Paper wise Learning Outcomes of the Course

Annual (1+1+1) and CBCS System (All Years)

Subject: Botany (UG)

Session: 2018-19

Under the current system i.e. CBCS (w.e.f. the Academic Session 2018-2019), Botany as a Generic Elective (GE) is part of the Basket 3 out of all the 4 baskets of choices for GE subjects, along with Physics. Hence, under the extant rules, Physics Honours students are not allowed to take up Botany as their Generic Elective. A student can take up *any 2 papers* from those enlisted below either in their 1st year i.e. 1st Semester and 2nd Semester ("GE1 BOTANY") or in their 2nd year i.e. 3rd and 4th Semester ("GE2 BOTANY"). The options available for Under Graduate students of other Honours subjects who take up Botany as their Generic Elective (GE) subject are as follows: Biodiversity (Microbes, Algae, Fungi and Archegoniate), Plant Ecology and Taxonomy (discussing primarily about Angiospermic flora), Plant Anatomy and Embryology (focussing mainly on Monocots and Dicots, the two groups of Angiosperms, Plant Physiology and Metabolism (containing both Physiology as well as Biochemistry of Plants), Economic Botany and Biotechnology (representing an amalgamation of economically important plants and aspects related to tissue culture and genetic engineering of plants) and Environmental Biotechnology (composed of issues related to Environment, sustainable development, xenobiotics and the legislation surrounding them).

Programme Outcome	1. Ensuring that the students get both practical and theoretical knowledge of the subject in a balanced manner. 2. Adopting the student-friendly approaches by encouraging the faculty in student discussion.

	3. Keeping up with the student's interest in the related fields as well as the core subject. 4. Holistic development of the students 5. Promoting leadership qualities. 6. Students will gain the knowledge of the diverse biological functions of plants and the role plants play as a major group of living organism.
Programme Specific Outcomes	7. At the end of the course the students are well-trained in the various aspects of Botany as well as the other related fields 8. The students get wholesome education in the core fields of Plant Molecular Biology and Biotechnology, Genetics, Microbiology, Ecology, Plant Taxonomy, Plant Anatomy and Morphology, Physiology and Metabolism, Mycopathology, Economic Botany etc. 9. The Ability Enhancement Compulsory Courses direct at the Environmental Awareness and enhancing the language grip in English and in mother tongue. 10. Discipline Specific Courses give practical and theoretical knowledge about the novel applied fields like medicine, industry, agriculture, bioinformatics and Environment related fields. 11. Skill Enhancement Courses help the students to increase their skills in some particularly new areas of Botany which may help the students in getting self-employment.

	12. Generic Elective Courses give students of other disciplines an insight into the Subject. 13. Assistance of the students in competitive exams like JAM. 14. Promoting sensitive attitude towards the natural surroundings. 15. Students will learn about various aspects of plant science including the diversity of plants, their distribution, economic importance, biological processes and their impact on environment.

Paper wise Outcomes [UG BOTH 1+1+1 SYSTEM]

PAPER	Outcomes
Paper 1	Study of nutrition, growth, range of thallus organization, classification, metabolism, reproduction, systematic position and economic importance of algae. Fungi, Bryophyte & Pteridophytes. Identification of various algae Fungi, Bryophyte & Pteridophytes.
Paper 2	Gymnology, Paleobotany, Morphology, Anatomy: Study of different characteristics, reproductive structures and economic

	importance of gymnosperms. Concepts about different kinds of tissues in plants, difference between meristematic and permanent tissues, simple and complex tissues. Structures of dicotyledonous and monocotyledonous root, stem, leaves; Concept and mechanism of secondary growth in plants; concepts about embryo and endosperms, are discussed.
Paper 3	Includes a cumulative analysis and study of important experiments of algae. Fungi, Bryophyte, Pteridophytes, Gymnosperms. Different Fossil slides, Morphological aspects of angiosperms & Anatomical slides are studied
Paper 4	This paper is completely in line with the UGC Model Curriculum 2011 and provides integrated knowledge about the different molecules found not only in plants as well as other domains of life in addition to the range of structures found inside the different types of living cells along with the knowledge of their corresponding functional roles.
Paper 5	The range of the most diverse and the most highly evolved group of plants i.e. the Angiosperms is addressed in this paper, with respect to their systematic positions, their economically important members and their phylogenetic and evolutionary nuances as well as a portion being dedicated to the interactions of different plants with and in the environment they inhabit.
Paper 6	Includes a cumulative analysis and study of important experiments of plants pertaining to their Cell Biology, Biochemistry, Systematics, and Ecology.
Paper 7	Intensively dealing with the study of the composition and behaviour of genes as well as the different molecules they influence and regulate and the biology of the latter.

Paper 8	A very interesting mixture of the physiological as well as the numerical aspects of the plants.
Paper 9	In tune with the current trends in biological methods, topics like rDNA technology and tissue culture are taught. Along with the aforementioned topics of Biotechnology, this paper also includes topics related to plant diseases and an additional portion on the different types of microbes and certain aspects of their biology.
Paper 10	In this paper, knowledge is imparted to the students about different mechanical section cutting techniques as well as techniques used in plant breeding. Along with the above students also learn methods to estimate the rates of various life processes of plants and also, the different methods of biostatistics prevalent in plant sciences.
Paper 11	Practical aspects of Microbiology and Plant Pathology are discussed in this paper.

PAPER-WISE LEARNING OUTCOMES

(CBCS) - Honours & Programme Course

PAPER	OUTCOMES
CC1	Biodiversity: Study of nutrition, growth, metabolism, reproduction, systematic position and economic importance of the microbes – bacteria, virus and algae. Identification of virus, bacteria, bacteroid from EM and various algae under microscope as well as EM. Performance of Gram stain and endospore stain.

CC2	Biochemistry and Cell Biology: This paper is completely in line with the UGC Model Curriculum 2011 and provides integrated knowledge about the different molecules found not only in plants as well as other domains of life in addition to the range of structures found inside the different types of living cells along with the knowledge of their corresponding functional roles.
CC3	Mycology and phytopathology: Study of the Characteristics, ecology, thallus organization, classification and life cycle of the various groups of true fungi, allied fungi, lichen and mycorrhiza. Discussion on the applied aspects of fungi and Phytopathology. Identification of the common fungi forms of lichens and mycorrhiza under microscope. Study of common plant diseases.
CC4	Archegoniate: After completion of this course, the students will be able to develop a clear concept about Archegoniate, Bryophytes, Pteridophytes and Gymnosperms & its habit, habitats & their reproductive mechanism and will understand about the structure, classification, reproduction, life cycle & economic importance of Bryophytes, Pteridophytes and Gymnosperms, also impart knowledge on plant evolution & their transition to land habitat and will develop skill in experimental techniques & methods of appropriate analysis of Bryophytes, Pteridophytes and Gymnosperms.
DSC1, GE1	Biodiversity: study of microbes i.e. bacteria and virus. Discuss different characteristics, range of thallus organization, classification, reproductive structure and economic importance of algae, fungi, archegoniate, bryophytes, pteridophytes and gymnosperm.

DSC2, GE2	Plant ecology & Taxonomy: Theoretical and practical aspects of the ecology (including abiotic factors like soil). Discussion on important aspects on the schemes of classification of angiosperms, with special attention to the information and recent developments in plant systematic and Study of Botanical code, botanical nomenclature, identification & phylogeny of angiosperms with relevant examples and explanation on nomenclatural problems.

Year-2018-19

Program Outcomes

Annual 1+1+1 system

(Part-I) Honours Paper 1	Classes in molecular and cellular biophysics, thermodynamics, microscopy and studies on biomolecules prepare students to start tackling the unsolved problems plaguing scientists at the intersection of life sciences and physical sciences. Our laboratory paper prepares students to conduct independent research and write scientific papers. Our experiences enable students to explore the frontiers of biophysics research, learn valuable scientific communication skills, and develop quantitative problem-solving skills. On completion of the paper, students are able to: 1.Get an idea about the historical events in microbiology 2. Understand the diversity in microbiology 3. Know the scope of Microbiology 4. Understand the taxonomic classification of microorganisms 5. Know parts of microscope and its types and understand principle, working, ray diagram and application of advance microscopes. 6. Develop fundamental knowledge about various biomolecules 7. Concept of bioenergetics
Paper 2	On completion of the paper, students are able to: 1.Understand concepts of growth and reproduction of bacteria 2. Know anatomy of prokaryotic cell 3. Know structural detail of eukaryotic cell 4. Understood various parts of cell and its importance
Paper-3 (Practical)	On completion of this paper, The students will define principle and Handling of Basic Microbiological Instruments

	Students will describe the fundamental understanding of the working of instruments, various staining techniques and its applications. Students can demonstrate an usage of different techniques for analysis and detection Critical analysis and evaluation of published research in the field of microbial techniques and biochemistry.
(Part-II) Honours Paper 4	The microbe use many different types of metabolic strategies and species can often be differentiated from each other based on metabolic characteristics. On completion of the paper, students are able to: 1.Get acquainted with various sterilization techniques 2. Use various method to control microbes. 3. Gather theoretical background of microbial cultivation 4. Understand various specialized techniques such as pasteurization 5. Understand the basic concepts related to enzymes 6. Qualitative and quantitative enzyme assay 7. Effect of environmental factors on enzyme 8. Enzyme kinetics and various biochemical pathway Microbial Metabolism 10. Anabolism and catabolism with examples.
Paper 5	This paper includes molecular biology and virology. It comprises of the interactions of different biomolecules in cells and their roles in life processes. The studies of genes and different molecules they regulate have been also included in this paper. On completion of the paper, students are able to: 1.Understand concept of genes and chromosomes, 2. Familiar with concept of mutations 3. Acquire knowledge and understanding the concepts of Microbial genetics, Molecular biology, 4. Concept of tumor immunology, type of tumors, immune mechanisms against tumors.
Paper-6 (Practical)	This paper includes the study of the growth curve of *E. coli* by tubidiometric and standard plate count methods, calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data, effect of temperature on growth of *E. coli*, effect of pH on growth of *E. coli* and demonstration of minimum inhibitory concentration by Phenol coefficient test.

Part-III Honours Paper 7	By studying immunology students are able to learn how immunology-the study of human immune system which controls infections and provides immunity against microorganisms-can apply to a range of areas in the biomedical sciences. The goal of this paper is to provide students basic knowledge of environment and their role in life sustenance. The students can identify and analyze environmental problems as well as the risks associated with them.
Paper 8	Upon successful completion of the paper, students are expected to be able to: 1. Understand the beneficial role of microorganisms in fermented foods and in food processing and the microbiology of different types of fermented food products – dairy, pickles, Legume and cereal based food products 2. Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods 3. Know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage 4. Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods. 5. Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries 6. Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation 7. Understand of the basis of food safety regulations and Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food 8. Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.
Paper 9	After completion of the paper the students will be able to: 1. To know the basics and concepts of various biotechnological related terms 2. Elucidate the significance of transgenic plants as bioreactors for the production of enzymes, plant bodies, edible vaccines and therapeutic proteins 3. Address bioethical and biosafety issues related to plant transgenics Explain the basics of animal biotechnology 4. Elucidate the molecular techniques involved in gene manipulation and rDNA technology 5. Explain the gene transfer methods for the production of transgenic animals

	6. Address bioethical and biosafety issues related to animal transgenics 7. Gain experimental knowledge to perform animal biotechnology related experiments 8. Explain the application of biotechnology in medical and its allied fields, gene therapy , genetic counseling 9. Acquire knowledge about antisence technology, Pharmacogenetics, Toxicigenomics, Tissue engineering, Boimolecular engineering and the impact of these novel strategies on human population. 10. Address the bioethical issues & concerned linked to medical biotechnology 11. Understand the basic principles of environment microbiology and be able to apply these principles to understanding and solving environmental problems – waste water treatment and bioremediation. 12. Know the Microorganisms responsible for water pollution especially Water-borne pathogenic microorganisms and their transmission • Comprehend the various methods to determine the Sanitary quality of water and sewage treatment methods employed in waste water treatment. 13. Know how viruses can be used as tools to study biological processes, as cloning vectors and for gene transfer.
Paper-10 (Practical)	1. Basic Understanding of Immunology and antibiotic sensitivity test. 2. Principles and hand-on experience of immunoassays.
Paper-11 (Practical)	Students will be able to: 1. Identification of the quality of food and water. 2. Basic understanding of fermentation techniques.

Annual 1+1+1 system (Part-III) General

Part-I General Paper-1	The students will be directed about the history, fundamentals of microbiology and current research in bacteriology. Students will be acquainted to the fundamental understanding of the biological machinery of bacteria along with systematic and evolutionary life. Students will be demonstrated to an understanding and ability for deployment of scientific methods including observation, hypotheses testing, data

	collection, and analysis. Students will be acclimatized to critical analysis and evaluation of published research in the field of bacteriology.
Paper-2	On completion of the paper, students are able to: 1. Get acquainted with different types of cell structure. 2. Use various method to control microbes. 3. Gather theoretical background of microbial cultivation 4. Understand various specialized techniques such as pasteurization 5. Understand the basic concepts related to enzymes 6. Qualitative and quantitative enzyme assay 7. Effect of environmental factors on enzyme 8. Enzyme kinetics and various biochemical pathway Microbial Metabolism 10. Anabolism and catabolism with examples 11. Bacterial photosynthesis.
Paper-3 (Practical)	The practical paper also aims to demonstrate fundamental knowledge of staining techniques, examination of bacteria from natural habitat and preparation of standard bacteriological medium.
Part-II General Paper-4	The paper will give an overview of medically important virus families, their replication strategies and mechanisms for development of viral infectious diseases. Topics will include taxonomy, replication strategies, pathogenicity and transmission of viruses and, additionally, diagnosis, prevention and treatment of viral diseases. Antiviral immunity and viral evasion will also be covered. Common human viral infections will be the main focus of the paper, and emphasis will be put on virus-host interactions as a key to understanding the diversity of viruses and viral diseases. This paper will emphasize the molecular mechanisms of DNA replication, repair, transcription, protein synthesis, and gene regulation in both prokaryotes and eukaryotes.
Paper-5	This paper gives an applied aspect of Microbiology, which includes role of microbes in industries, various industrial processes and industrial research. This paper aims to impart fundamental knowledge of metabolic reactions in microbial cell, genetic engineering, their growth, development and its relevance to applied microbiology.

Paper-6 (Practical)	The objective of this paper is to train students practically in basic and applied principles of pure culture and their preparation. The paper involves demonstration and on-hand training of various microbiological techniques and enumeration of bacteria by Breed's method.
Part-III General Paper 7	By studying immunology students are able to learn how immunology-the study of human immune system which controls infections and provides immunity against microorganisms-can apply to a range of areas in the biomedical sciences. The goal of this paper is to provide students basic knowledge of environment and their role in life sustenance. The students can identify and analyze environmental problems as well as the risks associated with them.
Paper 8 (Practical)	1. Basic Understanding of Immunology and antibiotic sensitivity test. 2. Principles and hand-on experience of immunoassays and identification of bacteria from root nodules.

BSc. MICROBIOLOGY (CBCS)

SYLLABUS: SEMESTER-I

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSC 1	**CORE**	**INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (Theory)**	**60**	**04**	**60**

Course Objective:

The aim of this course is to familiarize the students with the elementary history of the subject Microbiology and the various theories proposed for Microbial existences which are used in understanding the basics of Microbiology in general. The core course will also help to describe the world-changing scientific contributions of pioneering scientist of the 17^{th} to 18^{th} century. The core course will help the students to understand the importance of morphological distinctness with respect to species diversity of Algae, Fungi and Protozoa and their Evolutionary relationship that exist in between them. They will try to critically think why algae, fungi and protozoa are studied in Microbiology. Moreover, core course will also provide a comprehensive understanding of the origin of various techniques used in Microbiology and development of ideas to exhibit the techniques origin and development of ideas to exhibit the techniques for isolation of pure culture.

Program Outcome:

After successful completion of this course students will be able to:

- Demonstrate an understanding of the principles of scientific inquiry.
- Demonstrate the ability to think critically and employ critical thinking skills.
- Demonstrate the ability to make connections between concepts across Microbiology.
- Describe the contributions of eminent pioneer microbiologist, Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky and Selman A. Waksman in the establishment of the field of Microbiology.
- Describe the evidence that support the Germ theory of disease.
- Define microbes in the words of Leeuwenhoek and as we know them today.
- Explain why protozoa, algae, and non-microbial parasitic worms are studied in microbiology.
- List and answer four questions that propelled research in what is called the "Golden Age of Microbiology."
- Identify the scientists who argued in favour of spontaneous generation.
- Compare and contrast the investigations of Redi, Needham, Spallanzani, and Pasteur concerning spontaneous generation.
- List four steps in the scientific method of investigation.
- Discuss the significance of Pasteur's fermentation experiments to our world today.
- Explain why Pasteur may be considered the Father of Microbiology.
- Identify the scientist whose experiments led to the field of biochemistry and the study of metabolism.
- List at least seven contributions made by Koch to the field of microbiology
- List four groups of algae, and describe the distinguishing characteristics of each
- List the four steps that must be taken to prove the cause of an infectious disease.
- Describe the contribution of Gram to the field of microbiology.
- Identify six health care practitioners who did pioneering research in the areas of public health microbiology and epidemiology.
- Name two scientists whose work with vaccines began the field of immunology.
- List four major questions that drive microbiological investigations today.
- Identify the field of microbiology that studies the role of microorganisms in the environment.
- Name the fastest-growing scientific disciplines in microbiology today.
- List the economically important group of Algae, Fungi and Protozoa

- Describe the ultrastructure of viruses
- List several economic benefits derived from algae.
- List four ways in which water moulds differ from true fungi
- Describe the five kingdom system of classification

BSc. MICROBIOLOGY (CBCS)

SYLLABUS: SEMESTER-I

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSC 2	CORE	BACTERIOLOGY (THEORY)	60	04	60

Course Objective:

The objective of the Bacteriology paper is to acquaint the student with the basic concepts of bacteriology for the development of the right attitudes by the Microbiology students to better understand the theoretical aspects of Bacteriology. The course is also intended to provide a thorough background on the anatomical and cellular organisation of the basic fundamental unit of all living organisms called cell. The course will also help the student to understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also understand the structural similarities and differences among various physiological groups of bacteria/archaea. The student will be able to understand various physical and chemical means of sterilization, historical background of culture growth media and their applications. Know more about various microbial techniques for the isolation of pure cultures in an artificial growth media along with the safe laboratory practices. Moreover, the topics also provide an opportunity to understand the importance of three distinct Domain system of life (Eubacteria, Archaebacteria and Eukaryotes). The coverage of important archaeal and eubacterial groups has been expanded and updated for coherent understanding.

Program Outcome:

After successful completion of this course students will be able to:

- Demonstrate an understanding of the principles of scientific inquiry.
- Demonstrate the ability to think critically and employ critical thinking skills.
- Demonstrate the ability to make connections between concepts across Microbiology.
- Describe the cellular organisation of prokaryotic and eukaryotic cells
- Differentiate the cell wall characteristics of Gram Positive and Gram Negative Bacteria
- Describe the importance of differential staining procedure: Gram and Acid fast staining

- Describe the importance of differential staining procedure in medical microbiology
- Describe the importance of Archaebacteria
- List two structures that are unique to Gram-negative and to Gram-positive cells, and provide the function of each.
- List two structures that both Gram-negative and Gram-positive cells have in common, and provide the function of each.
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- Comment on the cell wall characteristics of Archaebacteria
- Describe the effect of antibiotic on the growth of prokaryotic organisms with respect to cell wall architecture
- Differentiate the plasma membrane structure of archaea and prokaryotic organism
- Comment on the Ribosome of Prokaryote and Eukarya
- Describe the process of sporulation in Gram positive bacteria
- State two unique structures present in Eukaryotes, but not in Bacteria and Achaea.
- Describe the structure of endospore
- List the various stages of endospore formation
- List the methods of pure culture isolation
- Describe the various methods of pure culture isolation
- List the important technique available for maintaining the pure culture for short term and long term preservations
- How can anaerobic bacteria be brought into culture growth
- State the difficulties faced by microbiologist in isolating pure culture
- Describe the various methods available in determining non-cultural bacteria.
- List the various types of Microscope used in the field of Microbiology
- Describe the mechanical part and functioning of Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope
- Explain why microscope is used in Microbiology
- Describe the nutritional requirements in bacteria
- List the various type of media used in microbiology
- What is a culture and culture media

- Classify various types of media based on function and composition
- How can bacterial growth be enriched
- Describe the physical and chemical methods of sterilization
- Explain the mode of action biocides for controlling microorganisms
- Describe the general process of asexual reproduction
- Explain the logarithmic increase in growth
- Describe the various phases of growth
- Calculate the mean generation time and specific growth rate constant
- List the three Domains of the phylogenetic tree of life. State a unique characteristic of each Domain
- List two features of a useful molecular/evolutionary clock.
- Explain what features of 16S rRNA make it useful to compare the evolutionary relationship between organisms.
- Determine the two most related and two least related organisms from a short list of 16S rRNA sequences.
- Draw inferences about evolutionary relatedness of organisms based on phylogenetic trees.
- Describe the general characteristics of the different members of Archaebacteria
- Describe the overall features related to alpha, beta and gamma proteobacteria
- Describe extensively the features of low G+C Firmicutes
- Describe extensively the features of high G+C Actinobacteria
- Briefly describe the important cellular features associated with cyanobacteria
- Explain the role of heterocyst in nitrogen fixation

SYLLABUS: SEMESTER-II

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSC:03	CORE	BIOCHEMISTRY (THEORY)	60	04	60

Objective:

Biochemistry is an evolving science where researchers are making new discoveries every day. The objective of this course is to teach students the fundamentals concepts in biochemical chemistry and thermodynamics. Enable student to understanding the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions. The student will be able to incorporate these concepts into their basic learning of chemical structures needed for understanding of chapter in other courses where basic chemical are used as a precursor for the generation of biological macromolecules i.e., integration of metabolism with biochemistry. The biochemistry course has been designed to meet up the fundamentals required for understanding the chemical biology of microbes and human health. Finally to give an overview of major biomolecules –carbohydrates, lipids, proteins, amino acids, nucleic acids, vitamins, enzymes, their classification, structure, and function will be dealt in details. The fundamental and conceptual knowledge of properties, structure, and function of enzymes, enzyme kinetics and their regulation will be covered using models.

Program Outcome:

- The students will have wide exposure of bio-molecular interactions and bioenergetics of biochemical pathways.
- The students will learn how all bio-molecules are composed of monomers subunits and functions in living systems.
- The students will have comprehensive knowledge of biochemical pathways leading to synthesis and catabolism of major bio-molecules.

Discipline specific elective

SYLLABUS: SEMESTER II

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSE- 01	DSE	Virology (Theory)	60	04	60

Objective:

This course is offered to students to gain basic knowledge on Introduction to Virology and is followed by an exploration of theories of viral origin. The Virology course is designed in a lucid manner outlining the essential morphological architecture, physiological, and genetic elements of viruses as well as viroids, satellites, and prions. They will also know how viruses are classified. The concept of interferon, proto-oncogenes is presented and their updated discussion of the role of viruses in causing cancer shall be discussed in detail.

