, standing and pranayama.
8. Define physical fitness, components of physical fitness, factors influencing physical fitness, development of physical fitness components

9. Learn about the concept of add types of first aid a prerequisite qualities of first aider first aid box and types of sports injuries and their first aid treatment.

Course outcome of B.Sc.-III year physical education and sports

(Paper code - B -003)

This course will enable the students to:

1. Know about the meaning and definition of kinesiology and biomechanics and importance in physical education and sports.
2. Learn about axis and planes, fundamental movements around various joints, Newton's law of motion, center of gravity.
3. Understand the meaning of sports training, strength, speed, endurance, flexibility, co-ordinative ability.
4. Learn about the meaning of sports medicine and importance in physical education and sports.
5. Know the concept of ergogenic aids, therapeutic modalities, rehabilitation of athlete after injury or sickness.
6. Meaning and definition of recreation, role in physical education and sports, types of recreation.
7. Meaning and definition of test and measurement, importance in the field of sports.
8. Know about frequency table, measures of Central tendency, measures of variability, correlation (product moment correlation only).

**Dr.Parveen Ahmed
(Assistant professor)**

Department of physical education and sports