Program Outcome:

After successful completion of this course students will be able to:

- Demonstrate an understanding of the principles of scientific inquiry.
- Demonstrate the ability to think critically and employ critical thinking skills.
- Demonstrate the ability to make connections between concepts across Microbiology.
- Define viruses and label its different parts
- Describe the importance of viruses
- Give a general characteristics of viruses
- Give an examples of double stranded single stranded DNA/RNA virus
- Explain the importance of different theories of viral origin
- Describe the various methods available for isolation, purification and cultivation of viruses
- Contrast non-enveloped and enveloped viruses
- What are the possible ways available for the classifications of viruses
- Describe the structure of lambda phage virus
- Compare and contrast DNA and RNA viruses
- Compare and Contrast Plant and animal Viruses
- Explain in details the one step growth curve
- Describe the life cycle patterns of lambda phage
- Describe the role of molecular switches in regulating lytic and lysogenic cycles
- Compare and contrast the differences between lysogenic and latent viral infections
- Explain the various modes of Persistent, non-persistent, vertical and horizontal viral transmissions
- List the salient features of viral nucleic acids with respect to Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV)
- Know how viruses are classified
- Understand the architecture of viruses
- Know the methods used in studying viruses
- Classify the virus on the basis ofreplication strategies of representative viruses from the seven Baltimore classes

- Understand the interactions between viruses and the host immune system
- Describe the terms Oncogenes and tumor suppressor genes, and how tumor viruses interact with these products and their intersecting pathways and cause oncogenesis.
- Explain the term oncogenic with respect to viruses
- Differentiate between oncogenes and protooncogenes
- Give a concise account of oncogenic DNA and RNA viruses
- Describe the importance of antiviral compounds and their mode of action
- Explain vaccine strategies and mechanisms of antiviral drugs and Interferons
- What are interferon and comment on their mode of action
- Know how viruses can be used as tools to study biological processes, as cloning vectors and for gene transfer.

PRACTICAL PAPERS

BSc. MICROBIOLOGY (CBCS)

SYLLABUS: SEMESTER-I

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSC:1.1	CORE	INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (PRACTICAL)	60	02	20

Course Objective:

The students will be attending a laboratory session of 6 hours weekly and they have to perform the practical related to the course list. The Purpose of the lab course is to introduce students to the various types of instruments used in microbiology laboratory. They will learn to take weight measurements using electronics balance for preparing microbial media and reagents required in laboratory along with the art of sterilisation using autoclaves, membrane filter, and hot air oven. The main objective of this subject is to help students identify the different latest measurement and sterilisation techniques available for specific microbiological applications. Lastly, the course is so designed to provide greater safety awareness and to alert students to potential hazards in performing certain experiments in working laboratory.

Program Outcomes:

This course will lead the students to

- Understand the various measurement techniques available.
- Understand the basic working of instruments used for measurement.

- Understand the errors in measurements and their rectification.
- Understand the importance of aseptic practises in Microbiology laboratory.
- Demonstrate practical skills in microscopy and their handling techniques along with staining procedures

BSc. MICROBIOLOGY (CBCS)

SYLLABUS: SEMESTER-I

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSC:2.1	CORE	BACTERIOLOGY (PRACTICAL)	60	02	20

Course Objective: The course aims at developing an appreciation about the principles, functions of culture media used in microbiology laboratory and functioning of various instruments. Know various types of culture media and their applications and also understand various physical and chemical means of sterilization

Program Outcomes: After completion of course students will be able to:

- Work independent in microbiological laboratory.
- To apply the principles and theories learned in the theory in the practical work context.
- Develop mastery of aseptic techniques.
- To perform routine culture handling task safe and effectively.

SYLLABUS: SEMESTER-II

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSC:3.1	CORE	BIOCHEMISTRY (PRACTICAL)	60	02	20

Course Objective:

The purpose of this practical course is to provide a basis for understanding the basic working design and use of spectrophotometer for determination of linear quantitative curve for the estimation of biological macromolecules, with basic operation and limitations of spectrophotometer. The course is intended to equip students with a basic understanding of the underlying principles of quantitative and qualitative research methods. This course also helps the students to understand the preparation of reagents and serial dilutions for preparation of standard curve. They will also learn the effect of physical factors and inorganic components mainly the heavy metals on the activity of functional molecules like enzymes.

Program Outcomes: After completion of course students will be able:

- To use spectrophotometer independently for carrying biochemistry experiments.
- To master hands on experience with electronic instruments.

BSc. MICROBIOLOGY (CBCS)

SYLLABUS: SEMESTER-II

PAPER CODE	COURSE TYPE	COURSE TITLE	HOURS	CREDITS	MARKS
DSE1.1	DSE	VIROLOGY (PRACTICAL)	60	02	20

Course Objective:

To reinforce learning in the virology course through hands-on experience with plaque assay determination using agar double layer technique and plant assay using focal lesion technique. This course is intended to understand the students to critically analyze the operation of various electron microscopes for ultra-structure determination and morphological characterization of viruses.

Programme Outcomes:

After completion of this course, the students will be:

- Capable of working with sewage sample for water quality analysis using plaque assay.
- To understand the importance of various method used in studying viruses.
- Describe electron micrographs of both the animal and plant viruses.
- Know viral diversity using electron micrograph.

Learning Outcomes

CHEMISTRY

Syllabus

PART- I, II AND III

B.Sc. Honours & GENERAL Course

Chemistry (Honours) Part-I			
YEAR	**PAPER**	**TOPIC**	**LEARNING OUTCOMES**
1	**PAPER-I**	**GROUP-A (ORGANIC)**	**After successful completion of these chapters students will have the knowledge of:** **Classification, and Nomenclature, Hybridization, Shapes of molecules,Influence of hybridization on bond properties.** **Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges;Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.** **Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions. Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers,** **Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.** **The chemistry of aliphatic and aromatic hydrocarbons:Aliphatic Hydrocarbons: Alkanes- Preparation : catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: mechanism forfree radical substitution: halogenation. Alkenes : elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; cis alkenes. Reactions: cis-addition (alkaline KMnO4) and trans-addition (bromine) with**

			mechanism, addition of HX [Markownikoff's (with mechanism) and antiMarkownikoff's addition], hydration, ozonolysis. Alkynes: Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alkaline KMnO4. **Benzene and its reactivity , Concept of resonance, resonance energy. Heat of hydrogenation, heat of combustion of Benzene, mention of C-C bond lengths and orbital picture of Benzene. Concept of aromaticity - aromaticity (definition), Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation) Reactions - General mechanism of electrophilic substitution, mechanism of nitration, Friedel Craft's alkylation and acylation. Alkyl halides in detail.**
		GROUP-B **(INORGANIC)**	**After successful completion of these chapters students will have the knowledge of:** **Bohr's theory for hydrogen atom, atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations.** **Characterize bonding between atoms, molecules, interaction andenergetics. Hybridization and shapes of atomic, molecular** **orbitals, bond parameters, bond- distances and energies.** **Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p-block elements.**
		GROUP-C **(PHYSICAL)**	**In this course the students are expected to learn:** **Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms,**

			continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states. **Postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.** **Intensive and extensive variables; state and path functions; isolated, closed and open systems. First law: Concept of heat, Q, work, W, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of Q, W, ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Thermochemistry: Heats of reactions: standard states; enthalpy of formation and enthalpy of combustion and its applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes. Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Joule-Thomson coefficient and inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Partial molar quantities, Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases. Statement of Third Law of thermodynamics and calculation of absolute and residual entropies of substances.**
1	**PAPER-II**	**PRACTICAL**	**Students will have the experience of Organic qualitative analysis and organic compounds preparation with melting point determination through this course.**
Chemistry (General) Part-I			

1	**PAPER-I**	**GROUP-A** **(ORGANIC)**	**In this course the students will have the following knowledge:** **Understand hybridisation,electronic displacement, cleavage of bonds,empirical and molecular formula determination. Understand preparation, properties and various reactions of alkanes, alkenes , alkynes,alcohols,aldehydes and ketones. Detect extra elements in organic compounds.**
		GROUP-B **(PHYSICAL)**	**In this course the students will learn:** **Deviations from ideal gas behaviour, Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.** **Postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path ,their temperature and pressure dependence, variation of viscosity with temperature. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) .** **Concept of heat, Q, work, W, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of Q, W, ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions Joule-Thomson coefficient and inversion temperature.Heats of reactions: standard states; enthalpy of formation and enthalpy of combustion and its applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. statement of the second law of thermodynamics. Carnot cycle. Concept of entropy. Gibbs free energy.**
1	**PAPER-II**	**GROUP-A** **(INORGANIC)**	**In this portion students will learn:** **Natural radioactivity; group displacement law, law of radioactive decay, half-life and average life of radio-elements, radioactive equilibrium, Stability of atomic nucleus, n/p ratio, nuclear binding energy, nuclear forces, nuclear reactions, fission, fusion, transmutation of elements, Age determination, radiocarbon dating.** **Bohr's theory for hydrogen atom, atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their**

			significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle **Hybridization and shapes of atomic, molecular orbitals, bond parameters, bond- distances and energies. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements.**
		GROUP-B **(PHYSICAL)**	**In this course the students are expected to learn:** **Equilibrium constants and their quantitative dependence on temperature, pressure and concentration (Le Chatelier Principle, Quantitatively). Clausius-Clapeyron equation and its applications.Phase rule and its application to one component system. Nernst distribution law.** **Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid.** **Relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.**
1	**PAPER-III**	**PRACTICAL**	**Students will have the experience of Organic qualitative analysis and organic compounds preparation with melting point determination through this course.**
Chemistry (Honours) Part-II			
2	**PAPER-III**	**Organic Chemistry**	**After successful completion of these chapters students will have the knowledge of:** **Preparation of Alcohols, Phenols and Ethers by reduction of aldehyde, ketones, carboxylic acids, esters. Reaction with hydrogen halides, phosphorus trihalides. Oppeneaur oxidation, oxidative cleavage of dihydric alcohols. Pinacol-Pinacolone rearrangement.** **Electrophilic substitution reactions, Fries rearrangement, Reimer Tiemann reaction. Preparation, cleavage and autoxidation of Ethers** **Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3 dithianes. Nucleophilic addition to carbonyl**

			group; Benzoin, Aldol condensation, Benzilic acid rearrangement. Cannizzaro reaction. Meerwein-Pondorf-Verley, Michael, haloform reaction. **Preparation and general reactions of carboxylic acids, acid chlorides, esters. Decarboxylation, esterification.** **Structure, physical properties, identification of primary, secondary and tertiary amines (the Hinsberg method). Hofmann, Curtius, Lossen and Schmidt reaction. Diazomethane and their uses.** **Isomerism, types of isomerism, chirality, enantiomerism, optical activity, specific rotation, diastereomers, racemic mixture, resolution** **Kinetics of nucleophilic substitution of alkyl halides: SN1 and SN2 mechanism- effect of solvent, structure, leaving group. 1,1 (α) and 1,2 (β) elimination: mechanism, E1, E2, E1cB, elimination versus substitution.**
2	**PAPER-IV**	**Inorganic Chemistry**	**On successful completion of the course students will be able to:** **Basic principles of G-M counter, Separation of isotopes.** **Natural radioactivity; group displacement law, law of radioactive decay, half-life and average life of radio-elements, radioactive equilibrium, Stability of atomic nucleus, n/p ratio, nuclear binding energy, nuclear forces, nuclear reactions, fission, fusion, transmutation of elements, Age determination, radiocarbon dating, medicinal and agricultural applications of radioisotopes.** **Comparative study:** **For all the groups - with regard to electronic configuration, atomic, ionic radius, valence states.** **Gr I A: Li, Na, K, Rb, Cs** **Hydration energy of the ions, Softness of the metals;** **Hydrides - stability; Difference of the Li from other members.** **Gr V B: N, P, As, Sb, Bi** **Inert pair effect in Bi.** **Hydrides - Stability, variation of basic character, variation of bond angles. Halides - hydrolysis and Oxy-acids.** **Gr. VI B: O, S, Se, Te**

			Hydrides - stability, acid character, bond angle, Halides, Oxy-acids. **Gr: VII B: F. Cl, Br, I** **Reactivity, Bond dissociation energy, Colour;** **Hydrides - stability, acidic character.** **Basic character of halogens; Oxy-acids.** **Gr IB, Gr. IIB - Complexes, Oxidation states, and abnormal valence states.** **Compounds of Noble gases.** **Per acids of S. Classification of hydrides, Diborane, Borazole. Phosphonitriles, Interhalogen compounds, Pseudohalogens, Silicones.** **Arrhenius, Bronsted-Lowry, Lewis concepts of acids and bases. Hard soft and base (HSAB) concept.**
2	**PAPER-V**	**Physical Chemistry**	**By the end of this course, students will be able to learn:** **Thermodynamic derivation of equilibrium constant, The reaction isotherm. Pressure and temperature dependence of equilibrium constant; vant's Hoff equation, Principle of Le Chatelier and Braun; Effect of pressure, temperature, Concentration and Inert gas on equilibrium; Study of a few important homogeneous reactions.** **Thermodynamic criterion of phase equilibria, Clausius-Clapeyron equation, Phase rule & its application to one component systems Water,Sulphur, two components systems** **Surface tension - capillary action formation & stability of bubbles, determination. Viscosity of liquid - temperature dependence, determination. Dipole moment - application of dipole moment for structure determination.** **Chemical Potential of solute & solvent in solutions; Relative lowering of vapour pressure, Elevation of boiling point, Depression of freezing point, Osmotic pressure-their measurements, colligative properties of strong and weak electrolytes, Solution of gases in liquids, Henry's law and Raoult's law, Duhem-Margules equation. Ideal solutions of liquids in liquids, non-ideal solutions of liquids in liquids, Azeotropes. Nernst distribution law applications.**

			Reversible and irreversible cells, emf and its measurements, Galvanic cell, Electrical and electrochemical potential, Different types of half cells, cell reactions, Nernst equation, Reference electrodes, Concentration cell, Liquid junction potential; Determination of E0 from EMF measurements. **Ionic equilibria: Solubility products, common-ion effect, ionic product of water, pH, Hydrolysis of salts, Buffers and Neutralization indicators.** **Electrolysis, Arrhenius theory of dissociation, Ostwald dilution law. Metallic and electrolytic conduction, conductance of solutions, variation of conductivity with concentration, Determination of Λ, transference numbers and ionic mobility, Hydration of ions. The Walden's rule. Applications of conductance measuments e.g. conductometric titrations.**
2	**PAPER-VI**	**Practical**	**Inorganic Qualitative Analysis**
			Chemistry (General) Part-II
2	**PAPER-IV**	**GROUP-A** **(ORGANIC)**	**By the end of this course, students will be able to learn:** **1. Preparation and application of Grignard reagent, ethyl acetoacetate 2. Primary, Secondary and Tertiary amines: Basic concept, separation, preparation of primary amines: Hofmann hypobromite, Schmidt and Curtius reactions (mechanism omitted)** **3. Optical isomerism: Chiral Centre, optical isomerism of lactic acid and tartaric acid, geometrical isomerism of maleic acid and fumaric acid.** **4. Carbohydrates: Definition, classification, structure and properties of glucose. 5. Benzene: Rule of aromaticity, halogenation, Nitration, Friedel-Crafts reaction. 6. Aromatic amines: Diazonium salts, Benzoin condensation.**
2	**PAPER-IV**	**GROUP-B** **(INORGANIC)**	**By the end of this course, students will be able to understand:** **1. Characteristics of transition metal, reason for their differences from representative metals. Comparative study: Gr. VB: N, P, As, Sb, Bi. Electronic configuration, valence. Hydrides- preparation, stability, basic properties. Gr. VI B: O, S-valence, Hydrides-boiling points, acidic character. Gr. VII B: Special properties of Fluorine and Iodine.**

			2. Oxyacids: Name, structural formula, one method of preparation for each, nature of existence, basicity of (1) Chlorine (2) Per acids of sulphur. **3. Extraction and chemistry of Ni, Sn.** **4. Chemistry of: Hydrazine, Sodium nitroprusside, Silicone, Borazene.** **5. Carbonisation of coal: Superphosphate; Detergent Soap.**
2	**PAPER-V**	**GROUP-A** **(INORGANIC)**	**After the completion of this part students will be able to learn :** **1. Simple idea of Double salt and Complex salt. Perfect and imperfect complex, Nomenclature (IUPAC), Werner's coordination theory, ligand-monodentate, tri and** **tetradentate, ambidentate, Chelate, Innermetallic complex (first order), Geometrical and optical isomerism in inorganic complexes.** **2. Principles of Fe++- K2Cr2O7 titration, estimation of Cu2+. Calculation of errors - mean, median, mode, standard deviation.**
		GROUP-B **(PHYSICAL)**	**After the completion of this part students will be able to learn the following:** **Order and molecularity, Integrated rate laws for zero, first & second order reactions, Determination of order of reaction, Elementary treatment of opposing, consecutive, parallel reactions. Effect of temperature on reaction rate** **Laws of photochemistry, quantum yield, Lambert-Beer's law and its application. Elementary ideas of Fluorescence, Phosphorescence.** **Reversible and irreversible cells, emf and its measurements, Galvanic cell, Electrical and electrochemical potential, Different types of half cells, cell reactions, Nernst equation, Reference electrodes.** **Ionic equilibria: Solubility products, common-ion effect, ionic product of water, pH, Hydrolysis of salts, Buffers and Neutralization indicators.** **Photoelectric effect, Wave particle duality, Uncertainty Principle , Principle of Pure Rotational and vibrational Spectroscopy .** **Adsorption of gases by solids, Types of adsorption, Effect of temperature and pressure, Freundlich and Langmuir adsorption**

			isotherm, Theory of homogeneous Catalysis. Colloids: Classification, Preparation, Stability, Purification.
2	**PAPER-VI**	**Practical**	**Inorganic Qualitative Analysis**
			Chemistry (Honours) Part-III
3	**PAPER-VII**	**Organic Chemistr**	**After the completion of this portion students will be able to learn the following:** **Bonding, antibonding and nonbonding MO's. Electronic configuration of H2 and N2. MO's of π systems: 1,3-butadiene, benzene. HOMO, LUMO.** **Electrocyclic reactions-disrotation, conrotation, Diels-Alder reaction.** **The electromagnetic spectrum , Range of ultraviolet region, units of wavelength. absorption laws, molar absorptivity, types of electronic transitions, effect of conjugation (visible region), colour of conjugated organic compounds, chromophore, auxochrome, bathochromic, hypsochromic, hypochromic shifts, Woodward Fieser empirical rules for λmax calculation of dienes.** **Infrared (IR) region-Relation between bond order and position of IR bands, effect of resonance, fingerprint region, identification of intramolecular and intermolecular hydrogen bonding, characteristic absorption of various organic functional groups in IR spectra. Proton magnetic resonance and spectrum, number of signals, equivalent and non-equivalent protons, position of signals, chemical shift, nuclear shielding and deshielding, proton counting, splitting of signals, spin spin coupling, coupling constant, interpretation of 1HNMR spectra of ethyl bromide, ethanol, acetophenone.** **Structure determination of naphthalene and phenanthrene.** **Aromatic characteristics of pyrrole, furan, thiophene and pyridine, mechanism of nucleophilic substitution reaction in pyridine, preparation and reaction of indole with special reference to Fisher indole synthesis.** **Introduction to proteins, classification, structure, zwitter ion, isoelectric point, Gabriel phthalimide, synthesis of amino acids.** **Proteins: classification, denaturation, partial hydrolysis, determination of primary structure sequence of amino acids.**

			Synthesis of ethyl acetoacetate, Claisen condensation, keto-enol tautomerism. 7. Baeyer strain theory: Shortcomings of relative stability of the cycloalkanes, conformational analysis of cyclohexane, mono and dimethyl substituted cyclohexane, decalin.
3	**PAPER-VIII**	**Inorganic Chemistry**	**After the completion of this paper students will be able to learn the following:** **Wave-particle duality, de Broglie equation, Heisenberg uncertainty principle, Schrodinger wave equation. :** **Basic postulates, setting up of trial wave function for H2 molecule (brief introduction), success of M.O. theory over V.B. theory in explaining the paramagnetism of O2 molecule, energy diagram of the MO of N2, CO, NO. Explanation of monatomic He and Ne.** **Characteristics of bonding metals, failure of classical theory of valence, Brief and qualitative approach of band theory (M.O.), classification of alloy system and Hume Rothery rule.** **Werner theory with illustrative examples, nomenclature, theory of coordination bond - valence bond approach, detection of complex formation, factors affecting the complex formation, dependence of stability on chelation, magnetic property of the complexes, isomerism including geometrical and optical, inner metallic complexes.** **Splitting of the d-orbitals in octahedral, tetrahedral and square planar crystal field; crystal field stabilization energy, magnetic property, 'd-d' spectra including brief introduction to selection rules.** **The thermodynamic stability of metal complex and factors affecting the stability.** **Definition of π-acid ligands, Carbonyls – structure and bonding. Nitrosyls, Brown ring compound, Roussin's salt structure, nitropruside.** **σ-bonded organometallic, structure of dimeric trimethyl aluminum, π-bonded organometallic compound - Zeise's salt, Ferrocene.** **Chemistry of U, Pt and their Important Compounds** **Reaction in Non-aqueous Solvents: Liq. NH3, liq. HF.**

			Classification of essential elements in human body system, trace and ultramicro trace elements, preliminary ideas composition and functions of Hemolglobin, Myoglobin and Metaloenzymes (Containing iron, copper and zinc: 2 examples of each type. **Chemistry of Lanthanides and Actinides:** **Electronic structure, oxidation states, Lanthanide contraction, isolation (ion exchange method), similarities between the later actinides and the later lanthanides with respect to oxidation states.**
3	**PAPER-IX**	**Physical Chemistry**	**By the end of this course, students will be able to learn:** **Structural distinction between solids and liquids, Types of solids, Laws of crystallography, Crystal systems, Bravais, lattices, Point groups, Space groups, designation of planes and faces, Diffraction of X-rays by crystals - Bragg's equation, density of cubic crystal, Crystal structures of NaCl & KCl, radius ratio rules, classification & structure (elementary idea).** **Adsorption of gases by solids, Types of adsorption, Effect of temperature and pressure, Freundlich and Langmuir adsorption isotherm, Theories of homogeneous and heterogeneous catalysis, Acid- base catalysis.** **Extent of reaction, order and molecularity, Integrated rate laws for zero, first & second order reactions, Determination of order of reaction, Elementary treatment of opposing, consecutive, parallel, chain reactions. Effect of temperature on reaction rate, Collision and transition state theories.** **Laws of photochemistry, quantum yield, Lambert-Beer's law and its application. Steady state approximation, Kinetics of photochemical reactions: Decomposition of HI and Reaction between H2, and Br2, Elementary ideas of Fluorescence, Phosphorescence, Photo-sensitized reaction and Chemiluminescence.** **Colloids: Classification, preparation, purification, stability, colloidal electrolytes and their properties. Emulsion: preparation; emulsifier.** **Concepts of permutation, combination, factorials & probability. Thermodynamic probability and entropy. Boltzmann Distribution (No derivation), Partition Function.** **Black body radiation, photoelectric effect, Compton effect, Planck's quantum theory, Wave particle duality, Uncertainty**

			principle, Wave mechanics- Schrodinger equation and its solution for free particle and particle in a box, interpretation of Ψ , degeneracy; Postulates of quantum mechanics, Hamiltonian Operator, Eigen value, Eigen function, Hydrogen atom (elementary idea), Pauli Exclusion principle. **Regions of electromagnetic spectrum, Born Oppenheimer Approximation. Rotational spectrum of diatomic molecules: energy levels of rigid rotator, selection rules, applications.** **Vibrational (infrared) spectrum: energy levels of Simple Harmonic Oscillator, selection rules, applications.** **Raman Spectrum.** **Enzyme Catalysis: Lock & Key theory, Michaelis - Menten equation.** **Nucleic acids: constituents of DNA, RNA, elementary ideas of structure of DNA & RNA. Study of energy rich compound ATP.**
3	**PAPER-X:**	**Group A (Analytical Chemistry)**	**After the completion of this part students will be able to understand the following:** **1. (A) The Treatment of Analytical Data:** **Accuracy, Precision, classification of errors, minimization of errors, mean , medium, mode, standard deviation; method of least square (y = mx + c).** **(B) Computers:** **General introduction to computers, different components of a computer, binary numbers & decimal numbers.** **2. Principle of Gravimetric Analysis, co-precipitation and post-precipitation and their removal (condition for precipitation), efficiency of washing.** **3. Gas Chromatography, Column chromatography- Types, Principle Process, Separation of mixture; paper chromatography and thin layer chromatography.** **4. Solvent Extraction: Theory, efficiency, percentage extraction, separation factor, complexing agent in solvent extraction, selection of solvent.** **5. Ion-exchange: Principle, quality of resins, ion exchange equilibrium, ion-exchange capacity process, deionization of water.**

			6. Electroanalytical Chemistry: Standard electrode potential, Sign conventions, electrochemical series of its significance, Redox potentials, Formal potential, Theory of redox indicators, Elementary idea of voltammetry.
		Group B (Industrial Chemistry)	**After the completion of this part students will be able to learn the following:** **1. Fuel: Definition and calorific value, classification of fuel:** **(a) Solid fuel: High and low temperature carbonization of coal. Objects and products of high and low temperature carbonization of coal.** **(b) Liquid fuel: Flash point, aniline point, knocking, anti-knock compounds, Octane number, cetane number, types of gasoline - natural, straight-run, reformed, Aviation and synthetic gasolines.** **(c) Gaseous fuel: Water gas, producer gas and LPG .** **2. Manufacture and uses common glass, Difference between glass and porcelain. Manufacture, composition and uses of Potland cement - setting of cement. Manufacture and uses of Stainless Steel.** **3. Fibres: Requirement of fibre forming polymer. Difference between natural and synthetic fibres. Manufacture and uses of Nylon 66.** **Synthetic rubber: Difference between natural and synthetic rubber. Vulcanisation. Manufacture and uses of Buna-S.** **4. Oils and fats: Differences, Hydrogenation of oils, Production of Vanaspati. Rancidity of oil. Soap and detergents: Difference between Soap and detergents. Mechanism of cleaning action of detergents. Bio-degradability and biodegradable polymers.** **5. Drugs: Defination, Preparation and uses of some common drugs: Sulphathiazole, Sulpha guanidin, Aspirin, Novalgin and penicillin-G.** **Insecticides: Definition, Classification according to the mode of action. Preparation and uses of D.D.T., Dithion and Dithocarbamte.**

			6. Paints: Constituents of paints and varnishes. Manufacture, Setting and requirements of a good paint. **7. Fertilizers: Defination and necessity of Fertilizers. Manufacture of Urea.**
3	**PAPER-XI**	**Practical**	**Students will also have hands on experience of standard solution preparation in different concentration units and learn quantitative inorganic estimation of Fe3+ and Ca2+, Fe3+ and Cu2+ and Fe3+ and Cr3+ in mixtures through acid-base and redox reactions .**
3	**PAPER-XII**	**Practical**	**From these Physical Chemistry Experiments , students will be able to learn how to do the following experiments:** **1. Determination of composition of given unknown solution by the measurement of viscosity using Ostwald's viscometer** **2. Determination of composition of given unknown solution by the measurement of surface tension using Stalagmometer** **3. Conductometric titration: Oxalic acid vs. NaOH, HCl vs. NaOH, CH3COOH vs. NaOH 4. Determination of rate constant for the acid hydrolysis of methyl acetate at room temperature** **5. Determination of pH of the supplied CH3COOH-CH3COONa buffer solution colorimetrically using bromocresol green indicator**
			Chemistry (General) Part-III
3	**PAPER-VII**	**Industrial Chemistry**	**Students will be able to learn the following:** **1. Fules: (i) Gaseous fuels: Manufacture & uses of Producer gas, Water-gas and Bio-gas. (ii) Liquid fuels: Crude of oil- refining, Gasolene, Octane number, Cetane number, Antiknock compounds.** **2. Non-Conventional Sources of Energy; Solar energy, Wind energy.** **3. Paints and Pigments: Methods of Preparation & uses of Ultramarine blue. 4. Ceramics: Manufacture of glazed porcelain (household items).** **5. Insecticides: Different classes of insecticides - organophosphorous, carbamates.**

			6. Oils and fats: Distinction between oils & fats, Saponification value, Iodine value, Hydrogenation of fats & oils. **7. Polymers: Preliminary ideas of polythene, PVC (composition & uses).** **8. Cement: Cement-its composition, manufacture & uses, setting of cement.**
3	**PAPER-VIII**	**Practical**	**Students will also have hands on experience of standard solution preparation in different concentration units and learn quantitative inorganic estimation of Fe^{3+} and Cu^{2+} through acid-base and redox reactions . Also will have the idea to do and report Project Work**

Learning Outcomes

CHEMISTRY

Syllabus

CHOICE BASED CREDIT SYSTEM

B.Sc. Honours & Program Course (SEM I AND II)

SEMESTER	PAPER	TOPIC	LEARNING OUTCOMES
1	CC-1	Inorganic Chemistry	1. Atomic theory and its evolution. 2. Learning scientific theory of atoms, concept of wave function. 3. Elements in periodic table; physical and chemical characteristics, periodicity. 4. To predict the atomic structure and molecular geometry based on accepted models. 5. To understand atomic theory of matter, composition of atom. 6. Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms. 7. Characterize bonding between atoms, molecules, interaction and energetics. Hybridization and shapes of atomic, molecular orbitals, bond parameters, bond- distances and energies.
1	CC- 2	Physical Chemistry	1. By the end of this course, students will be able to learn: A) Postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperatureand pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure.Maxwell distribution and its use in evaluating different molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. B) Behaviour of real and ideal gases, compressibility factor and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Derivation of van der Waals equation and its application in explaining real gas behaviour, other equations of state (Berthelot, Dietirici); virial equation of state; van der Waals equation expressed in virial form and calculation

			of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states. **C) Structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents.Temperature variation of viscosity of liquids and comparison with that of gases.** **D) Laws of Crystallography, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, and KCl.** **E) Classification of electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; exact treatment of dissociation constants of mono-, di-and tri-protic acids. Hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, and buffer action. Solubility and solubility product of sparingly soluble salts ,solubility product principle and its applications. Calculation of pH at various stages of acid – base titration.Theory of acid–base indicators; selection of indicators .** **From the experience of laboratory experiments students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of such experiments.**
1	**GE- 1**	**Section A: Inorganic Chemistry**	**1. Atomic theory and its evolution.** **2. To predict the atomic structure** **and molecular geometry based on**

			accepted models. 3. Characterize bonding between atoms, molecules, interaction and energetics. Hybridization and shapes of atomic, molecular orbitals, bond parameters, bond-distances and energies.
		Section B: Organic Chemistry	**Understand electronic displacement, cleavage of bonds, reactive intermediates, organic acids and bases, aromaticity. Draw and demonstrate conformations with respect to alkanes, interconversion of wedge formula, Newman, Sawhorse and Fischer representation, Chirality, configurations, CIP rule. Understand preparation, properties and various reactions of alkanes, alkenes and alkynes. Detect extra elements in organic compounds, measure Rf value, separate components by paper chromatography in laboratory.**
1	**DSC-1**	**Section A: Inorganic Chemistry**	**1. Atomic theory and its evolution. 2. To predict the atomic structure and molecular geometry based on accepted models. 3. Characterize bonding between atoms, molecules, interaction and energetics. Hybridization and shapes of atomic, molecular orbitals, bond parameters, bond-distances and energies.**
		Section B: Organic Chemistry	**Comprehend electronic displacement, cleavage of bonds, reactive intermediates, organic acids and bases, aromaticity. Represent and determine conformations with respect to alkanes, interconversion of wedge formula, Newman, Sawhorse and Fischer representation, Chirality, configurations, CIP rule. Interpret preparation, properties and various reactions**

			of alkanes, alkenes and alkynes. Recognize extra elements in organic compounds, chromatography and Rf value, separation of components by paper chromatography in laboratory.
2	**CC-3**	**Organic chemistry**	**The students learned the fundamental concept of organic chemistry as well as stereochemistry. They could relate the concepts like steric hindrance, configuration, etc to the mechanism of various reactions of aliphatic and aromatic hydrocarbons. They developed experience to conduct the experiments on the determination of melting point, boiling point and purification of organic compounds.**
2	**CC-4**	**PHYSICAL CHEMISTRY**	**1. By the end of this course, students will be able to understand the following:** **A) Intensive and extensive variables; stat and path functions; isolated, closed and open systems; laws of thermodynamics. Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U, and H for reversible, irreversible and free expansion of ideal and ven der Waals gasses under isothermal and adiabatic conditions.** **B) Heats of reactions, enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermodynamics data, Kirchhoff's equation and effect of pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature. Concept of entropy; thermodynamics scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of enthalpy, Calculation of entropy change for reversible and irreversible processes.** **Concept of residual entropy, calculation of absolute entropy of molecules.** **Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature;**

			Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. **C) Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.** **D) Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants Kp , Kc and Kx. Le Chatelier principle; equilibrium between ideal gases and a pure condensed phase.** **E) Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.** **Doing laboratory experiments students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of such experiments.**
2	**GE -2**	**Section A: Physical Chemistry**	**On the completion of the course the students will become well verse with::** **A) Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Kirchhoff's equation. Statement of Third Law of**

			thermodynamics and calculation of absolute entropies of substances. **B) Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^0 , Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.** **C) Concept of strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product. Applications of solubility product principle.**
		Section B: Organic Chemistry	**Understand preparation of aromatic hydrocarbons like the benzene, different reactions of benzene, nucleophilic substitution reactions, preparation and various reactions of alkyl and aryl halides. Describe preparation, characteristics and reactions of alcohols phenols and ethers. Different aliphatic and aromatic aldehyde and ketones and their preparation and various related reactions. Able to purify organic compounds by crystallization, determine melting point and boiling point, prepare different organic compounds in laboratory.**
2	**DSC -2**	**Section A: Physical Chemistry**	**Upon successful completion students should be able to to understand the following:** **A) Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.**

			B) Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^0 , Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases. **C) Concept of strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product. Applications of solubility product principle.**
		SectionB: Organic Chemistry	**Explain preparation of aromatic hydrocarbons like the benzene, different reactions of benzene, nucleophilic substitution reactions, preparation and various reactions of alkyl and aryl halides. Describe preparation, characteristics and reactions of alcohols phenols and ethers. Discuss different aliphatic and aromatic aldehyde and ketones and their preparation and various related reactions. Account for the purification of organic compounds by crystallization, determination of melting point and boiling point, preparation of different organic compounds in laboratory.**

Course Outcomes:

B.Sc. Zoology (Honours) Annual 1+1+1 System

Part - I

Paper – I - Origin of Life - Systematics - Animal Diversity – Non-chordates

- Develops concepts regarding various theories and experiments about organic evolution
- Understanding of general taxonomic rules on animal classification
- Knowledge of classification of Non-chordates along with studies on various physiological functions and interactions of non-chordate organisms with examples

Paper – II - Animal Diversity – Chordates – Structural Adaptation – Zoogeography

- Knowledge of classification of protochordates and chordates along with studies on various physiological functions and interactions of chordate organisms with examples
- Imparts conceptual knowledge of vertebrate adaptations in relation to their environment
- Gather knowledge about distribution of fauna in different zoogeographical realms

Paper – III – Practical

- First-hand knowledge about identification of non-chordate and chordate specimens (fresh and preserved) along with larval forms and study of endoskeleton of vertebrates

Part - II

Paper – IV – Cell & Molecular Biology – Laboratory & Analytical Techniques – Biochemistry

- Basic concepts of Cell and Molecular Biology along with various cellular functions

- Knowledge about different techniques used in Cell and Molecular Biology
- Knowledge of different biochemical processes of cells

Paper – V - Genetics – Immunology – Animal Physiology – Endocrinology & Reproductive Biology

- Develop idea about Mendelian & non-Mendelian inheritance, genetic disorder, gene mutations and sex determination
- Gather knowledge on types of immunity, antigen-antibodies and their properties, vaccines, diseases
- Students are taught the detailed concepts of digestion, respiration, excretion, the functioning of nerves and muscles of animals
- Gain knowledge about hormones and endocrine mechanisms and relation with Developmental Biology

Paper – VI – Practical

- Students are able to handle microscopes, work with camera lucida and micrometers
- Students are able to conduct *Paramoecium* culture, tissue preparation, isolation and estimation of DNA
- Students can perform histological, analytical and biochemical techniques

Paper – VII – Practical

- Students are able to study meiosis and pedigree analysis
- Students are able to conduct Blood grouping and immunological techniques
- Students are taught about various parameters of haematology

Part - III

Paper – VIII – Histology & Histochemistry – Developmental Biology & Teratology – Adaptation, Behaviour & Evolution

- Description about histological and histochemical details of organs of body
- Imparts the knowledge about developmental processes of different animals along with teratology
- This course helps students to gain fundamental knowledge about theories and nature of evolution, speciation, mimicry and colouration

Paper – IX – Ecology – Environmental Biology and Toxicology – Animal Behaviour

- Imparts knowledge to the student regarding various laws of ecology, types of ecosystem, population and community characteristics and dynamics
- Students gain fundamental knowledge of environmental pollutions due to toxic materials and their effects over ecosystem and learns about sustainable development
- Gains knowledge in the areas of animal behavior and sociobiology

Paper – X – Applied Zoology – Conservation Biology & Wildlife – General Informatics & Bio-informatics

- Understands concepts of fisheries, sericulture, apiculture, poultry, dairy along with tissue and cell culture techniques
- Gains understanding of wildlife, biodiversity and conservation Biology
- Students will gain knowledge about Bio-informatics

Paper – XI – Practical

- Students gain skill to prepare different stages of embryos of chick
- Students gain skill about quantification of various ecological parameters

Paper – XII – Practical

- Field visits to various ecological areas like sea-shore, tea plantations, zoological gardens allowed students to prepare reports on them

- Dissertation works on the biodiversity resources in and around the college made students aware of the biodiversity of their locality
- Students gain skill in operating different statistical softwares

B.Sc. Zoology (General) Annual 1+1+1 System

Part - I

Paper – I - Structural Diversity of Non-chordates and Chordates

- Knowledge of classification of Non-chordates along with studies on various physiological functions and interactions of non-chordate organisms with type specimens
- Knowledge of classification of chordates along with studies on various physiological functions and comparative anatomy of organs of chordate with examples

Paper – II - Biochemistry –– Cell Biology – Genetics

- Students gain knowledge of different biomolecules and biochemical processes of cells
- Gather basic concepts of Cell Biology along with various cellular functions
- Idea about Mendelian, non-Mendelian inheritance, genetic disorder, gene mutations and sex determination

Paper – III – Practical

- Students will gain skill about slide preparation, staining and mounting
- Identifications of non-chordate and chordate specimens (fresh and preserved) along with larval forms and sections

Part - II

Paper – IV – Histology – Developmental Biology– Endocrinology & Immunology

- Basic concepts of histology of various organs of body
- Basic concepts of developmental biology regarding developmental processes of frog
- Gain knowledge about hormones and endocrine mechanisms
- Imparts knowledge about types of immunity, antigens-antibodies and their properties, vaccines, diseases

Paper – V - Animal Physiology – Molecular Biology – Biotechnology & Biostatistics

- Students are taught the detailed concepts of circulation, respiration, the functioning of nerves of animals
- Basic concepts of Molecular Biology along with functions of DNA and RNA and study of Genetic Engineering
- Students gain knowledge about statistical analysis in biological fields

Paper – VI – Practical

- Students are able to identify bones, histological sections, embryological stages of chick
- Students performed biochemical and statistical techniques

Part - III

Paper – VII – Ecology – Evolution – Applied Zoology

- Imparts knowledge to the student regarding various factors of ecology, types of ecosystem, population and community characteristics and dynamics
- Gains knowledge in the areas of animal behavior, wildlife, biodiversity and conservation Biology
- Understands processes of fisheries, sericulture, apiculture, poultry, dairy along with crop pest management techniques

- Students gain knowledge about various disease related vectors and their impact on human

Paper – VIII – Practical

- Identification of zooplanktons and phytoplanktons
- Gain skill about histological slide preparation, staining and mounting
- Students gain skill about determination of pH and quantitative analysis of blood cells
- Students are able to parasites from rectal and fecal contents of animals
- Students are able to collect parasite and pest specimens.

CBCS Zoology Honours

Semester I Zoology Honours

CC1- Non-Chordates I

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

- Develop understanding on the diversity of life with regard to non-chordates.
- Classify animals on the basis of their morphological characteristics/ structures.
- Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.
- The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

CC2 –Ecology

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

- Know the evolutionary and functional basis of animal ecology.
- Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
- Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.
- Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.

- Solve the environmental problems involving interaction of humans and natural systems at local or global level.

Semester I Zoology GE

GE 1 PAPER 1 (Group-A) -Animal Diversity

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

- Develop understanding on the diversity of life with regard to non-chordates and chordates.
- Classify animals on the basis of their morphological characteristics/ structures.
- Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.
- The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

GE 1 PAPER 1 (Group-B) -Insect Vectors and Diseases

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

- Understand the morphology, life cycles and behaviour of insects and their physiology
- Develop awareness about the causative agents and control measures of many commonly occurring diseases.
- Develop understanding about the favourable breeding conditions for the vectors.
- Devise strategies to manage the vectors population below threshold levels, public health importance.

- Undertake measures or start awareness programmes for maintenance of hygienic conditions, avoidance of contact from vector, destruction of breeding spots in the vicinity of houses and cattle shed by public health education campaign.

GE 1 PAPER 1 (Group-C)-Aquatic Biology

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

- Understand and apply relevant scientific principles in the area of aquatic biology
- Employ scientific methodologies such as experimentation and data analysis in the area of aquaculture
- Critically analyse, interpret and evaluate information relevant to aquaculture
- Understand the life cycles and behaviour of fish and diseases of them
- Assess and identify the disease causing organisms of fish and their control measures
- Appreciate the multidisciplinary nature of the study of aquatic biology and engage positively with people and ideas beyond their own discipline.
- Explore some of the unique environmental problems dealing with aquatic environments.
- Develop *employable skills* in freshwater biological water quality analysis.

Semester I Zoology Programme Courses

DSC-Paper I ANIMAL DIVERSITY

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

- Develop understanding on the diversity of life with regard to non-chordates and chordates.
- Classify animals on the basis of their morphological characteristics/ structures.
- Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.

- Understand how morphological change due to change in environment helps drive evolution over a long period of time.
- The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

Semester II Zoology Honours

CC3–Non-Chordates II

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

- Develop understanding on the diversity of life with regard to non-chordates.
- Classify invertebrates on the basis of their morphological characteristics/ structures.
- Develop critical understanding about basic body plan of the non-chordates.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand basic physiological processes carried out in the organisms for their survival.
- The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills.
- It will further enable the students to think and interpret individually due to different animal species chosen.

CC 4 - Cell Biology

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

- Understand the functioning of nucleus and other cellular organelles and understand the intricate cellular mechanisms involved.
- Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.

- Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.
- Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programme, organ transplant, etc.
- Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

Semester II Zoology GE

GE 1 PAPER 2 (Group- A) -Human Physiology

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

- Understand the process of digestion and its control
- Develop understanding in muscle structure and contraction mechanism
- Learn the process of respiration and transport of gases
- Understand kidney structure and regulation of urine formation
- Understand heart structure and functioning
- Understand function of endocrine glands and formation of gametes.

GE 1 PAPER 2 (Group- B) -Food, Nutrition and Health

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

- Understand the role of food and nutrients in health and disease.
- Provide culturally competent nutrition services for diverse individuals.
- Implement strategies for food access, procurement, preparation, and safety that are relevant for the culture, age, literacy level, and socio-economic status of clients and groups.
- Perform food system management and leadership functions that consider sustainability in business, healthcare, community, and institutional areas.

GE 1 PAPER 2 (Group- C) -Environment and Public Health

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

- Identify current national and global public health problems.
- Aware about the issues of food safety, water safety, vaccination, exercise and obesity, exposure to toxins.
- frame a public health plan during any epidemic or spread of infectious disease etc.
- Analyze case studies of infant mortality and obesity.
- Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.
- Solve the environmental problems involving interaction of humans and natural systems at local or global level.
- Assess the health inequalities with regard to gender, race, ethnicity, income etc.

GE 1 PAPER 2 (Group- D) -Animal Cell Biotechnology

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

- Develop an understanding of the fundamental molecular tools and their applications of DNA modification and cloning.
- 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 such research and innovations have made science interdisciplinary and applied.
- Develop future course of their career development in higher education and research with a sound base.
- Apply their knowledge with problem solving approach to recommend strategies of genetic engineering for possible applications in Biotechnology and allied industry.

<u>Semester II Zoology Programme Courses</u>

DSC Paper 2- COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

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

- Develop an understanding of the evolution of vertebrates thus integrating structure, function and development.
- Understand the basic plan of different organ system in different classes of vertebrates in relation to evolutionary significance.
- Have an overview of the evolutionary concepts including homology and homoplasy, and detailed discussions of major organ systems.
- Develop an understanding of the related disciplines, such as cell biology, neurophysiology, pharmacology, biochemistry etc.
- Get a flavor of research besides improving their writing skills and making them well versed with the current trends. It will further enable the students to think and interpret individually due to different aspects chosen. Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through the important processes of cell division, cell differentiation and morphogenesis.

- Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
- Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
- Understand how the field of developmental biology has changed since the beginning of it with different phases of developmental research predominating at different times.
- Understand the relevance of developmental biology in medicine or its role in development of diseases.

PROGRAMME OUTCOMES FOR SESSION 2018-19:-

- Explaining physiological processes of all body systems in detail and on an appropriate level (knowledge, comprehension, application and analysis)
- Understanding the role of body systems and mechanisms in maintaining homeostasis
- To explain how the activities of organs are integrated for maximum efficiency
- Demonstrating higher level critical thinking skills, solving problems, and following directions.
- To manipulate equipment and carry out analytical procedures
- Observation phenomena, record and analyze data, and infer from data
- To construct graphs from data and obtain information from graphs
- To work effectively in a group and work safely in a lab setting
- Using computer hardware and software to obtain information, analyze data, and communicate with the instructor and other students
- Directing their own learning activities to meet course objectives

PROGRAMME SPECIFIC OUTCOMES:-

- Students develop a strong foundation in the Fundamental concepts of Biology and Human Physiology.
- Students can function successfully in a laboratory and field setting.
- Students can employ the scientific method to generate new information.
- Students can synthesize a cogent argument in the language of science.
- Demonstrate a working knowledge of the foundational concepts of biology, including cellular, organismic, tissue level, biochemical and biostatistical physiology.
- Rigorously and ethically apply the scientific methods to questions in biology by formulating testable hypotheses, and gathering and analyzing data to assess the degree to which they support the hypotheses.
- Employ quantitative reasoning skills to present results and explain their significance.
- Demonstrate information literacy by locating, critically analyzing, and discussing primary literature.
- Clearly communicate, orally and in writing, using a standard scientific format with accurate use of conventions such as citations, graphs, and statistics.

Course Outcomes:-

SEMESTER-I		
Course Code	Course Name	Course Outcomes
CC1T	Cellular Basis of Physiology	1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles 2. Students will understand how these cellular components are used to generate and utilize energy in cells 3. Students will understand the cellular components underlying mitotic cell division. 4. Students will apply their knowledge of cell biology to selected examples of changes in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation. 1. 5.Learn about the structure and function of membranes and explain how cells target the transport of proteins and other molecules within the cell. 2. 6.Concept of the cellular and molecular basis of the excitability of the nervous system. 3. 7.Differences between channels and transporters and the role of these proteins in the uptake of nutrients and neurotransmitters, and in ion homeostasis and signalling; 4. 8. Understand the molecular basis of a range of diseases in which membrane transport proteins play a role.
CC2T	Biological Physics & Enzymes	1. Learning about the structure and function of important biomolecules and cellular systems. 2. Problems in medical physics, and techniques for radiation therapy of cancer and diagnostic use of magnetic resonance tomography. 3. Knowledge about various biophysical techniques like chromatography, autoradiography, electrophoresis, cell fractionation, tracer's technique, nanoparticles and its applications. 4. Cellular phenomenons following biophysical principles like, diffusion, osmosis, viscosity, surface tension, laminar and streamline flow of liquids etc.

		• 5.Define enzyme structure and define differences between enzymes and normal catalytic substances. 6.To recognize the catalytic substances, explain chemical structure of enzymes and recognize the enzymes chemical structure. • 7. cofactor and coenzymes chemical structure recognize chemical structures of biological cofactor and coenzymes, express important coenzymes and the groups they transfer, to recognize biologic coenzymes and explain activity of catalytic center. 8.To recognize catalytic center and define factors that effect enzyme activity. To explain heat, pH , concentration and the other factors on the effect of activity. • 9.To define enzyme kinetics, recognize Km, define conformation changes of enzyme, recognize conformation, define enzyme specifity, recognize specifity, explain allosteric enzymes, recognize allosteric enzymes, define activators and inhibitors and recognize activators and inhibitors.

SEMESTER- II		
Course Code	Course Name	Course Outcomes
CC3T	Physiology of Nerve and Muscle Cells	1. To identify the major components of the nervous system and describe their functions. 2. Describe the composition and location of nervous tissue. And locate and identify the parts of a neuron. 3. To describe the structural types of neurons. 4. Learn about the types of neuroglia and their functions. 5. Explain how resting and action potentials contribute to nerve function. 6.Describe the process of neurotransmission and identify major neurotransmitters and describe their functions. 7.To identify the three types of muscle and describe the muscular system's functions. 8. Describe the location and function of skeletal muscles and locate and identify smooth muscle in the body.

		9. Locate and identify the blood vessels and conduction system that supply and innervate cardiac muscle. 10. Describe the distinguishing features of each of the three types of muscle. and identify the major skeletal muscle regions of the body. 11.Describe the blood supply and innervation of skeletal muscles. Describe the microscopic structure of skeletal muscle tissue. 12.Explain how an impulse generated by the central nervous system results in the contraction of a skeletal muscle. 13. Describe the location and function of smooth muscle, identify smooth muscle layers of the stomach and describe the location and function of cardiac muscle.
CC4T	Chemistry of Biomolecules	1.Identify their chemical elements and the difference between simple sugars and complex carbohydrates. Compare and contrast the structure and function of the following carbohydrates and where they are found: glucose, glycogen, starch, cellulose, chitin. 2. Identify their chemical elements and functional groups .Recognize the structure of an amino acid and the peptide bond that connects di-, tri, and polypeptides. 3. Recognize the presence of 20 amino acids and that not all are essential amino acids. Summarize the function of proteins and recognize the importance of the three dimensional shape of a protein on its function and the role of non-covalent bonds in maintaining the shape of a protein. 4. Identify their chemical elements and learn their property of insolubility in water. Identify the three groups of lipids. Compare and contrast saturated, mono-unsaturated, and poly-unsaturated fatty acids. 5.Explain the importance of poly-unsaturated fatty acids and why omega-3 and omega-6 fatty acids are considered essential. List sources of polyunsaturated fatty acids. 6. Identify their chemical elements and components of a nucleotide. Describe the function of DNA o Compare and contrast the 2 types of nucleic acids: DNA and RNA. 7. Students will explain/describe the synthesis of proteins, lipids, nucleic acids, and carbohydrates and their role in metabolic pathways like glycolysis, glycogenolysis, TCA cycle, beta-oxidation of fatty acids, deamination, transamination, urea cycle etc along with their regulation at the epigenetic, transcriptional, translational, and post-translational

		levels including RNA and protein folding, modification, and degradation. Regulation by non-coding RNAs will be tied to the developmental and physiological functioning of the organism.

SEMESTER-III		
Course Code	Course Name	Course Outcomes
CC5T	Circulating Body Fluids	1.To identify the components of blood and describe the components and functions of plasma. 2. Describe the production of red blood cells and their role in oxygen transport. 3. Identify the different types of white blood cells and describe their functions. 4.Explain how platelets contribute to the formation of blood clots and describe the production of platelets. 5. Describe the circulation of lymph throughout the body and locate and identify the major vessels of the lymphatic system also dentification lymphatic tissues and describe their functions. 6. Knowledge about various blood and blood group related disorder like, leukemia, leukocytosis, purpura, leukopenia and erythroblastosis foetalis.

CC6T	Circulation	1.Description the functions of the heart and the pericardium, the heart's location relative to the lungs, diaphragm, thoracic cage, and ribs. 2.Identification the layers of the heart wall and describe each layer's function, location and identification the four chambers of the heart. 3. to describe the flow of blood through the heart and the role of each atrium, ventricle, and valve in this process and identify the four valves of the heart. 4. Locate and identify the systemic and pulmonary vessels that enter and exit the heart, the arteries and veins of coronary circulation and describe their function, the function of the conduction system. 5. Students will lear about the steps of electrical conduction that lead to ventricular contraction and the major structures of the conduction system and the purpose of an electrocardiogram. 6. Gain knowledge about the steps of the cardiac cycle and learn how cardiac output is determined. 7. They will learn to locate and identify the autonomic nervous system structures that control and innervate the heart and identify the five major types of blood vessels and describe their functions. 8.Know about the structure and function of arteries, veins, arterioles, venules, and capillaries an 9.Know the structural differences between arteries and veins. • Describe the relationship between blood pressure and resistance. • Explain how arterial blood pressure is measured. • Describe systolic and diastolic pressure. • Identify the major routes of circulation and describe their functions. • Locate and identify the vessels of pulmonary circulation. Explain how pulmonary veins and arteries differ from systemic veins and systemic arteries.

CC7T	Functions of The Nervous System	This unit contains chapters on Nervous Tissue, Spinal Cord and Spinal Nerves, Brain, Cranial Nerves, Somatic and Autonomic Nervous Systems, and Special Senses. At the conclusion of this unit, students will be able to: • Identify the major components of the nervous system and describe their functions. • Describe the composition and location of nervous tissue. • Locate and identify the parts of a neuron. • Describe the structural types of neurons. • Describe the types of neuroglia and their functions. • Explain how resting and action potentials contribute to nerve function. • Describe the process of neurotransmission. • Identify major neurotransmitters and describe their functions. • Locate and identify the spinal cord and its meninges. • Locate and identify the cross-sectional structures of the spinal column. • Describe the distribution and function of gray and white matter in the spinal cord. • Explain how sensory signals and motor commands are relayed through the spinal cord and spinal nerves. • Locate and identify the spinal nerves and nerve plexuses. • Explain what a dermatome is and identify skin regions innervated by each spinal nerve. • Locate and identify major spinal nerves and structures they innervate. • Describe the somatic reflex arc. • Locate and identify anatomical regions of the brain. • Locate and identify anatomical structures that surround and protect the brain. • Identify the ventricles of the brain and describe their function. • Locate and identify blood vessels that supply the brain. • Identify structures of the brain stem and describe their functions. • Identify the parts of the cerebellum and describe their functions. • Identify structures of the diencephalon and describe their functions. • Identify structures of the limbic system and describe their functions. • Identify structures of the cerebrum and describe their functions. • Locate and identify the anatomical features of the cerebrum. • Locate and identify functional regions of the cerebral cortex. • Locate and identify the 12paired cranial nerves by name and number. • Locate and identify the cranial nerves that transmit special sensory signals. • Locate and identify the cranial nerves that transmit motor signals. • Locate and identify the cranial nerves that transmit both sensory and motor signals. • Describe the pathway and functions of each cranial nerve. • Describe the functions of the somatic and autonomic nervous systems. • Identify structures of somatic sensation and describe their functions. • Describe the motor functions of the somatic nervous system. • Describe the sensory and motor pathways of the somatic nervous system. • Describe the roles of the basal ganglia and cerebellum in somatic nervous system function. • Describe the functions of the somatic and autonomic nervous systems. • Describe the structure of the autonomic nervous system. • Describe the roles of the sympathetic and parasympathetic nervous systems.

SEMESTER-IV		
Course Code	Course Name	Course Outcomes
CC8T	Nutrition	1. Utilize knowledge from foundational sciences as a basis for understanding the role of food and nutrients in health and disease. 2. Integrate scientific information, research, and critical thinking into evidence- based practice. 3. Demonstrate professionalism and ethical behavior in all areas of practice. 4. Engage in advocacy on issues that affect public health and nutrition policy. 5. Establish a basis for lifelong learning and interprofessional collaboration. 6. Utilize the Nutrition Care Process to deliver state-of-the-art, safe and effective nutrition care. 7. Provide culturally competent nutrition services for diverse individuals and communities using a variety of communication strategies. 8. Facilitate health behavior change using nutrition counseling techniques with patients and clients. 9. Apply basic principles of entrepreneurship to dietetics practice. 10.Implement strategies for food access, procurement, preparation, and safety that are relevant for the culture, age, literacy level, and socio-economic status of clients and groups. 11.Perform food system management and leadership functions that consider sustainability in business, healthcare, community, and institutional arenas.
CC9T	Gastrointestinal System	This unit contains chapters on Oral Cavity, Esophagus and Stomach, Accessory Organs of Digestion, and Small and Large Intestines. At the conclusion of this unit, students will be able to: • Identify the major components of the digestive system and describe their functions. • Describe the overall structure, sections and layers of the alimentary canal. • Describe the components and functions of major digestive juices, and explain where they are produced. • Explain how oral

		cavity structures contribute to the digestive process. • Locate and identify major structures of the oral cavity. • Describe the process of chewing and swallowing. Locate and identify the salivary glands and ducts. • Locate and identify the muscles of mastication. • Identify the epiglottis and describe its function during swallowing. • Describe the process of peristalsis. • Describe the location and pathway of the esophagus. • Locate and identify the regions of the stomach • Describe the role of the liver, gallbladder, and pancreas in producing, transporting, and storing digestive juices. • Identify the bile ducts and describe their function. • Identify the pancreatic ducts and duodenal papillae and describe their function. • Locate and identify the major arteries supplying the liver, gallbladder, and pancreas. • Describe the process of absorption that occurs in the small intestine. • Describe the function of circular folds and villi in the small intestine. • Locate and identify the regions of the small intestine. • Describe the digestive processes that occur in the large intestine, including the role of bacteria.
CC10T	Respiration	This unit contains chapters on the Upper Respiratory System, Lower Respiratory System, and Respiration. At the conclusion of this unit, students will be able to: Locate and identify each lobe and external feature of the lungs. • Describe the location and structure of alveoli. • Describe the location and functions of type I alveolar cells, type II alveolar cells, and alveolar macrophages. • Describe the internal structures of the lungs. Explain how the respiratory and circulatory systems work together during external respiration. • Describe external respiration and identify the structures involved. • Using Dalton's Law, explain why oxygen and carbon dioxide are exchanged between the lungs and the bloodstream. • Describe internal respiration and identify the structures involved. • Explain how imbalances of oxygen and carbon dioxide in the bloodstream affect respiratory rate. • Locate and identify the nervous system structures that regulate respiration.

SEMESTER-V		
Course Code	Course Name	Course Outcomes
CC11T	Special Senses	After completion of this unit students will be able to:- • Locate and identify anatomical structures of the special senses. • Describe the process of olfaction.

		• Identify cranial nerves and describe the pathway of sensory impulses for each special sense. • Describe the process of taste. • Describe the process of vision. • Explain how eye shape affects vision. • Describe the role of the optic chiasm in binocular vision. • Describe the process of hearing. • Describe the process of equilibrium.
CC12T	Endocrinology	This unit contains chapters on Hormone Action and Regulation and Endocrine Organs and Functions. At the conclusion of this unit, students will be able to: • Identify the major components of the endocrine system and describe their functions. • Locate and identify the primary and secondary endocrine organs. • Describe the mechanisms of hormone action and the role hormones play in body functions. • Identify the hypothalamus and pituitary gland and describe their role in hormone production. • Identify hormones produced by the hypothalamus and describe their functions. • Identify hormones produced by the anterior lobe of the pituitary gland and describe their functions. • Identify hormones released by the posterior lobe of the pituitary gland and describe their functions. • Locate and identify target organs of pituitary hormones. • Locate and identify the thyroid gland. • Identify hormones produced by the thyroid gland and describe their functions. • Locate and identify the parathyroid glands. • Identify hormones produced by the parathyroid glands and describe their functions. • Locate and identify the adrenal glands. • Identify hormones produced by the adrenal glands and describe their functions. • Locate and identify the pineal gland, and describe its functions. • Locate and identify the pancreas. • Describe the location and function of pancreatic islets, and identify hormones they produce. • Describe how pancreas hormones blood glucose level. • Identify hormones produced by secondary endocrine organs and describe their functions. • Describe how hormones regulate the stress response.

SEMESTER- VI		
Course Code	Course Name	Course Outcomes

CC13T	Reproductive Functions	This unit contains chapters on the Male Reproductive System, Female Reproductive System, and Sexual Reproduction and Development. At the conclusion of this unit, students will be able to: • Identify the major components of the male and female reproductive systems and describe their functions. • Locate and identify the structures that make up the male reproductive system. • Describe the role of each male reproductive structure in producing, storing, and transporting semen. • Describe blood supply and innervation of the testes. • Describe the process of spermatogenesis. • Locate and identify the regions of the male urethra. • Describe the composition and functions of semen. • Describe the physiological changes that occur during erection and ejaculation. • Identify the hormones involved in male reproductive functions. • Locate and identify the structures that make up the female reproductive system. • Identify the hormones involved in female reproductive functions. • Describe the process of oogenesis. • Locate and identify blood vessels that supply the uterus and ovaries. • Describe the phases of the female reproductive cycle. • Describe the role of each female reproductive structure in sexual reproduction. • Locate and identify structures involved in lactation. • Describe the process of lactation.
CC14T	Formation and Excretion of Urine	This unit contains chapters on Kidney Anatomy and Physiology, Urine Production, and Urine Storage and Information. At the conclusion of this unit, students will be able to: • Describe the position of the kidneys relative to other anatomical structures. • Locate and identify structures of the kidneys and describe their functions. • Locate and identify blood vessels that supply the kidneys. • Describe the path of blood flow through the nephron. • Describe the location, structure, and function of a nephron. • Describe the process of glomerular filtration. • Locate and identify structures involved in glomerular filtration. • Explain how the filtration membrane filters blood plasma to create filtrate. • Describe the processes of reabsorption and secretion, and explain why they are important. • Describe the composition of normal urine. • Explain how urine concentration is hormonally regulated. • Locate and identify the structures involved in urine storage and elimination, and trace the pathway of urine from the kidneys out of the body. • Describe the position of the bladder relative to other structures in the male and female. • Describe the internal anatomy of the bladder. • Describe the process of micturition. • Explain how micturition is controlled by the nervous system. • Locate and identify urinary system structures involved in maintaining urinary continence.

DISCIPLINE SPECIFIC ELECTIVES(DSE)		
Course Code	Course Name	Course Outcomes
DSE1T	Biological Statistics	1. Demonstration of familiarity with intermediate statistical theory and methods, Statistical Inference, Linear Regression, Categorical Data Analysis and Modern Causal Methods, Epidemiology, Longitudinal Data Analysis, and Survival Analysis. 2. Demonstration of familiarity with core content of at least one area in health sciences: for example- genetics. Students will be able to: • Formulate and perform a descriptive and inferential analysis of a public health or other health sciences study using statistical software. • Reshape data for analysis using a programming or statistical language. • Interpret the findings from a moderately complex analysis. • Identify distribution form relating to the variable/variables. • recognize normal distribution. • interpret data via normal distribution. • define the principal concepts of probability. • recognize the binomial distribution. • interpret data via binomial distribution. • Apply hypothesis testing via some of the statistical distributions. • define some concepts about hypothesis testing. • apply hypothesis testing to the data through these concepts. • arrange the results of the hypothesis testing and make a statistical decision. • Define the principal concepts about biostatistics. • recognize the definition of statistics, its subject and its relation with the other sciences. • restate the principal concepts about biostatistics. • Collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data.

		• identify data relating to variable/variables. • identify convenient sample by using sampling theory.
DSE	Microbiology and Immunology	This unit will prepare the students to:- 1.Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures. 2.Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes. 3.Understand the structural similarities and differences among various physiological groups of bacteria/archaea. 4. Know various Culture media and their applications and also understand various physical and chemical means of sterilization. 5. Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae. 6.Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively comprehend the various methods for identification of unknown microorganisms. 7.Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and Heterotrophy. 8.Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement. 9. The students will be able to identify the cellular and molecular basis of immune responsiveness. 10. The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease. 11. The students will be able to describe immunological response and how it is triggered and regulated. 12. The students will be able to demonstrate a capacity for problem-solving about immune responsiveness. 13. The students will be able to transfer knowledge of immunology into clinical decision-making through case studies presented in class.

SKILL ENHANCEMENT COURSE (SEC)		
Course Code	Course Name	Course Outcomes
SEC1T	Clinical Biochemistry	This course aims to the following learning outcomes : 1. Knowledge of the historical background for Clinical Biochemistry. 2. Explain the basic elements of core Biochemistry and specialized tests of biochemistry. 3. Compare and contrast the basic differences between carbohydrate, lipid and protein metabolism abnormalities. 4. Describe and identify the main characteristics of diagnosis, screening, and prognosis of disease. 5. Apply the processes of scientific research to use in emergency services in clinical biochemistry. 6. Distinguish scientific explanations that show the hormonal disorders during disease. The students will also be able to develop their:- ***Knowledge***: 1- To describe and outline of branches of clinical biochemistry. 2- To Recall and differentiate between morphological changes in liver, kidney and other organs. 3- To define the different types of disease. 4- To able differentiate clinically diabetes mellitus, renal failure, and liver disease. 5- To get acquainted with the basics of abnormalities inside the cells during disease. 6- To memorize how the endocrine control. ***Cognitive Skills:*** 1- To refer different abnormalities affecting liver, kidney, and other organs. 2- To recognize an overview of the general metabolism disorders. 3- To know characteristics of liver failure and kidney failure. 5- To identify lipoprotein disorders. 6- To contrast the pattern of different types of mineral metabolism disorders.
SEC2T	Clinical Dietatics: Human Nutrition & Diet Survey	***I. HUMAN NUTRITION*** I. **Community** Students will be able to interpret and apply nutrition concepts to evaluate and improve the nutritional health of communities. I. **Medical Nutrition Therapy (MNT)** Students will be able to interpret and apply nutrition concepts to evaluate and improve the nutritional health of individuals with medical conditions

		Food Students will be able to identify and apply food principles to food and nutrition systems **Education/Communication** Students will be able to demonstrate a variety of communication strategies in nutrition and food education emphasizing information technology **Management** Students will be able to apply management principles to evaluate human, physical and fiscal resources in organizations **Professional Issues** Students will be able to integrate knowledge and skills in food and nutrition with professional issues affecting the nutrition and/or dietetics fields. ***DIET SURVEY*** After studying this course, you should be able to: • List the six key nutrient groups and explain their role in a healthy diet • Understand and calculate body mass index (BMI), and use such calculations to predict desirable weight ranges for individuals • Explain the importance of a balanced diet in terms of energy intake • Explain how genetic and environmental variables may interact to produce variability in human body weight and adiposity both within and across generations • Apply an understanding of gene–environment interactions to possible explanations of variability in body weight and adiposity.

Statistics Department (2018-19) (Annual and CBCS, combined)

CBCS System

1st Semester

Sl. No.	Paper	Learner's Out Come
1.	GE T1 – Statistical Methods	After completion of the course, students learn about mean, median, mode, range, variance, and standard deviation. Demonstrate an understanding of descriptive statistics. Explain the difference between descriptive statistics and inferential statistics.
2.	GE P1 – Statistical Methods Lab	After completion of the course, students acquire knowledge of practical problem solving techniques on different measures of Statistics.

1st Semester

Sl. No.	Paper	Learner's Out Come
1.	PCC T1 – Descriptive Statistics	After completion of the course, students learn about mean, median, mode, range, variance, and standard deviation. Demonstrate an understanding of descriptive statistics. Explain the difference between descriptive statistics and inferential statistics.
2.	PCC P1 – Descriptive Statistics Lab	After completion of the course, students acquire knowledge of practical problem solving techniques on different measures of Statistics.

2nd Semester

Sl. No.	Paper	Learner's Out Come
1.	GE T2 – Fundamentals of Probability Theory	After completion of the course, students learn about the concept of probability and probability distributions helps to understand the uncertainty and randomness occur in many aspects of our daily life.
2.	GE P2 – Introductory Probability Lab	After completion of the course, students acquire knowledge of practical problem solving techniques on different probability trials and distributions.

2nd Semester

Sl. No.	Paper	Learner's Out Come
1.	PCC T2 – Probability Theory & Distributions	After completion of the course, students learn about the concept of probability and probability distributions helps to understand the uncertainty and randomness occur in many aspects of our daily life.
2.	PCC P2 – Probability Theory & Distributions Lab	After completion of the course, students acquire knowledge of practical problem solving techniques on different probability trials and distributions.

Annual System

UG Part I General

Sl. No.	Paper	Learner's Out Come
1.	Paper I	After completion of the course, students learn about mean, median, mode, range, variance, and standard deviation. Demonstrate an understanding of descriptive statistics. Explain the difference between descriptive statistics and inferential statistics.

Sl. No.	Paper	Learner's Out Come
2.	Paper II	On successful completion of the course students will be able to: 1. Calculate probabilities by applying probability laws and theoretical results. 2. Identify an appropriate probability distribution for a given discrete or continuous random variable and use its properties to calculate probabilities. 3. Calculate statistics such as the mean and variance of common probability distributions. 4. Calculate probabilities for joint distributions including marginal and conditional probabilities.

		5. Determine whether random variables are independent and find their covariance and correlation. 6. Apply results from large-sample theory and the Central Limit Theorem to approximate a sampling distribution.

Sl. No.	Paper	Learner's Out Come
3.	Paper III (Practical)	After completion of the course, students acquire knowledge of practical problem solving techniques on different measures of Statistics and Probability trials.

UG Part II General

Sl. No.	Paper	Learner's Out Come
1.	Paper IV	After completion of the course, students learn about the characteristics of a sampling distribution. Describe the general properties of sampling distributions and the use of standard error in analyzing them. Also learn the difference between a frequency distribution and a sampling distribution and the difference between discrete and continuous sampling distributions.

Sl. No.	Paper	Learner's Out Come
2.	Paper V	On successful completion of the course students will be able to: 1. Explain the concept of estimation of parameters. 2. Calculate the problems related to point estimation and interval estimation.

		3. Explain the concepts of Testing of Hypotheses, (Large Sample Tests small sample test). 4. Solve the problems related to Testing of Hypotheses, (Large Sample Tests small sample test). 5. Hypothesize various advanced statistical techniques for modelling and exploring practical situations.

Sl. No.	Paper	Learner's Out Come
3.	Paper VI (Practical)	After completion of the course, students acquire knowledge of practical problem solving techniques on sampling methods and methods of statistical inference.

UG Part III General

Sl. No.	Paper	Learner's Out Come
1.	Paper VII	After completion of the course, students learn about Statistical quality control, Indian Statistical System, Population Statistics, Different design models, Index number and also Time series analysis.

Sl. No.	Paper	Learner's Out Come
2.	Paper VIII (Practical)	After completion of the course, students acquire knowledge of practical problem on CRD, RBD and LSD model also of Statistical quality control Index number and Time series analysis.

Paper Wise Outcomes

Department of Philosophy

Siliguri College

Session: 2018-2019

I+I+I System

The B.A Philosophy Honours course of I+I+I system provides a multidimensional syllabus for the students, which brings certain positive outcomes into their life. The paper wise outcomes of the I+I+I system can be narrated in the following way.

PART-I

The first year of the B.A Philosophy Honours course of I+I+I system contain two paper (paper-I & paper-II).

Paper-I (Indian Philosophy): The paper one is concerned about the great Indian Philosophical School, both the theistic and atheistic schools. This paper provides a wide overview on Philosophical issues of ancient and medieval India. Such study also helps the students to have an understanding about the meaning of life and reality.

Paper –II (Ethics and Western Logic- part-i): Paper two is concerned about the ethics and Logic. The Study of ethics makes students aware about the meaning and purpose ethical principles which ultimately helps students to live a sound life. The paper two also provides a comprehensive idea about the basic notion of propositional logic. The study of logic helps students to enhance their logical understanding.

PART-II

The Second year B.A Honours syllabus provides two papers (paper-III & paper-IV).

Paper-III (Western Philosophy): The paper three is concerned about Western Philosophy. In that paper students obtain a wide understanding about the philosophical idea of certain Greek Philosophers like Socratic, Plato and Aristotle and some Western Philosophers like Locke, Berkley, Hume, Descartes, Spinoza, Leibnitz and Kant. Such study helps the students to acquire an understanding about the meaning of life and reality.

Paper-IV (Western Logic part-ii & Philosophy of Religion): The paper four contains some advance notions of western logic like quantification logic, which helps students to become aware the developments into the field of logic. The paper four also contains some philosophical understanding about nature of religion. The understanding about the nature of religion makes students able to understand the role of religion in human life.

PART-III

The Third year B.A Honours syllabus provides four papers (paper-V, VI. VII, VIII) among which there is a special/ optional paper.

Paper-V (*Tarkasamgraha*) : Fifth paper is concerned about one of the most fundamental text of Nyaya Philosophy namely, *Tarkasamgrah.* The study of *Tarkasamgrah* makes students aware about some certain epistemological concern of Nyaya Philosophy.

Paper VI- (Analytic Philosophy): the paper six of the 3rd year B.A Philosophy Honours course actually concerned with certain analytic philosophical understanding of J. Hospers. The study his book namely *An Introduction to Philosophical Analysis* helps students to become aware about certain analytical concepts of language. It also helps students to analyse certain metaphysical concepts like causality.

Paper-VII (Social & Political Philosophy): Paper seven is concerned about the certain social and political concepts like Society, Community, Democracy, Equality etc. The study of this paper makes students aware about the social and political relationship, notion, ideas etc.

Paper-VIII (Optional Paper): Paper eight is an optional paper. The 3rd year B.A Philosophy Honours course provides some papers like Phenomenology, Problems of mind etc. All this optional papers are comprehensive and thought provoking. The study of this optional paper enhances the intellectual capacity of the students.

PAPER WISE COURSE OUTCOMES

CBCS SYSTEM

DEPARTMENT OF PHILOSOPHY

SILIGURI COLLEGE

SESSION-2018-2019

SEMESTER-I

The CBCS Philosophy syllabus of the first semester provides two core courses/major papers. The first core course concerned with some Indian Philosophical schools. And the second core course is concerned with the Western Logic. The study of these two core course altogether makes students aware about the philosophical concepts of both Indian and Western philosophical traditions.

The CBCS Philosophy syllabus of the first semester also provides one minor papers/GE papers for the students of Programme course. This minor paper is concerned with the Indian Philosophy. This paper makes students aware about some Indian Philosophical traditions like Charvaka, Buddhism etc.

SEMESTER-II

The CBCS Philosophy syllabus of the Second semester provides two core papers. The core paper is concerned with some Western Philosophical Traditions This paper provides a wide overview on Philosophical issues of ancient and medieval western arena. Such study also helps the students to have an understanding about the meaning of life and reality.

The second core paper is concerned with the western logic. This paper contains some advance notions of western logic like quantification logic, which helps students to become aware the developments into the field of logic.

The CBCS Philosophy syllabus of the second semester also provides one minor papers/GE papers for the students of Programme course. This paper is concerned with ethics. The Study of ethics makes students aware about the meaning and purpose ethical principles which ultimately helps students to live a sound life.

Paper wise outcome General Course

I+I+I=System

Session-2018-2019

Department of Philosophy

Siliguri College

PART-I

Paper-I Indian Philosophy: The paper one is concerned about the very fundamental concepts of some Atheistic Indian Philosophical Schools namely Charvaka, Jaina and Buddhism. This paper provides a wide overview on Philosophical issues of ancient Atheistic schools. Such study helps the students to get acquainted with the certain argumentative traditions.

Paper-II Western Philosophy- This paper is concerned with the certain western epistemological and metaphysical issues. This paper helps students to have a proper idea concerning the western conception about the sources knowledge, nature of knowledge.

Paper-III Psychology- This paper is concerned about certain theories and conceptions of Psychology. The successful study of this paper makes students able to understand certain psychological concepts like, interception, perception etc.

PART-II

Paper-IV Indian Philosophy- The paper four is concerned about the very fundamental concepts of some Theistic Indian Philosophical Schools namely Nyaya, Vaishesika, Yoga etc. This paper provides a wide overview on Philosophical issues of ancient theistic schools.

Paper-V Western Logic- This paper is concerned with western logic. This paper provides a comprehensive idea about the basic notion of propositional logic. The study of logic helps students to enhance their logical understanding.

Paper-VI Social and Political Philosophy- this Paper is concerned about the certain social and political concepts like Society, Community, Democracy, Equality etc. The study of this paper makes students aware about the social and political relationship, notion, ideas etc.

PART-III

Paper VII Ethics- Paper Seventh is concerned with basic notion of Western and Indian ethical issues like moral and non-moral actions, Niskama Karma etc. the study of such ethical concepts makes students able to have a systematic understanding of ethics.

Paper wise outcome General Course

CBCS SYSTEM

Session-2018-2019

Department of Philosophy

Siliguri College

SEMESTER-I

COURSE: DSC1 PAPER-I

FUNDAMENTALS OF INDIAN PHILOSOPHY

This minor paper is concerned with the Indian Philosophy. This paper makes students aware about some Indian Philosophical traditions like Charvaka, Buddhism,Samkhya, Yoga etc. . This paper provides a wide overview on Philosophical issues of ancient and medieval India.

SEMRESTER-II

COURSE: PAPER-II

WESTERN LOGIC

This Paper provides a comprehensive idea about the basic notion of propositional logic. The study of logic helps students to enhance their logical understanding.

YEAR 18-19

Department of Nepali Syllabus Outcoms of I+I+I system

B.A. Honours (18-19)

1st year

Paper 1- Nepali Kavita ra Nepali Upanayas- *Study of selected Nepali poem and Novel to initiate their ability to appreciate Nepali literature*

Paper 2- Nepali Katha ra Nepali Natak - *Analysis and study of Nepali short stories and Play written by different writers .*

2nd Year

Paper 3-Sahityaka Tatwa ra Nepali Kavita- *Awareness about significant literary ideologies (Eastern and Western) that influenced Nepali literature. Study of selected Nepali poem.*

Paper4- Nepali Katha ra samanaya Bhasa vigyan Ko Parichya- *Study of selected Nepali short stories. Understand and analyse Nepali linguistic technicalities and grammar.*

3rd year

Paper 5- Sahitya sidhant ra pramukh vaadharu ra samakalin Nepali Kavita - *Analysis and study of different literary ideologies that influenced Nepali literature. Analysis and study of contemporary Nepali poem.*

Paper 6- samakalin Nepali Upanayas ra Aakhaneter Nepali gadhya sahitya- *Analysis and study of contemporary Nepali Novel and essay.*

Paper 7- Nepali Natak Ra Nepali Basha Vigyan- *Understand and analyse Nepali linguistic technicalities and grammar.*

Paper 8- Nepali Sahityatihasko parachya ra (i) Nepali Prabandha Kabya (ii)Nepali Anudit Sahitya (iii)Nepali Lok Sahitya [any one]- *Comprehensive understanding of growth and signification of Nepali literary history*

B.A. General

1st. Year

Paper1- Bashako Payichya- *Understand and analyse Nepali linguistic*

Paper 2-Aakhaneter Gaydhya ra Nepali Sahityako itihas –*Comprehensive understanding of growth and signification of Nepali literary history.*

Paper 3-Nepali Kavita- *Analysis and study of contemporary Nepali poetry.*

2nd Year

Paper 4- Sahitya Tatwa - *Awareness about significant literary ideologies (Eastern and Western) that influenced Nepali literature.*

Paper5- Nepali Katha- *Analysis and study of contemporary Nepali short stories.*

Parer 6 -Nepali Natak- *Concise introduction to Nepali play and Analysis and study of some contemporary Nepali play.*

3rd Year

Paper 7- Nepali Kavita ra Nepali Upanayas- *Analysis and study of selected Nepali poem and Novel written by different writers that develops their creativity, critical understanding of social influences and an ability to appreciate the rich heritage of Nepali literature.*

MIL Nepali- *Understand and analyse of Nepali grammar.*

DEPARTMENT OF NEPALI SYLLABUS OUTCOME OF CBCS SYSTEM

COURSE OUTCOMES (18-19)

1st & 2nd SEM (Honours)

CC 1. NEPALI SAHITYAKO ITIHAS- Comprehensive understanding of growth and signification of Nepali literary history.

CC 2. NEPALI KAVITA- Analysis and study of Nepali poem.

CC3. SAHITYAKA TATTWA- Awareness about significant literary ideologies (Eastern and Western) that influenced Nepali literature.

CC4. PRAMUKH SIDDHANTA RA VADAHARU- Analysis and study of different literary ideologies that influenced Nepali literature.

1ST & 2ND SEM (Program)

DSC 1. NEPALI NATAK- Concise introduction to Nepali play.

DSC 2. NEPALI KAVITA- Concise introduction to Nepali poem.

LEARNING OUTCOMES OF ECONOMICS (HONOURS) 2018-19 (ANNUAL 1+1+1 SYSTEM-ALL YEARS)

ECONOMICS (HONOURS) COURSE

PART-I

PAPER I: GR. A- MICROECONOMICS:

- Understand the fundamentals of microeconomics
- Understand how economists use economic models to solve basic microeconomic problems
- Learn to use mathematics and graphs in common economic applications
- Understand the problem of decision making of an individual or firm
- Analyze the effects and causes of government policies
- Use the fundamental techniques to think about a number of policy questions related to the operation of the real economy.
- Good standards of employability.

GR. B- MACROECONOMICS:

- Explain the concepts of Macroeconomics and its interrelations with Microeconomics.
- Associate the current economic phenomenon with existing theory and put their views on contemporary economic issues.
- Apply the principle of Macroeconomics in explaining the behavior of Macroeconomic variables at national as well as global level.
- Use mathematics in common economic applications
- Analyze the effects and causes of government policies and provide suggestive policy measures
- Good standards of employability

PAPER II: GR. A- MATHEMATICAL ECONOMICS

- Demonstrate the role of quantitative techniques in the field of business/industry, illustrate different types of equations, solve equations and system of equations, understand the concept of sets, illustrate and apply basic set operations.

- Explain the rules for calculating derivatives, uses and application in calculating inter-relationship among total, marginal and average cost and revenue, calculate maxima, minima, elasticity, decide the optimal level of production for a firm.
- Demonstrate the rules for calculating integration; describe the importance and application of integration in consumers' and producers' surpluses, total revenue and cost.
- Illustrate matrix operation, minors, cofactors, use cofactor method to find inverse of a matrix, use Cramer's rule to solve systems of equations.
- Demonstrate knowledge of basic concept of linear program, duality, capacity to solve linear programming problems', familiar with the basic techniques most commonly used in economic problems.

GR. B- STATISTICS:

- Have the versatility to work effectively in a broad range of analytic, scientific, government, financial, health, technical and other positions
- Have a broad background in Mathematics and Statistics
- Be familiar with a variety of examples where mathematics or statistics helps accurately to explain abstract or physical phenomena.
- Recognize and appreciate the connections between theory and applications
- Perform statistical inference in several circumstances and interpret the results in an applied context
- Design experiments, carry them out, and analyze the data they yield.
- Demonstrate understanding of the concepts of time series and its applications in different areas.

PART-II

PAPER III: GR. A- MICRO ECONOMICS

- Demonstrate marginal productivity theory of distribution, theory of wages, identify different types of rent, illustrate different theories of interest and profits.
- Understand how factor market works, identify the various determinants of firm's demand for factor services, bilateral monopoly, demonstrate monopsony in factor market and factor market equilibrium.
- Understand how factor market works, illustrate basic tools in welfare economics, and illustrate the concept of social welfare functions and compensation principles.

- Identify the various types of investment function analysis and understand the elements of social cost benefit analysis.
- Understand international and inter regional trade, identify and understand various trade theories, analyze the various types of restrictions of international trade.

GR. B- MACRO ECONOMICS

- Define and explain the process of calculating national income, identify its components, demonstrate circular flow of income, analyse the various income identities with government and international trade, define the concept of green accounting.
- Understand Say's law of market, classical theory of employment and Keynes objection to the classical theory, demonstrate the principle of effective demand and income determination.
- Explain the meaning of consumption function, relationship between APC and MPC, consumption and income, concept of multiplier and analyse the theories of absolute and relative income hypotheses.
- Understand the relationship between investment and savings, demonstrate investment multiplier, and understand the meaning of MEC and MEI.
- Illustrate the meaning of interest, analyse the various theories.

PAPER IV: GR. A- MATHEMATICAL ECONOMICS

- Improve the mathematical skills necessary to study economics.
- Identify, solve and interpret the characteristics of each family of functions: linear, polynomial, exponential, logarithmic and quadratic.
- Analyze nonlinear functions using differential calculus.
- Use integration and matrix algebra techniques in economic analysis.
- Find the solution for constrained optimization problems using methods of substitution and Lagrange multiplier for both equality and inequality constraints.
- Generates good standards of employability.

GR. B- STATISTICS:

- Collect appropriate data needed, manipulate and draw inferences, describe the concept of statistical averages, use and apply central tendency, dispersion, skewness, and kurtosis.

- Demonstrate the basic concept of probability, theoretical distribution, probability theorems; solve probability problems by applying probability concept.
- Explain concept of correlation, analyze and interpret covariance and correlation coefficient, illustrate ordinary least squares and use it to estimate regression coefficient.
- Describe the components of time series, apply time series analysis in business scenarios, illustrate the different types of index numbers, and calculate index numbers.
- Measure mortality rates, population growth, reproduction rate, rate of natural increase, net reproduction rate, knowledge in understanding how the population profile of a country is changing, estimate population trend.

Part-III

PAPER V: GR. A- DEVELOPMENT ECONOMICS:

- Demonstrate familiarity with some central themes and issues of economic development.
- Demonstrate the understanding of the difference between growth and development, major growth theories, the measurement of inequality, significance of agriculture in developing countries, poverty and population issues facing the world, international trade, and importance of foreign aid.
- Analyse empirical evidence on the patterns of economic development.
- Read critically the journal literature in the area of economic development.

GR. B- ENVIRONMENTAL ECONOMICS:

- Realize the importance and influence of environment on the economy including the quality of manpower. Arouse their feelings to make cleaner environment so as to achieve harmonious development.
- Understand that environmental problem is not the problem of a single country or region but a global problem/issue. Hence, policy formulation may be for all countries.
- Demonstrate the scientific management of waste materials; realize the role and importance of individuals to keep the environment clean.
- Understand the causes and victims of environmental pollution like poverty, population explosion, and over-use of resources, careless or unscientific dump/management of wastes.
- Suggest appropriate measures to correct environmental degradation, aware of those ingredients such as healthy climate, quality of human beings, domestic and other natural habitats and biodiversity levels, productivity and productions, sustainability, etc. are all influenced by environment.

PAPER VI: GR. A- INTERNATIONAL ECONOMICS:

- Have a good conceptual understanding of the key concepts and practical applications of both international trade and international finance.
- Outline the development of trade theory historically, differentiating standard classical and orthodox trade theories.
- Analyze the links between trade, international finance, economic growth and globalization, with a particular emphasis on the experiences of developing countries.
- Critically comment on and participate in current debates on international economic policy.
- Generates good prospects of employment.

GR. B-PUBLIC ECONOMICS:

- Understand the sources of finance both public and private; demonstrate the role of government to correct market failures and possible advantage of public financing.
- Attain the advantages and knowledge of public investments and other government expenditures. Understand the causes of growing public expenditures for various programmes and policies within and outside the country.
- Understand the possible burden, benefits and distribution of various types of taxes among various classes of people, know the general trend and impact on general welfare and arouse them to suggest good and bad tax system.
- Understand the needs of public borrowing from all possible sources to meet necessary public investment/expenditures. Also be alerted to find sources for repayment.
- Deliver effectively the preparation of budget and how they are passed in the house. Understand the changes in size and flexibility of state and central budget along with the role played by Finance Commission.

PAPER VII: GR. A- INDIAN ECONOMIC HISTORY:

- Basically, the course focuses the idea of Indian Economic system during British colonial period during 1857-1947.
- Can find the overall condition of Agriculture and industry more specifically agricultural activities and the production process prior to the 1890's and the condition of the farmers, land, labour exploitation, condition of credit market etc. Students more able to know the degree of brutality under colonialism through the incidence of resource extraction and economic drain and biased trade policies.
- Understand Broader and prolonged impact of colonialism/imperialism by the British govt. on Indian economy.

GR.B- INDIAN ECONOMIC PROBLEMS AND PLANNING:

- To comprehend the basic characteristics of economic development and economic growth.
- To understand the indices of economic development.
- To analyze the demographic trends in India.
- To realize the causes and measures of poverty inequalities and unemployment.
- Grasp the importance of planning undertaken by the government of India
- Understand the foundation of economic reforms and also the ongoing planning undertaken by the government.
- Analyze the effects and causes of government policies and provide suggestive policy measures.

PAPER VIII: GR. A- FINANCIAL ECONOMICS:

- Explain the broad features of Indian financial institutions with its apex banks' objectives and purview. Also understand the instruments to control credit in the country.
- Effectively narrate the kinds and components of money with its regulatory system, be aware of the functions, objectives and limitations of commercial banks.
- Identify the existence and development of non-banking financial institutions, know the important role of Mutual funds, LIC, investment companies etc., utilize and effectively participate in the development process.
- Understand the conditions of financial markets and its impact in the economy.
- Demonstrate the role and significance of foreign exchange rate and its markets with its impact on various sectors in the economy.

GR. B- INDIAN ECONOMIC POLICY AND PERFORMANCE:

- Develop ideas of the basic characteristics of Indian economy, its potential on natural resources.
- Understand the importance, causes and impact of population growth and its distribution, translate and relate them with economic development.
- Grasp the importance of planning undertaken by the government of India, have knowledge on the various objectives, failures and achievements as the foundation of the ongoing planning and economic reforms taken by the government.
- Understand agriculture as the foundation of economic growth and development, analyse the progress and changing nature of agricultural sector and its contribution to the economy as a whole.

LEARNING OUTCOMES OF ECONOMICS (GENERAL) 2018-19 (ANNUAL 1+1+1 SYSTEM-ALL YEARS)

ECONOMICS (GENERAL) COURSE

PART-I

MICRO ECONOMICS (GROUP A):

- Understand the fundamentals of microeconomics
- Understand how economists use economic models to solve basic microeconomic problems
- Learn to use mathematics and graphs in common economic applications
- Understand the problem of decision making of an individual or firm
- Analyze the effects and causes of government policies
- Use the fundamental techniques to think about a number of policy questions related to the operation of the real economy.
- Good standards of employability.

MACRO ECONOMICS (GROUP A):

- Explain the concepts of Macroeconomics and its interrelations with Microeconomics.
- Associate the current economic phenomenon with existing theory and put their views on contemporary economic issues.
- Apply the principle of Macroeconomics in explaining the behavior of Macroeconomic variables at national as well as global level.
- Use mathematics in common economic applications
- Analyze the effects and causes of government policies and provide suggestive policy measures
- Good standards of employability

INDIAN ECONOMICS (GROUP A):

- To comprehend the basic characteristics of economic development and economic growth.
- To understand the indices of economic development.
- To analyze the demographic trends in India.
- To realize the causes and measures of poverty inequalities and unemployment.
- Grasp the importance of planning undertaken by the government of India
- Understand the foundation of economic reforms and also the ongoing planning undertaken by the government.
- Analyze the effects and causes of government policies and provide suggestive policy measures.

PART-II

MICRO ECONOMICS (GROUP B):

- Demonstrate marginal productivity theory of distribution, theory of wages, identify different types of rent, illustrate different theories of interest and profits.
- Understand how factor market works, identify the various determinants of firm's demand for factor services, bilateral monopoly, demonstrate monopsony in factor market and factor market equilibrium.
- Understand how factor market works, illustrate basic tools in welfare economics, and illustrate the concept of social welfare functions and compensation principles.
- Identify the various types of investment function analysis and understand the elements of social cost benefit analysis.
- Understand international and inter regional trade, identify and understand various trade theories, analyze the various types of restrictions of international trade.

MACRO ECONOMICS (GROUP B):

- Define and explain the process of calculating national income, identify its components, demonstrate circular flow of income, analyse the various income identities with government and international trade, define the concept of green accounting.

- Understand Say's law of market, classical theory of employment and Keynes objection to the classical theory, demonstrate the principle of effective demand and income determination.
- Explain the meaning of consumption function, relationship between APC and MPC, consumption and income, concept of multiplier and analyse the theories of absolute and relative income hypotheses.
- Understand the relationship between investment and savings, demonstrate investment multiplier, and understand the meaning of MEC and MEI.
- Illustrate the meaning of interest, analyse the various theories.

INDIAN ECONOMICS (GROUP B):

- Develop ideas of the basic characteristics of Indian economy, its potential on natural resources.
- Understand the importance, causes and impact of population growth and its distribution, translate and relate them with economic development.
- Grasp the importance of planning undertaken by the government of India, have knowledge on the various objectives, failures and achievements as the foundation of the ongoing planning and economic reforms taken by the government.
- Understand agriculture as the foundation of economic growth and development, analyse the progress and changing nature of agricultural sector and its contribution to the economy as a whole.

PART-III

DEVELOPMENT ECONOMICS:

- Demonstrate familiarity with some central themes and issues of economic development.
- Demonstrate the understanding of the difference between growth and development, major growth theories, the measurement of inequality, significance of agriculture in developing countries, poverty and population issues facing the world, international trade, and importance of foreign aid.
- Analyse empirical evidence on the patterns of economic development.
- Read critically the journal literature in the area of economic development.

ELEMENTRY STATISTICS:

- Collect appropriate data needed, manipulate and draw inferences, describe the concept of statistical averages, use and apply central tendency, dispersion.

- Organize, manage and present data.
- Analyze statistical data graphically using frequency distributions and
- cumulative frequency distributions.
- Analyze statistical data using measures of central tendency, dispersion
- and location.

LEARNING OUTCOMES OF ECONOMICS (HONOURS) 2018-19 (UNDER CBCS SYSTEM-SEMESTER I AND II ONLY)

Semester-I

Introductory Microeconomics:

- Understand the fundamentals of microeconomics
- Understand how economists use economic models to solve basic microeconomic problems
- Learn to use mathematics and graphs in common economic applications
- Understand the problem of decision making of an individual or firm
- Analyze the effects and causes of government policies

- Use the fundamental techniques to think about a number of policy questions related to the operation of the real economy.
- Good standards of employability.

Mathematical Methods for Economics-I:

- Demonstrate the role of quantitative techniques in the field of business/industry, illustrate different types of equations, solve equations and system of equations, understand the concept of sets, illustrate and apply basic set operations.
- Explain the rules for calculating derivatives, uses and application in calculating inter-relationship among total, marginal and average cost and revenue, calculate maxima, minima, elasticity, decide the optimal level of production for a firm.
- Demonstrate the rules for calculating integration; describe the importance and application of integration in consumers' and producers' surpluses, total revenue and cost.
- Illustrate matrix operation, minors, cofactors, use cofactor method to find inverse of a matrix, use Cramer's rule to solve systems of equations.
- Demonstrate knowledge of basic concept of linear program, duality, capacity to solve linear programming problems', familiar with the basic techniques most commonly used in economic problems.

Semester-II

Introductory Macroeconomics:

- Define and explain the process of calculating national income, identify its components, demonstrate circular flow of income, analyse the various income identities with government and international trade, define the concept of green accounting.
- Understand Say's law of market, classical theory of employment and Keynes objection to the classical theory, demonstrate the principle of effective demand and income determination.
- Explain the meaning of consumption function, relationship between APC and MPC, consumption and income, concept of multiplier and analyse the theories of absolute and relative income hypotheses.
- Understand the relationship between investment and savings, demonstrate investment multiplier, and understand the meaning of MEC and MEI.
- Illustrate the meaning of interest, analyse the various theories.

Mathematical Methods for Economics-II:

- Improve the mathematical skills necessary to study economics.
- Identify, solve and interpret the characteristics of each family of functions: linear, polynomial, exponential, logarithmic and quadratic.
- Analyze nonlinear functions using differential calculus.
- Use integration and matrix algebra techniques in economic analysis.
- Find the solution for constrained optimization problems using methods of substitution and Lagrange multiplier for both equality and inequality constraints.
- Generates good standards of employability.

LEARNING OUTCOMES OF ECONOMICS (GENERAL) 2018-19 (UNDER CBCS SYSTEM- SEMESTER I AND II ONLY)

Semester-I

Microeconomics:

- Understand the fundamentals of microeconomics
- Understand how economists use economic models to solve basic microeconomic problems
- Learn to use mathematics and graphs in common economic applications
- Understand the problem of decision making of an individual or firm
- Demonstrate marginal productivity theory of distribution, theory of wages, identify different types of rent, illustrate different theories of interest and profits.
- Understand how factor market works, identify the various determinants of firm's demand for factor services, bilateral monopoly, demonstrate monopsony in factor market and factor market equilibrium

Semester-II

Macroeconomics:

- Define and explain the process of calculating national income, identify its components, demonstrate circular flow of income, analyse the various income identities with government and international trade, define the concept of green accounting.
- Understand Say's law of market, classical theory of employment and Keynes objection to the classical theory, demonstrate the principle of effective demand and income determination.

- Explain the meaning of consumption function, relationship between APC and MPC, consumption and income, concept of multiplier and analyse the theories of absolute and relative income hypotheses.
- Understand the relationship between investment and savings, demonstrate investment multiplier, and understand the meaning of MEC and MEI.
- Illustrate the meaning of interest, analyse the various theories.

2018-19

BCA (Old)

- **1st SEMESTER:**
- **11: (English Language- N/A)**
- **12: (Mathematics- N/A)**

- **CC 13: (Introduction to Information Technology)**

By the end of the course, successful students can use digital technology like internet , wifi, routers, LAN etc. with ease. That will be helpful in real life understanding.

- **14: (Basic Electronics and Introduction to Logic & Organization)**

To give knowledge of some basic electronic components and circuits. It also helps to study logic gates and their usage in digital circuits.

- **15: (Physics- N/A)**

- **16: (Laboratory I- Windows and Office Tools)**

It helps students to become familiar to work in thewindows computer with the help ofits basic tools.

- **2nd SEMESTER:**
- **21: (Mathematics- N/A)**
- **22: (Data Structure through C Language)**

Data structures and algorithms (DSA) goes through solutions to standard problems in detail and gives students an insight into how efficient it is to use each one of them using a start up language like C. It also teaches you the science of evaluating the efficiency of an algorithm. This enables you to choose the best of various choices.

- **23: (Business System Analysis, MIS and ERP Fundamentals)**

On completion of this course the studentsare able to Explain what systems are and how they are developed .Explain the need for and value of a formalized step-by-step approach to the analysis, design, and implementation of computer information systems. Use tools and techniques for process and data modelling.

- **24: (Computer Architecture)**

On completion of this course the students are able to understand the structure, function and characteristics of computer systems, also can understand the design of various functional units and components of computers, identify the elements of modern instructions sets and their impact on processor design.

- **25: (Alternative English- N/A)**

- **26: (Laboratory II- Data Structure through C)**

Can understand Data Structure properties practically using C language.

- **3rd SEMESTER:**
- **31: (System Programming)**

Understand basic concepts in systems programming. Understand basic concepts in UNIX file systems and process control. Understand UNIX system calls. Develop skills to write programs using system services.

- **32: (Computer Oriented Numerical & Statistical Methods)**

Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. Analyse and evaluate the accuracy of common numerical methods.

- **33: (Microprocessor and Assembly Language)**

Microprocessor gets an understanding of microprocessor based machine works and what are the roles of the main IC in modern Computer.

In Assembly language programming, students learn to develop low level or hardware level language specially 8085 microprocessor.

- **34: (DBMS with ORACLE)**

Enhance the knowledge and understanding of Database analysis and design. Enhance the knowledge of the processes of Database Development and Administration using SQL and PL/SQL. Enhance Programming and Software Engineering skills and techniques using SQL and PL/SQL.

- **35: (OOP with C++)**

Understand programs using objects and data abstraction, class, and methods in function abstraction. Analyze, write, debug, and test basic C++ codes using the approaches introduced in the course.

- **36: (Laboratory III- Programming using C++)**

Analyze problems and implement simple C++ applications using an object-oriented software engineering approach on practical life problems.

- **4th SEMESTER:**
- **41: (Computer Graphics)**

After learning the course the students should be able to explain fundamental concepts within computer graphics such as geometrical transformation, illumination models, removal of hidden surfaces and rendering, etc.

- **42: (Visual Programming with VB)**

VB, a GUI Programming language. Upon completion of this course, the student will be able to design, create, build, and debug Visual Basic applications.

- **43: (Windows Programming)**

The students can develop windows applications and GUI using structured and object-based programming techniques.

- **44: (Data Communications and Computer Networking)**

Be familiar with the architecture of a number of different networks. Understand the principles of protocol layering. Be familiar with modern communication systems. Understand the basic aspects of packet-based protocol design and implementation.

- **45: (Laboratory IV- Windows Programming)**

Students learn GUI design practically.

- **46: (Laboratory V- VB & ORACLE)**

Students should be able to design, create, build, and debug Visual Basic applications and Database applications practically.

- **5th SEMESTER:**
- **51: (Optimization Techniques)**

Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.

- **52: (Web Technology with Java)**

At the end of the course, students should be able to design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's. Also get introduced in the area of Online Game programming.

- **53: (UNIX and Shell Programming)**

On completion of this course the student should be able to identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.

- **54: (Software Engineering)**

An ability to work in one or more significant application domains. Work as an individual and as part of a multidisciplinary team to develop and deliver quality software. Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.

- **55: (Laboratory VI- Unix and Networking)**

Shell scripts are used here to write scripts or develop programs in UNIX/LINUX based systems.

- **56: (Laboratory VII- Java and Internet Lab)**

Students learn to develop java programs and small Apps.

- **6th SEMESTER:**
- **61: (Environmental Studies- N/A)**

- **62: (AI and Expert Systems)**

Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems. Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

- **63: (Compiler Construction)**

At the end of the course, students will understand different considerations and phases of compilation, the impact of language attributes upon the compilation process, the effect of hardware feature on the generated code and the practical fundamentals of compiler implementation.

- **64: (Human Resource Management- N/A)**

- **65: (Project)**

It helps students to choose a specific problem and reproduce its computerized version of that, which provides a real life working environment.

- **66: (Presentation of Project & Viva Voce)**

It makes them confident for their upcoming future.

Under CBCS System

- **Semester I:**
- **AEC 11: (N/A)**
- **CC 12: (Programming Fundamentals using C)**

Programming in C helps to learn a very powerful computer language which lays the foundation of learning other modern computer languages easily.

- **CC 13: (Digital Electronics)**

Gives the core knowledge about computer hardware and the working of its components.

- **GE 14: (N/A)**
- **CC 12L: (Programming Fundamentals using C Lab)**

Earns to develop computer programs which can be used to solve various kinds of daily life problems.

- **CC 13L: (Digital Electronics Tutorial)**

Gives the core knowledge about computer hardware and the working of its components.

- **GE 14L: (N/A)**
- **Semester II:**
- **AEC 21: (N/A)**
- **CC 22: (Programming in JAVA)**

At the end of the course, students should be able to design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's. Also get introduced in the area of Online Game programming.

- **CC23: (Computer System Architecture)**

On completion of this course the students are able to understand the structure, function and characteristics of computer systems, also can understand the design of various functional units and components of computers, identify the elements of modern instructions sets and their impact on processor design.

- **GE 24: (N/A)**
- **CC 22L: (Programming in JAVA Lab)**

Students learn to develop java programs and small Apps.

- **CC 23TL: (Computer System Architecture Lab)**

Gives the practical knowledge about computer hardware and the working of its components.

- **GE 24TL: (N/A)**

2018-19

Under 1+1+1 system

Computer Science (Hons):

- **First Year:**
- **Paper 1: (Digital Electronics and Computer System Architecture)**

Gives the core knowledge about computer hardware and the working of its components. On completion of this course the students are able to understand the structure, function and characteristics of computer systems, also can understand the design of various functional units and components of computers, identify the elements of modern instructions sets and their impact on processor design.

- **Paper 2: (Numerical Analysis, LPP,Basic Electronics)**

Students learn the mathematical formulation to solve real life problems and also write program codes to implement various algorithms.

- **Second Year:**
- **Paper 3:(Programming in C, Operating system,Data Structure, Theory of Computation)**

Programming in C helps to learn a very powerful computer language which lays the foundation of learning other modern computer languages easily.

Operating System gives an idea about how system software works. Students gets better idea about hardware, software co-ordination.

Data structure lays the foundation of maintaining data in computer with cost effectiveness. Thus Students get the idea of which data structure to use under circumstances.

Theory of Computation lays the foundation of learning about various kinds of machines and grammar's and languages associated with it.

- **Paper 4:(Practical on C programming)**

Earns to develop computer programs which can be used to solve various kinds of daily life problems.

- **Third Year:**
- **Paper 5:(Microprocessor, Advance System Architecture, Network, Digital Graphics)**

Microprocessor gets an understanding of microprocessor based machine works and what are the roles of the main IC in modern Computer.

In Networking, interconnectivity among computers is of utter importance these days. Students get knowledge about various components in Networking.

In Computer Graphics, after learning the course the students should be able to explain fundamental concepts within computer graphics such as geometrical transformation, illumination models, removal of hidden surfaces and rendering, etc.

- **Paper 6:(Object Oriented Programming using C++, DBMS, Software Engineering, Internet Technology, VB)**

Understand programs using objects and data abstraction, class, and methods in function abstraction. Analyze, write, debug, and test basic C++ codes using the approaches introduced in the course.

Enhance the knowledge and understanding of Database analysis and design. Enhance the knowledge of the processes of Database Development and Administration using SQL and PL/SQL. Enhance Programming and Software Engineering skills and techniques using SQL and PL/SQL.

An ability to work in one or more significant application domains. Work as an individual and as part of a multidisciplinary team to develop and deliver quality software. Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.

VB, a GUI Programming language. Upon completion of this course, the student will be able to design, create, build, and debug Visual Basic applications.

- **Paper 7:(Practical on Assembly Language, VB,HTML)**

In Assembly language programming, students learn to develop low level or hardware level language specially 8085 microprocessor.

Students should be able to design, create, build, and debug Visual Basic applications and Database applications practically.

In HTML, students should be able to design and develop webpages.

- **Paper 8:(Practical on C++, PL/SQL, Shell Script)**

Analyze problems and implement simple C++ applications using an object-oriented software engineering approach on practical life problems.

Enhance Programming and Software Engineering skills and techniques using SQL and PL/SQL.

Shell scripts are used to write scripts or develop programs in UNIX/LINUX based systems.

Computer Science (General):

- **First Year:**
- **Paper 1: (Computer Fundamental, Digital Logic)**

To give knowledge of some basic electronic components and circuits. It also helps to study logic gates and their usage in digital circuits.

- **Paper 2: (Data and File Structure)**

Data and File structure lays the foundation of maintaining data in computer with cost effectiveness. Thus Students get the idea of which data structure to use under circumstances.

- **Paper 3: (Windows and Office Tools Lab)**

It helps students to become familiar to work in the windows computer with the help of its basic tools.

- **Second Year:**
- **Paper 4: (C Programming, Operating System)**

Programming in C helps to learn a very powerful computer language which lays the foundation of learning other modern computer languages easily.

Operating System gives an idea about how system software works. Students gets better idea about hardware, software co-ordination.

- **Paper 5: (Computer Architecture, System Analysis and Design)**

On completion of this course the students are able to understand the structure, function and characteristics of computer systems, also can understand the design of various functional units and components of computers, identify the elements of modern instructions sets and their impact on processor design.

In System Analysis and Design, the students are able to explain what systems are and how they are developed .Explain the need for and value of a formalized step-by-step approach to the analysis, design, and implementation of computer information systems. Use tools and techniques for process and data modelling.

- **Paper 6: (C Programming Lab)**

Earns to develop computer programs which can be used to solve various kinds of daily life problems.

- **Third Year:**
- **Paper 7: (DBMS, Visual Basic, Network and Internet)**

Enhance the knowledge and understanding of Database analysis and design. Enhance the knowledge of the processes of Database Development and Administration using SQL and PL/SQL. Enhance Programming and Software Engineering skills and techniques using SQL and PL/SQL.

VB, a GUI Programming language. Upon completion of this course, the student will be able to design, create, build, and debug Visual Basic applications.

In Networking, interconnectivity among computers is of utter importance these days. Students get knowledge about various components in Networking.

- **Paper 8: (DBMS, Visual Basic Lab)**

Enhance Programming and Software Engineering skills and techniques using SQL and PL/SQL.

Students should be able to design, create, build, and debug Visual Basic applications and Database applications practically.

Under CBCS System

Computer Science (Hon's)

- **Semester I:**
- **AEC 11: (N/A)**
- **CC 12: (Programming Fundamentals using C)**

Programming in C helps to learn a very powerful computer language which lays the foundation of learning other modern computer languages easily.

- **CC 13: (Computer System Architecture)**

On completion of this course the students are able to understand the structure, function and characteristics of computer systems, also can understand the design of various functional units and

components of computers, identify the elements of modern instructions sets and their impact on processor design.

- **GE 14: (N/A)**
- **CC 12L: (Programming Fundamentals using C Lab)**

Earns to develop computer programs which can be used to solve various kinds of daily life problems.

- **CC 13L: (Computer System Architecture Lab)**

Gives the practical knowledge about computer hardware and the working of its components.

- **GE 14L: (N/A)**
- **Semester II:**
- **AEC 21: (N/A)**
- **CC 22: (Programming in JAVA)**

At the end of the course, students should be able to design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's. Also get introduced in the area of Online Game programming.

- **CC23: (Discrete Structures)**

Various Mathematical structures are often used in computer to solve problems. This subject is of immense help.

- **GE 24: (N/A)**
- **CC 22L: (Programming in JAVA Lab)**

Students learn to develop java programs and small Apps.

- **CC 23TL: (Discrete Structure Tutorial)**

Various Mathematical structures are often used in computer to solve problems. This subject is of immense help.

- **GE 24TL: (N/A)**

<u>Computer Science Program course (DSC)</u>

- **Semester I**
- **CC 1: (Computer System Architecture)**

On completion of this course the students are able to understand the structure, function and characteristics of computer systems, also can understand the design of various functional units and components of computers, identify the elements of modern instructions sets and their impact on processor design.

- **CC 1T: (Computer System Architecture Tutorials)**

On completion of this course the students are able to understand the structure, function and characteristics of computer systems, also can understand the design of various functional units and components of computers, identify the elements of modern instructions sets and their impact on processor design.

- **DSC 2A: (N/A)**
- **DSC 3A: (N/A)**
- **AEC 1: (N/A)**
- **Semester II**
- **CC 2: (Programming Fundamentals Using C)**

Programming in C helps to learn a very powerful computer language which lays the foundation of learning other modern computer languages easily.

- **CC 2L: (Programming Fundamentals Using C LAB)**

Earns to develop computer programs which can be used to solve various kinds of daily life problems.

- **DSC 2B: (N/A)**
- **DSC 3B: (N/A)**
- **AEC 2: (N/A)**

<u>Computer Science (GE) for others Hon's Students</u>

- **Semester I**
- **GE 1A: (Digital Electronics)**

Gives the core knowledge about computer hardware and the working of its components.

- **Semester II**
- **GE 2A: (Programming in C)**

Programming in C helps to learn a very powerful computer language which lays the foundation of learning other modern computer languages easily.

- **GE 2AL: (Programming in C Lab)**

Earns to develop computer programs which can be used to solve various kinds of daily life problems.

Department of History (1+1+1) system

B.A. History Hons and Programme course

Programme Outcome	Developing intellectual and social skills through a nuanced understanding of historical concepts; creating individuals who comprehend the fundamental socio-economic bases of the social matrix; creating socially conscious citizens who are aware of the rich cultural tradition and heritage of our county.
Programme Specific Outcome	a. On successful completion of the Programme, the students will have a sound understanding of the varied forces that shape society.
	b. A strong command over the current historiographical trends seen across the world.
	c. A comparative understanding of different societies and their cultural practices which would sensitize them to accept diversities.
	d. An in depth understanding of history would also prepare them to sit for various competitive exams as well as to pursue a career in academia.

COURSE OUTCOMES

Courses	Outcomes
Indian History (Papers 1-4 taught in First Year and Second Year History Hons.)	To acquire a comprehensive understanding of the history of India from the earliest period to 1947. There are 5 papers which deal with the political, social, economic and cultural history of India. For Programme course students Indian History is taught through 6 papers over their first two years .
European History (Papers 5-6 taught to Third Year History Hons.)	This course aims at providing students an understanding of the dynamics of European history . Through 2 courses the attempt is to identify students with some of the most important historical events that shaped Europe to become what it is today. Programme course students have one paper in their third year dealing with European History.
History of China and Japan	This course is an area-specific course, which explores the social and cultural formations of two major East Asian nations. Through an examination

(Paper 7 taught to Third Year History Hons.)	of their history, the aim is to educate students about the similar histories that shaped most countries across Asia. The final objective is to create a sense of shared legacy amongst the students with other cultural traditions.
International Relations (Paper 8 taught to Third Year History Hons.)	This course is aimed at providing students a look at the emerging discourses that have shaped relations between nation states in the post world war 2 era. It is hoped that students would come to terms with some of the social forces that affect our contemporary world now: ranging from global warming to terrorism to cyber crime.

PROGRAMME OUTCOMES, PROGRAMME SPECIFIC OUTCOMES AND COURSE OUTCOMES FOR HISTORY HONS COURSE

PROGRAMME NAME : B.A. HONOURS IN HISTORY

NUMBER OF SEMESTERS:6

PROGRAMME OUTCOMES

- Providing an environment for knowledge development
- Holistic approach towards the educational improvement of the young students
- Preparing students for jobs and further higher education
- Providing quality education for the economic, social , emotional needs of the students
- Ensuring an interactive teaching learning process among the teaching faculty and the students
- Developing interest among the students on the subject and also in extracurricular activities
- Recognising the capacities of the students in the field of study and other
- Implementing a pleasant environment for the students in their learning process
- Helping to develop the qualities of the students to be successful in future.

PROGRAMME SPECIFIC OUTCOMES

- Learning is encouraged through teaching- learning process , field trips and project preparation

- Encouraging the faculty members to participate in Faculty development and Orientation Programmes to update and improve their administrative, organisational and academic skills.
- Encouraging the faculty members to participate in seminar, conferences and workshops to develop their academic and research qualities
- To provide an overall development of students through gender awareness, environment consciousness, cleanliness,etc
- To provide value –education in students to provide a holistic development
- To help the students to prepare for competitive examinations.

COURSE OUTCOMES

Semester -I		
Course code	**Course Name**	**Course outcome**

Core 01	History of India-I	• Reconstructing Ancient Indian History. • Understanding Pre-historic hunter-gatherers. • Learning the Palaeolithic cultures- sequence and distribution; stone industries and other technological developments • Ability to identify Sources and tools of historical reconstruction. • To study the Mesolithic cultures- regional and chronological distribution; new developments in technology and economy; rock art • To identify the Understanding the regional and chronological distribution of the Neolithic and Chalcolithic cultures: subsistence, and patterns of exchange • To identyify the Origins; settlement patterns and town planning; agrarian base • To understand the craft productions and trade; social and political organization; religious beliefs and practices; art; the problem of urban decline and the late/post-Harappan traditions • To develop the ability to Cultures in transition Settlement patterns, technological and economic developments; social stratification; political relations; religion and philosophy; the Aryan Problem
Core 02	Social Formations and Cultural Patterns of the Ancient World	• To develop the understanding of Evolution of humankind; Palaeolithic and Mesolithic cultures • To grow the ability to study Food production: beginnings of agriculture and animal husbandry. • To understand the Bronze Age Civilizations of the world • To develop the capacity to know the Nomadic groups in Central and West Asia; Debate on the advent of iron and its implications • To build up the ability to understand Slave society in ancient Greece: agrarian economy, urbanization, trade • Polis in ancient Greece: Athens and Sparta; Greek Culture

		SEMESTER -II
Core-03	History of India-II (from 300 to 750 A.D.)	• To understand the Economy and Society (circa 300 BCE to circa CE 300) • Changing political formations (circa 300 BCE to circa CE 300) • Towards early medieval India [circa CE fourth century to CE 750] • Religion, philosophy and society (circa 300 BCE- CE 750)
Core- 04	Social Formations and Cultural Patterns of the Medieval World	• To understand the concept of Roman Republic, Participate and Empire &slave society in ancient Rome: Agrarian economy, urbanization, trade. • Religion and culture in ancient Rome • Crises of the Roman Empire. • Economic developments in Europe from the 7th to the 14th centuries: Organization of production, towns and trade, technological developments. Crisis of feudalism. • Religion and culture in medieval Europe • Societies in Central Islamic Land
		SEMESTER -III
CORE-05	History of India -III (750CE-1206CE)	• This paper examines the political, social and economic changes that took place In the period from 750 CE to 1206 CE. • Focus on the post-Gupta political formations that dominated the Indian subcontinent namely the Rashtrakutas, Pratiharas , Chalukyas , Pallavas and the Palas to name a few • The paper intends to focus on the historiographical debates surrounding trade and urbanization in the Early Medieval Period • Examination of the crystallization of the Hindu religious tradition and its impact on societal formations • Examines the coming of the Muslims into the sub-continent their earliest arrival in Sind and the subsequent Islamic incursions under Mahmud Ghazni and Muhammad

		Ghori; causes for their success and the implications of this Islamic entry.
CORE-O6	Rise of the Modern West	• This paper examines the development of the European world after the decline of the feudal mode of production • Focusses on the intellectual changes that took place in Europe through events like the Renaissance and Reformation • The paper examines the changing economic conditions of Europe analysing the factors that led to a shift of economic balance from the Mediterranean Sea to the Atlantic Ocean • New political trends in European polities are also examined particularly the idea of absolutism as seen across Western Europe and Eastern Europe

CORE-07	History of India-IV (1206-1526)	• This paper traces the historical characteristics of a period often termed as the 'Delhi Sultanate'. • Analysis of the Delhi Sultanate with a focus on the major political processes that shaped the rise and fall of several dynasties until the First Battle of Panipat. • Understanding the revenue system of the Sultanate and the nature of commercial transactions during this period • Examination of the impact of devotional movements like Sufism and Bhakti on the ideological milieu of the sub-continent • The final section of the paper accounts for the growth of regional polities through myriad case studies like that of the Vijaynagar kingdom, the Bahamani Sultanate and the Bengal Sultanate.
		SEMESTER -IV
CORE-08	Rise of Modern West-II	• Examines the age of Revolutions though detailed analysis of events like American Revolution, English Revolution, Scientific Revolution and Industrial Revolution • Provides a comprehensive overview about the crisis of the 17th century in Europe and the political, economic and ideological changes that took place through the course of this century.
CORE-09	History of India-V (1556-1605AD)	• This paper presents a detailed insight into the reign of the emperor Akbar • Focusing on the centrality of Akbar, this paper attempts to visualize the changes in political, technological and economic conditions brought about under the reign of Akbar • There is a detailed discussion on the nature of literary sources of Akbar's period ranging from Persian Chronicles to Vernacular textual traditions • The growth of a composite ideological culture under Akbar is also examined with special attention to the role of diverse religio-cultural practices and institutions like ibaadat-khana, sulh-i-kul, to name a few.
CORE-10	History of India-VI	• A continuation of the earlier paper by focusing on the successors of emperor Akbar.

	(1605-1707AD)	• This paper looks at the changes and continuity in administrative structures, political institutions, economic patterns, religious ideas as seen during the reign of Jahangir, Shahjahan and Aurangzeb. • An entire section examines the arrival of Europeans in the Indian Subcontinent as traders and the changing dynamics of the existant trading patterns. • The paper finishes with a detailed analysis of the causes for the decline of the Mughal state while also introducing students to the rich historiography around the nature of the eighteenth century in Indian history.

PROGRAMME OUTCOME, PROGRAMME SPECIFIC OUTCOME AND COURSE OUTCOME FOR B.A.(P) HISTORY UNDER CBCS SYSTEM

PROGRAMME OUTCOMES

- Providing an environment for knowledge development
- Holistic approach towards the educational improvement of the young students
- Preparing students for jobs and further higher education
- Providing quality education for the economic, social , emotional needs of the students
- Ensuring an interactive teaching learning process among the teaching faculty and the students
- Developing interest among the students on the subject and also in extracurricular activities
- Recognising the capacities of the students in the field of study and other
- Implementing a pleasant environment for the students in their learning process
- Helping to develop the qualities of the students to be successful in future.

PROGRAMME SPECIFIC OUTCOMES

- Learning is encouraged through teaching- learning process , field trips and project preparation
- Encouraging the faculty members to participate in Faculty development and Orientation Programmes to update and improve their administrative, organisational and academic skills.
- Encouraging the faculty members to participate in seminar, conferences and workshops to develop their academic and research qualities
- To provide an overall development of students through gender awareness, environment consciousness, cleanliness,etc
- To provide value –education in students to provide a holistic development
- To help the students to prepare for competitive examinations.

COURSE OUTCOMES

Semester -I		
Course	**Course Name**	**Course outcome**

code		
DSC-PAPER1	History of India-I(From earliest times to 300 CE) SEMESTER 1	• Reconstructing Ancient Indian History. • Understanding Pre-historic hunter-gatherers. • Learning the Palaeolithic cultures- sequence and distribution; stone industries and other technological developments • Ability to identify Sources and tools of historical reconstruction. • To study the Mesolithic cultures- regional and chronological distribution; new developments in technology and economy; rock art • To identify the Understanding the regional and chronological distribution of the Neolithic and Chalcolithic cultures: subsistence, and patterns of exchange • To identyify the Origins; settlement patterns and town planning; agrarian base • To understand the craft productions and trade; social and political organization; religious beliefs and practices; art; the problem of urban decline and the late/post-Harappan traditions • To develop the ability to Cultures in transition Settlement patterns, technological and economic developments; social stratification; political relations; religion and philosophy; the Aryan Problem • To understand the Economy and Society (circa 600 BCE to circa CE 300) marking the transition to agrarian society, its consequences and the proliferation of trade • To understand the formation of the state in the 6^{th} century BCE, and the subsequent changes that saw the growth of centralized state structures in the Mauryan period and its fragmentation in thee post-Mauryan age.
DSC-PAPER2	History of India-II (300 CE-1206 CE) SEMESTER 2	• This paper examines the political, social and economic changes that took place In the period from 300 CE to 1206 CE. • Focus on polities like the Guptas and subsequent post-Gupta political formations that dominated the Indian subcontinent

		namely the Rashtrakutas, Pratiharas , Chalukyas , Pallavas and the Palas to name a few • The paper intends to focus on the historiographical debates surrounding trade and urbanization in the Early Medieval Period • Examination of the crystallization of the Hindu religious tradition and its impact on societal formations • Examines the coming of the Muslims into the sub-continent their earliest arrival in Sind and the subsequent Islamic incursions under Mahmud Ghazni and Muhammad Ghori; causes for their success and the implications of this Islamic entry.
DSC-PAPER 3	History of India-III(From 1206-1707 CE) SEMESTER 3	• Analysis of the Delhi Sultanate with a focus on the major dynasties and kings. • Understanding the revenue system of the Sultanate and the nature of commercial transactions during this period • Examination of the impact of devotional movements like Sufism and Bhakti on the ideological milieu of the sub continent • The study of the Mughal period focusing on the formation of the Mughal empire its consolidation and its decline. • Examination of the political approach of the Mughals and their economic systems • Growth of regionalism is discussed though a study of Vijaynagar, Bahamanis and the later day Marathas
DSC-PAPER 4	History of India-(From 1707to 1947) SEMESTER 4	• This paper examines the consolidation and expansion of the British rule in India • The nature of the colonial economy is studied through a focus on their agrarian, industrial and commercial policies • The roots of Indian nationalism and its ideological origins in the social reform movements of 19th century are examined • Discussion on India's struggle for independence with a close examination of early nationalist approaches, Gandhian policies, and the menace of communalism • The process that led to the drafting of the Constitution and its main ideas are also emphasised upon in this paper.

DSE 1	History of North Bengal –I Fifth Semester	• The history of North Bengal is studied in the DSE paper offered to the students of Program course with a complete analysis of the political , economic and social dynamics of the region from the ancient Gupta period till the coming of the Koch kingdom • This helps students learn valuable aspects of the local history of the region where this university and its several colleges are located.
DSE 2	History of North Bengal –II Sixth Semester	• The final paper on the local history extends the discussion on the history of North Bengal by focusing on the changes witnessed by the region under colonial rule: • Discussion of the growth of hill stations, growth of plantation economy and commercialized agriculture. • The popular response to colonial rule in the region is discussed along with the various peasant movements that dotted the landscape of this region • Special emphasis is given to the development of Coochbehar kingdom during the freedom struggle and its subsequent merger with the Indian republic • The contentious identity issues prominent in this region is also examined through the study of the Rajbangshi Kshatriya movement

LEARNING OUTCOMES FOR UG-(1+1+1) PROGRAMME

B.Sc. (PHYSICS)

DEPARTMENT OF PHYSICS

SILIGURI COLLEGE, SILIGURI

OUR DEPARTMENT AIMS TO PROVIDE THEORETICAL AND PRACTICAL KNOWLEDGE FOR STUDENTS.

MISSION : As a Department, we are committed to

- Achieve academic excellence through a combined theoretical and experimental teaching of the subjects, proper internal assessment, constant evaluation process followed by written examination and practical examination along with viva-voce.
- Students will be able to demonstrate their understanding in physics (Mathematical method in physics, classical mechanics, properties of matter, electricity and magnetism, thermodynamics, basic electronics, modern physics, waves and optics, statistical mechanics, quantum mechanics, electromagnetic theory and special theory of relativity) through appropriate home assignment and examinations.

- Students will show that they have learned laboratory skills, enabling them to take measurements in a physics laboratory and analyze the measurements to draw valid conclusions.

- To prepare the students to be competent enough to face the challenge in appearing different examinations in National level and for higher studies.
- To promote quality and ethics among the students

Learning Outcomes for Different Topic

Students who have completed this course should be familiar with the main topics which are taught during the three years degree course of Honours in physics .

Part-I

Paper-I Full Marks -70

Group-A: Mathematical Methods of Physics
Group - B: Classical Mechanics-I
Group-C: General Properties of Matter

METHODS OF MATHEMATICAL PHYSICS.

COURSE CONTENT:

Central topics are Vectors, Orthogonal Curvilinear coordinate system, ordinary differential equations , partial differential equations, Fourier series, Matrices, probability and statistics

LEARNING OUTCOMES:

Students will demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.

CLASSICAL MECHANICS & PROPERTIES OF MATTE.

The main goal of the course is to introduce students to *classical mechanics*and its applications and for them *to learn the fundamentals of all important topic.*

COURSE CONTENT:

: Unit and Dimensions, Kinetics, Kinematics (Concept of Newton's laws of motion and it's application), System of particles, Rotational motion, Rigid bodies, Central forces and Gravitation, Elasticity, surface tension and Viscosity.

LEARNING OUTCOMES:

Students who have completed this course should have a deep understanding of Newton's laws,

They will be able to solve the Newton equations for simple configurations using various methods,

Student will have a better understanding about these topics and capable of tackling different physical problems related to above topics.

Paper-II Full Marks -70
Group-A: Heat
Group - B: Sound(Acoustics & waves)
Group-C: Electricity & Magnetism

THERMAL PHYSICS :

COURSE CONTENT: Kinetic Theory of Gases,Transport phenomena, Real Gasews, Conduction of Heat, Radiation, Thermometry, Basic concept of thermodynamic and variable, 1st Law of Thermodynamics, 2nd law of thermodynamics and entropy, Maxwell's Thermodynamic Relations, Heat engine and Refrigerator, Thermodynamic equilibrium and change of state, Chemical Thermodynamics, 3rd law of Thermodynamics and Low temperature Physics.

LEARNING OUTCOMES*:*

Student should be able to develop the understanding of various laws of kinetic theory, conduction and radiation of heat and their application in various systems and processes.Student should be able to develop the basic understanding of the concepts and underlying principles of Thermodynamics and their application in different thermodynamic system and natural processes.

WAVES AND OPTICS:

COURSE CONTENT: Vibrations (Linear Harmonic Oscillator, Superposition principle, Damped and forced vibration, Coupled Oscillations, Fourier analysis of complex vibration, acoustic filter), Waves, Sound waves, Doppler effect.

Learning Outcome

They understand the phenomena of simple harmonic motion and the properties of systems executing such motions.

Students will Develop an understanding of different vibrating systems Solve many types of problems involving wave motion.Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems. Understand the formation of Lissajous figures, formation of bits by combinations of harmonic motions with different frequencies and behaviour of transverse, longitudinal waves.Understand the principle of superposition of waves, so thus describe the formation of standing waves. Understand

the behaviour of sound wave in dispersine and non-dispersive media and propagation characteristics in different media. They can learn the application of Fourier's series to study different vibrations of string.

ELECTRICITY-I *COURSE CONTENT:* *Ele*ctrostatics in vacuum, Electric Dipoles, Dielectrics, Capacitance, Electrostatic energy, Boundary value problems, Method of Images.

LEARNING OUTCOMES :

After going through the course, the student should be able to

Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics. Apply Gauss's law of electrostatics to solve a variety of problems. Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential. Understand the dielectric properties of materials
Demonstrate a working understanding of capacitors. Solve different potential problems using the Method of Images and Bpundary value problems. Apply Kirchoff's law different bridges ond potentiometers.

Paper-III Full Marks -70
PRACTICAL

Group – A

Determination of moment of inertia of a metallic cylinder/rectangular bar about an axis pasing through its centre of mass.

Determination of acceleration due to gravity with Kater's pendulum.

Determination of the rigidity modulus of the material of a wire by static method.

Determination of the rigidity modulus of the material of a wire by dynamic method.

Determination of the surface tension of a liquid by capillary rise method.

Determination of the coefficient of viscosity of water by Poiseuille's method.

Verification of the laws of vibrating string with a sonometer.

Determination of the coefficient linear expansion of a solid by optical lever method.

Measurement of pressure coefficient of air with a constant volume gas thermometer.

Group – B

Determination of the Young's modulus of the material of a metallic beam by the method of flexure. (At least three lengths of the beam to be taken)

Determination of the surface tension by Jaeger's method and study of its variation with temperature.

Determination of the coefficient of viscosity of a highly viscous liquid by Stoke's method. (Density of the material of the spherical body and the liquid to be determined).

Determination of the thermal conductivity of a bad conductor in the shape of a disc by Lee and Chorlton's method.

Determination of the thermal conductivity of glas in the form of tube.

Determination of the boiling point of a liquid with a platinum resistance thermometer.

Determination of the melting point of a solid by thermocouple.

Measurement of J by Callendar and Barnes method.

Determination of the ECE of silver using potentiometer.

Paper-IV Full Marks -70
Group-A: Geometrical Optics
Group - B: Physical Optics
Group-C: Electronics-I

Geometrical Optics: Fermat's principle, Optical Systems: Optical Instruments, Dispersion. Seidel Aberrations.

Physical Optics: Wave Nature of Light, wave front, Huygen's principle, Interference, Diffraction, Interferometry, Optical instrument

LEARNING OUTCOMES:

They develop knowledge of ray optics & wave optics and an understanding of different properties of light such as reflection, refraction, interference, diffraction and polarization.

The student will learn to use the geometrical approximation, including Fermat's principle, the ray equation and paraxial matrix formalism for refractive and reflective surfaces. The student will be introduced to the design of optical systems and aberrations, with an emphasis on image forming systems.

The wave optics part of the course will give the student a thorough fundamental knowledge within interferometry, coherence and diffraction. Understand the formation of interference fringe pattern due to division of wave front and division of amplitude in biprism, Lloyd's mirror and formation of newton's ring. Understand the working of interferometer, diffraction grating, and holograms.

The student will get acquainted with Fresnel's and Fraunhofer's diffraction. The student will be able to calculate the diffraction from gratting, including the use of the convolution theorem for analyzing complex systems. The student will learn the connection between numerical aperture, F-number, spatial resolution and image quality for optical systems. Finally, the student will get a thorough introduction to image forming systems with emphasis on the human eye, the camera, the telescope and the microscope.

ELECTRONICS

COURSE CONTENT :Voltage source, Current source, active element, passive element. Network theorems (Thevenin’s, Norton’s, superposition, maximum power transfer).

Semiconductor Devices and applications(different types, different conduction and properties) , p-n junction diode, zener diode, avalanche and zener breakdown, applications of p-n junction diode, zener diode.

DIGITAL ELECTRONICS; Different number system and their conversion, Boolean alzabra, De Morgan’s theorem and their application, Properties of basic gates AND, OR, NOT, NAND and their realization using diodes and transistors

LEARNING OUTCOMES

Secure first-hand idea of different components including both active and passive
components to gain a insight into circuits using discrete components
Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis,
Understand the basic concepts of Semiconductor diodes such as pn junction diode, Zener diode with their characteristics and application.To apply the basics of diode to describe the working of rectifier and regulator circuits such as Full and half wave rectifiers. To solve examples on rectifiers for parameters such as Capacitance, load and source effect, line and load regulations, and circuit current.
Understand the basic concept of Bipolar Junction Transistor and it's different mode of biasing to act as an amplifier, a current source and a switch.
Learn about different number system their conversions and arithmetic operations used in digital system. Understand logic functions and logic gates and their realization by using diodes and transistors.

Paper-V Full Marks -70
Group-A: Thermodynamics
Group - B: Electricity-II

THERMODYNAMICS :

COURSE CONTENT: Basic concept of thermodynamic and variable, 1st Law of Thermodynamics, 2nd law of thermodynamics and entropy, Maxwell's Thermodynamic Relations, Heat engine and Refrigerator, Thermodynamic equilibrium and change of state, Chemical Thermodynamics, 3rd law of Thermodynamics and Low temperature Physics.

LEARNING OUTCOMES:

Student should be able to develop the basic understanding of the concepts and underlying principles of Thermodynamics and their application in different thermodynamic system and natural processes.

Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, working of heat engines and refrigeration system, the thermodynamic potentials and their physical interpretations. Learn about Maxwell's thermodynamic relations and associated relations with phase changes of matters and phenomenon occurring at low temperature.

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ELECTRICITY -II

COURSE CONTENT:

Electromagnetism, Source of magnetic field, Lorentz force, magnetic scalar and vector potential, electromagnetic induction, Magnetic field in material medium

Stationary Currents and DC circuits, Transients in DC circuit, Alternating Currents (LR, CR, LCR circuits, Q-factor,Power, Three phase system , AC & DC generator and motors all types of AC bridge for measurement of L and C, AC meters), Thermoelectricity.

LEARNING OUTCOME

:Student will be able to develop Both conceptual ideas and mathematical treatment in electricity and magnetsim . They will be able to describe and explain the fundamental physical principles and apply these principles together with logical and mathematical reasoning, to situations of the physical problems.

Learn the concept and origin of magnetic field and it's description.

Describe the magnetic field produced by magnetic dipoles and electric currents.

Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.

Understand the magnetic properties of materials and the phenomena of electromagnetic induction. Describe how magnetism is produced and list examples where its effects are observed.

Apply Kirchhoff's rules to analyze transient phenomenon in DC circuit and study the response across a resistor, inductor or capacitor and their graphical relationship between them when the circuits (series or parallel combination of L C R) is excited by AC source.

Understand the working of DC /Ac motor and generator AC bridges, meters and measuring instruments.

Learn different thermoelectric effect and their applications.

Paper-VI Full Marks -70
PRACTICAL

Group – A

1. Measurement of focal length of a convex lens by displacement method and hence to determine the focal length of a concave lens by combination method.
2. Determination of the refractive index of the material of a lens and that of a liquid using a convex lens and a plane mirror. (Radii of curvature of lens surfaces to be measured with the help of a spherometer).
3. Verification of the inverse cube law of magnetic dipoles. Comparison of moments of two magnetic dipoles and measurement of the earth's magnetic field with deflection and oscillation magnetometers.
4. Determination of end corrections of a metre bridge and to measure the specific resistance of a material in the form of a wire.
5. Determination of the resistance per unit length of the wire of a Carey-Foster's bridge and to measure an unknown resistance.
6. Determination of the temperature coefficient of the material of a coil using metre bridge.

Use of potentiometer- (a) comparison of two emfs, (b) measurement of low resistance.

Determination of the resistance of a mirror galvanometer by half deflection method and determination of its figure of merit.

Calibration of a suspended coil ballistic galvanometer by (a) direct method, (b) standard capacitance method and (c) standard solenoid method.

Group – B

1. To study the L-R circuit: to draw the phase diagrams, to study the current-voltage relationship across L and to study the variation of reactance of L with frequency and hence to find its value.
2. To study the C-R circuit: to draw the phase diagrams, to study the current-voltage relationship across C and to study the variation of reactance of C with frequency and hence to find its loss factor.
3. To study a series/parallel L-C-R ac circuit: to draw its response curve, to find its resonance frequency and to study the variation of Q with C (and L if possible).
4. Determination of the constant of a ballistic galvanometer and to measure the value of the capacitance by discharge and a high resistance by leakage.
5. To measure the flux of a magnetic field with a search coil and a ballistic galvanometer.
6. To measure the mutual inductance of two coaxial coils at various relative orientations using ballistic galvanometer.
7. Tracing the B-H loop of a ferromagnetic specimen in the form of an anchor ring using ballistic galvanometer and to determine the area under the hysteresis loop and finding the energy loss.
8. To measure the capacitance of a capacitor by an AC bridge (Wien Bridge).

   To measure the self-inductance of two coils separately by Anderson's bridge and the total inductance of the above two coils when they are connected in series and hence estimate the coefficient of coupling between the two coils.

Paper-VII Full Marks -70

Group-A: Classical Mechanics-II & Fluid Mechanics

Group - B: Statistical Mechanics

Group - C: Electronics-II

CLASSICAL MECHANICS – II & FLUID MECHANICS

COURSE CONTENT :

classical Mechanics: Degree of freedom, constrains, generalized coordinates. Virtual displacement and virtual work, D'Alembert's principle and it's application, Lagrangian dynamics, Hamiltonian Dynamics, Variational principle, Principle of least action, Poisson brackets, symmetry and conservation principles in classical mechanics, Small oscillations.

Learning Outcomes By the end of the module, students will have a solid knowledge of the central concepts of Classical Mechanics and will have acquired and trained important problem-solving skills. They will be able to establish the Lagrangian, and to derive and solve the equations of motions for many systems.Subject to the Principle of Least Action they can calculate conserved quantities from symmetries.They can calculate the Hamiltonian and establish the Hamilton equations.They will be familiar with canonical transformations and Hamilton-Jacobi theory.

Fluid Mechanics: Streamline flow, rotational and irrotational motion, velocity potential, Equation of continuity, Euler's equation of motion for an ideal fluid; NavierStoke's equation, Bernoulli's theorem and applications, Torricelli's theorem.

LEARNING OUTCOMES:

Understand the concepts of rotational vs. irrotational flows; stream functions, velocity potentials. Laplace equation and its relation to elementary plane flows of inviscid fluids: sinks, sources, vortex flows, and superposition of these flows.

Use Euler's and Bernoulli's equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible and inviscid fluids.

STATISTICAL MECHANICS:

COURSE CONTENT :

Basic concept:Phase space, macrostates, microstates, statistical weight, different types of system, ensembles, statistical definition of temperature, pressure, entropy and chemical potential.

Maxwell – Boltzmann statistics and it's application, Bose-Einstein statistics and it's application to lattice specific heat, Bose-Einstein condensation. Fermi-Dirac statistic and it's application.

LEARNING OUTCOMES:

On completion of this course a student should be able to:
1)define and discuss the concepts of microstate and macrostate of a model system
2)define and discuss the concepts and roles of entropy and free energy from the view point of statistical mechanics
3)define and discuss the Boltdsmann distribution and the role of the partition function
4)apply the machinery of statistical mechanics to the calculation of macroscopic properties resulting from microscopic models of magnetic and crystalline systems
5)discuss the concept and role of indistinguishability in the theory of gases; know the results expected from classical considerations and when these should be recovered
6)define the Fermi-Dirac and Bose-Einstein distributions; state where they are applicable; understand how they differ and show when they reduce to the Boltzman
distribution
7)apply the Fermi-Dirac distribution to the calculation of thermal properties of elctrons in metals
8)apply the Bose-Einstein distribution to the calculation of properties of black body radiation

ELECTRONICS-II

COURSE CONTENT :Voltage source, Current source, active element, passive element. Network theorems (Thevenin's, Norton's, superposition, maximum power transfer).

Semiconductor(different types, different conduction and properties) , p-n junction diode, zener diode, avalanche and zener breakdown, applications of p-n junction diode, zener diode.

BJT transistors, two port network analysis, biasing, h-parameters, equivqlentckt, transistor characteristic forCE, CB, CC configuration, load line , Q-point , application of transistor as amplifier, emitter follower, current source.

Multistage amplifier, RC-coupled amplifier, Gain and frequency response of amplifier, power amplifier, push-pull amplifier; Feedback amplifier, Oscillator, power supply, operational amplifier and it's application.

Field effect transistor, JFET, MOSFET, FET amplifier, Source Follower.

Communication principles: propagation of EM –wave in atmosphere, ground wave, sky wave, microwave transmission and communication. Modulation and demodulation- theory of AM, FM, channel bandwidth, detection of AM and FM.

Electronics Instruments;(Electronic voltmeters, multimeters, CRO and it's application.

DIGITAL ELECTRONICS; Different number system and their conversion, Boolean alzabra, De Morgan's theorem and their application, Basic gates and their applications, Combinational logic systems, Sequential logic systems, Microprocessor, programming in assembly language.

Course Outcome :

After completion the course student are able to

- Identify the unique vocabulary associated with electronics and explain the basic concepts of Semiconductor diodes such as pn junction diode, characteristics and ammeters, DC loadline, Zener diode.
  To apply the basics of diode to describe the working of rectifier circuits such as Full and half wave rectifiers. To solve examples on rectifiers for parameters such as Capacitance, load and source effect, line and load regulations, and circuit current.
- Draw and explain the structure of bipolar junction transistor. Explain the operation of each device in terms of junction bias voltage and charge carrier movement. Identify and explain the various current components in a transistor.
- Describe the application of transistors for Current and voltage amplification. Also to describe the characteristics of different configurations of the transistor. Describe DC load line and bias point. List, explain, and design and analyze the different biasing circuits.
- Sketch, explain and design the amplifier circuit for given specification and analyze them discuss oscillator principles, oscillator types, and frequency stability as it relates to its operation. Analyze and Design the different types of Oscillators. Discuss ideal and practical operational amplifier (op amp)

their electrical parameters, need for op amp. Explain and design different application circuits using op amp.

- Sketch and explain the basic block of communication system. State the principles of modulation and explain the different modulation techniques. Describe the theory and operation of radio systems and superheterodyne receivers. Solve simple examples.
- List and explain the different number system. Solve examples on converting one form of number system to another form. State Boolean laws and theorems. State and explain the different logic gates using truth table. Analyze and design different adder circuits.
- **explains half and full adders**
- **designs half and full adders**
- **explains half and full subtractors**
- **identifies combinational logic circuit**
- **explains the working principles of decoder, encoder,**
- **explains the working principles of multiplexer ,demultiplexer'**
- **recognize 7-segmented displayers**
- **shows the applications of combinational circuits**
- **use flip-flpos**
- **recognizes the working flip-flops**
- **prepares time flow chart ,logic symbol and truth table of R-S,JK,D and T type flip-flpos**
- **demonstrates flip-flop applications**
- **explains counters and registers**
- **recognizes asynchronous and synchronous counters**
- **designs up and down conters.**
- **explains memory units.**
- **recognizes RAM,ROM,PROM,EPROM,EEPROM**
- **recognizes the properties of memory units.**
- **Develop various types program me in assembly language.**

Paper-VIII Full Marks -70

Group-A: Physical Optics-II

Group - B: Electromagnetic Theory

Group - C: Special Theory of Relativity

Group - D: Solid State Physics

OPTICS:

COURSE CONTENT : POLARIZATION; Different types of polarization, production of polarized light, double refraction, optical axis, principal section and principal plane, uniaxial crystal, Polaroids, Production detection of and analysis of different types of polarization, Nicol prism, Babinet's compensator, Rotatory polarization and optical activity,polafimeters.

COHERENT OPTICS; Tempioral and spatial coherence, absorption and spontaneous and induced emissions of radiation in atom and molecules, Einstein A and B coefficients, population inversion, optical resonators, quality factor, principal of LASAR, Ruby lasar, He-Ne lasar; basic principles of holography.

FIBRE OPTICS; Optical fibre; Different types of optical fibre, communication through optical fibre, energy loss, bandwidth and channel capacity, attenuation and dispersion, splicing and couplers.Fibre sensor.

Student Learning Outcomes & Enabling Objectives

a. Explain polarization and Malus's Law. b. Describe birefringent optical devices and liquid crystal displays. c. Explain the principles of integrated optical modulators and acousto-optic modulators.

- Understand the laws of reflection and refraction and to calculate the reflection and transmission coefficients at plane interface in bounded media.
- Understand the linear, circular and elliptical polarisations of em waves. Production as well as detection of waves in laboratory.
- Analyze the Elliptically Polarised light using Babinet's Compensator

- Understand propagation of em waves in anisotropic media, uni-axial and biaxial crystals phase retardation plates and their uses.
- Understand the concept of optical rotation, theories of optical rotation and their experimental rotation, calculation of angle rotation and specific rotation.
- Understand the features of planar optical wave guide and obtain the Electric field components, Eigen value equations, phase and group velocities in a dielectric wave guide.
- Understand the fundamentals of propagation of electromagnetic waves through optical fibres and calculate numerical apertures for step and graded indices and transmission losses.

Understand coherence of light different types of lasers, its principle, properties of laser beam

- Understand the spontaneous and stimulated emission of radiation, optical pumping andpopulation inversion. Three level and four level lasers. Ruby laser and He-Ne laser indetails.

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ELECTROMAGNETIC THEORY;

COURSE CONTENT :

Generalization of ampere's law, displacement current, Maxwell's field equations, wave equation for electromagnetic field and its solution (plane and spherical wave), gauge invariance, transverse nature of field, Poynting vector and Poynting's theorem. Boundary conditions.Electromagnetic waves in isotropic dielectric medium; reflection and Refraction at plane boundary, reflection and transmission coefficients, Fresnel's formulae; change of phase on reflection, polarization on reflection and Brewster's law, total internal reflection. Electromagnetic waves in conducting medium; Maxwell's equation in homogeneous media, general wave equation, plane wave equations-harmonic wave solution, phase lag between electric and magnetic fields, exponential damping, skin depth, electrical and magnetic energy densities, their ratio; reflecting power of a metallic surface, wave guide. Equation of motion of an electron in a radiation field, Lorentz theory of dispersion (normal and anomalous), Sellmeier's and Cauchy's formulae; Scattering of radiation by a bound charge, Rayleigh scattering, absorption of light.

Learning outcomes of Electro Magnetic Theory :

After successful completion of this course, students will be able to: 1) Understand electric and magnetic fields in matter 2) Apply Maxwell's equations to various physical problems 3) Calculate EM wave propagation

- Achieve an understanding of the Maxwells equations, role of displacement current, gauge transformations, scalar and vector potentials, Coulomb and Lorentz gauge, boundary conditions at the interface between different media.
- Apply Maxwell's equations to deduce wave equation, electromagnetic field energy, momentum and angular momentum density.
- Analyse the phenomena of wave propagation in the unbounded, bounded, vacuum, dielectric, guided and unguided media.

・ Understand the laws of reflection and refraction and to calculate the reflection and transmission coefficients at plane interface in bounded media.

. Understand poynting theorem and its physical significance.
. Analyze Fresnel relations- Reflection (R) and Transmission (T) coefficients. Brewster's angle.
. Have an idea on skin depth , poynting vector and the concept of EM radiation of Inhomogeneous wave equation, harmonically oscillating source. Have an idea of the origin of dispersion and scattering phenomena.

Special Theory of Relativity;

COURSE CONTENT :

Velocity of light and it's measurement. Inertial frame, Gallilean principal of relativity, failure of principal in electrodynamics; aether drag hypothesis, aims and outcomes of Michelson – Morley experiment.Postulates of special theory of relativity, Lorentz transformation, length contraction, time dilation and simultaneity; velocity addition theorem, Relativistic Doppler effect.Variation of mass with velocity, form of relativistic momentum, force, kinetic energy; transformation relation for momentum, energy and force.Proper time and light cone; Minkowaski space; spacelike and timelike four vectors, causality.

LEARNING OUTCOME

STUDENT SHOULD BE ABLE TO

- Describe special relativistic effects and their effects on the mass and energy of a moving object.
- appreciate the nuances of Special Theory of Relativity (STR)

SOLID STATE PHYSICS;

COURSE CONTENT :

Different types of crystal structure, translational symmetry, lattice and basis, unit cell, reciprocal lattice, fundamental types of lattices, Miller indices, simple cubic, fcc and bcc lattices; Laue and Bragg equations, Determination of crystal structure by X-ray diffraction. Different types of bonding (ionic, covalent, metallic and van der Waals. Band theory of solid, energy band structure, electrons and holes, conductors, semiconductors and insulators; free electron theory of metals, effective mass, drift current, mobility, conductivity (electrical

and thermal), Wiedemann and Franz law, Hall effect, thermoelectricity, Seebeck, Peltier and Thomson effect, Thermoionic emission, Richardson equation, field emission.

DIELECTRIC PROPERTIES OF MATERIAL; Electronic, ionic and dipolar polarisability, local fields, induced and orientational polarization, molecular field in a dielectric, Clausius-Mosotti relation, ferroelectricity, piezoelectricity.

MAGNETIC PROPERTIES OF MATERIAL; Dia, para and ferromagnetism, Langevin's theory of diamagnetism, theory of paramagnetism, Curie's law; spontaneous magnetization and domain structure; Curie-Weiss law, hysteresis; ferri and antiferromagnetism.

LEARNING OUTCOME

On succcessful completion of course student will:

1. Understand different types of crystal structures in terms of the crystal lattice and the basis of constituent atoms.

2. Understand the theory of X-ray diffraction in the reciprocal lattice (k-space) formalism.

3. Apply the theory of lattice vibrations (phonons) to determine thermal properties of solids.

4. Study the problem of electrons in a periodic potential, examine its consequence on the band-structure of the solids.

5. Gain knowledge about the experimental techniques for crystal growth from solution and melt.

At the end of the course the student is expected to learn and assimilate the following.

- A brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, concept of Brillouin zones and diffraction of X-rays by crystalline materials.
- Knowledge of lattice vibrations, phonons and in depth of knowledge of Einstein and Debye theory of specific heat of solids.
- At knowledge of different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss.
- Secured an understanding about the dielectric and ferroelectric properties of materials.

- Understanding above the band theory of solids and must be able to differentiate insulators, conductors and semiconductors.
- Understand the basic idea about superconductors and their classifications.

Paper-IX Full Marks -70

Group-A: Atomic Physics
Group - B: Quantum Mechanics
Group - C: Nuclear and Elementary Particle Physics

ATOMIC PHYSICS;

COURSE CONTENT :

Structure of atom: Discovery of electron, Millikan's oil drop expt. And Thomson's expt., discovery of proton, Rutherford's experiment on the internal structure of atom, isobars, isotopes; mass spectrometers- Aston & Bainbridge and their use.

Atomic Spectra: Classical theory, Bohr- Sommerfeld atomic model and quantum condition, characteristics of atomic spectra, Balmar's formula, different spectral series and Rydberg constant. Hydrogen spectrum, excitation and ionization of atoms, Frank & Hertz expt., Stern-Gerlach expt and the intrinsic spin of the electron; magnetic moment of the electron; Lande g-factor, gyromagnetic ratio. Vectro atom model, space quantization; alkali spectra, screening effect, selection rules. Pauli exclusion principle; shell structure of the atom, the periodic table, X-ray (continuous and characteristic spectra); Mosley's law , Normal and anomalous Zeeman effect. Faraday effect, Stark effect and Kerr effect.

Learning outcome

This course will enable the student to get familiar with quantum mechanics formulation starting from Bohr model to Stern-Gerlach expt .
to have the idea of space quantization.

- Study of influence of electric and magnetic fields on atoms will help in understanding Stark effect and Zeeman Effect respectively.

・Syudy of vector atom model for many electron atomic system and their spectral analysis.

QUANTUM MECHANICS;

COURSE CONTENT :

Old quantum theory:Black body radiation, Photo-electric effect, Thomson scattering and Compton scattering , dual nature of light. Electron diffraction experiment.

Basic Quantum mechanics; de Broglie hypothesis; group velocity, phase velocity, particle velocity, Schroedingrt wave equation; equation of continuity, probabilistic interpretation of the wave function.Quantum number, Eigen function and eigen value, hermition operator, momentum energy and angular momentum operator. Expectation value, Bohr's correspondence and complementarity principles; Ehrenfest's theorem, stationary and non-stationary states.Commutation relation, Heisenberg's uncertainty principle (illustration and applications) Application of Schroedinger's equation to simple problems.(One dimensional potential well, potential barrier, free particle in a box, Linear Harmonic oscillator, Hydogen atom and diatomic molecules), Raman effect and it's application.

Learning Outcomes for Quantum Mechanics I.

> Students who completed this course should have a deep understanding of the mathematical foundations of quantum mechanics, and be able to solve the Schr¨odinger equation for simple configurations.

This course will enable the student to get familiar with quantum mechanics formulation.

・ Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and ability to discuss and interpret experiments that reveal the dual nature of matter.

・ Understand the theory of quantum measurements, wave packets and uncertainty principle.

・ After an exposition of inadequacies of classical mechanics in explaining microscopic phenomena, quantum theory formulation is introduced through Schrodinger equation.

- The interpretation of wave function of quantum particle and probabilistic nature of its location and subtler points of quantum phenomena are exposed to the student.
- Through understanding the behavior of quantum particle encountering a i) barrier, ii)potential, the student gets exposed to solving non-relativistic hydrogen atom, Linear harmonic oscillator for their spectrum and eigenfunctions.
- This basic course will form a firm basis to understand quantum many body problems.

NUCLEAR PHYSICS & ELEMENTARY PARTICLE;

COURSE CONTENT :

Gross properties of nuclei; Discovery of neutron, nuclear mass, charge, size, binding energy, iso-spin, nuclear spin and magnetic moment. Liquid drop model and Shell model of nuclei. Radioactivity, alpha decay, beta decay, gamma decay, Nuclear reaction, compound nucleus, artificial radioactivity, Nuclear fission and fusion. Discovery of different particles and their lifetimes and decay width.Four basic types of different natural interaction, quantum number, mass, spin, intrinsic parity, hypercharge and charge conjugation; conservation laws. Classification of elementary particles, Cosmic rays, Different types of accelerators, detectors and counters.

Learning Outcomes:

Students who completed this course should be able to

Explain external and internal properties of the **atomic** nucleus.
Describe basic models of the **atomic** nucleus.
Explain **nuclear** decays and radioactivity.
Evaluate radiation energy losses by passage through matter
Explain the origin of elementary particle and cosmic rays.

Explain how accelerators , partical & radiation detectors are work and be able to use them for research purpose.

Explain processes of **nuclear** collisions and **nuclear** reactions.

- Learn the basic aspects of nuclear reactions, the Q-value of such reaction and its derivation from conservation laws, The reaction cross-sections, the types of nuclear reactions, direct and compound nuclear reactions, Rutherford scattering by Coulomb potential.

- Learn some basic aspects of interaction of nuclear radiation with matter- interaction of gamma ray by photoelectric effect, Compton scattering and pair production, energy loss due to ionization, Cerenkov radiation.
- Learn about the detectors of nuclear radiations- the Geiger-Mueller counter, the scintillation counter, the photo-multiplier tube, the solid state and semiconductor detectors.
- The students are expected to learn about the principles and basic constructions of particle accelerators such as the Van-de-Graff generator, cyclotron, betatron and synchrotron. They should know about the accelerator facilities in India.
- Gain knowledge on the basic aspects of particle Physics the fundamental interactions, elementary and composite particles, the classifications of particles: leptons, hadrons (baryons and mesons), quarks, gauge bosons. The students should know about the quantum numbers of particles: energy, linear momentum, angular momentum, isospin, electric charge, colour charge, strangeness, lepton numbers, baryon number and the conservation laws associated with them.

Paper-x Full Marks -70
PRACTICAL

Adjustment of a Spectrometer by Schuster's method and to calibrate the spectrometer (D - λ curve) and hence to determine an unknown wavelength.

To draw the μ-λ curve for the material of a prism using a spectrometer and to find the dispersive power.

To determine the wavelength of a monochromatic light by Fresnel's bi-prism.

To determine the wavelength of a monochromatic light by Newton's ring method.

Measurement of the slit width and the separation between the slits of a double slit by observing the diffraction and interference fringes using spectrometer.

To find the number of lines per centimeter of a plane transmission grating and hence to measure the wavelength of an unknown spectral line and to determine the resolving power of the grating.

7. To calibrate a polarimeter and hence to determine the concentration of a given sugar solution.

8. To verify the Brewster's law and Fresnel formulae for reflection of electromagnetic waves with help of a spectrometer, a prism and two Polaroid sheets.

9. To study the diffraction pattern of a crossed grating with the help of a laser source.

(At least two laboratory classes should be devoted to explain the functions and use of spectrometer and polarimeter at the beginning).

Computer Training and Experiments.

Few laboratory classes to be allotted for Computer fundamentals and Programming in C.

Computer Fundamentals: Block diagram, CPU, Memory, I-O devices, software-hardware, concepts of operating system (OS)- DOS, WINDOWS/LYNUX.

Programming in C: Variables type, operators and expressions, if-else, else-if, switch, loops-while, for and do, break and continue, go to and labels; array- one and two-dimensional.

Student will write five programs in C and execute them on a computer.

Paper-XI Full Marks -70
PRACTICAL

Paper – XI

One experiment to be performed during the B.Sc. Part-II Practical Examination in Paper XI. (Distribution of Marks: LNB-5; Viva-20; Experiment- 40).

1. To verify Thevenin's theorem, Norton's theorem and maximum power transfer theorem using a resistive Wheatstone's bridge with a DC source.

2. (a) To draw the I-V characteristics of a p-n junction diode.

   (b) To draw the forward and reverse bias characteristics of a zener diode and to study its voltage regulation characteristics relating to the variation of load current, variation of line voltage and ripple.

3. To draw the characteristics of a bipolar junction transistor (BJT) in CE and CB modes and to find its parameters α and β.

4. To measure the hybrid parameters and leakage current of a transistor using an AC source.

5. To construct a single stage voltage amplifier using a transistor in CE mode on a breadboard and to measure its voltage gain, bandwidth, input and output impedances form the study of frequency response curve.

6. To construct an emitter follower on a breadboard using a BJT and to study its voltage gain, bandwidth, input and output impedances.

7. To construct a regulated power supply on a breadboard using feedback and a zener diode for voltage regulation and to study its characteristics.

8. To study the input offset voltage, input bias current, input offset current of an OPAMP and use it as an (a) inverting and no inverting amplifier, (b) differential amplifier (c) integrator and (d) differentiator.

9. To construct a Wien bridge oscillator using OPAMP and to study the waveform of the oscillator and calibrate it using a CRO.

10. (a) To construct the OR, AND and NOT gates using discrete components and verify the truth tables using them.

    (b) To verify the truth tables of NOR, NAND and Ex-OR gates using IC gates.

    (c) To verify that the NOR and NAND gates are universal gates

    (d) To Verify De Morgan's theorem using IC gates.

11. To study the Fourier spectrum of (a) a square wave, (b) a saw tooth wave and (c) a half sinusoidal wave with the help of CRO.

12. To study the 8085 microprocessor

LEARNING OUTCOMES FOR UG-CBCS PROGRAMME

B.Sc. (PHYSICS)

CC-I: MATHEMATICAL PHYSICS-I

(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

• Revise the knowledge of calculus, vectors, vector calculus, probability and probability distributions. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.

• Learn the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.

•Learn the Dirac delta function its properties, which have applications in various branches of Physics, especially quantum mechanics.

•In the laboratory course, learn the fundamentals of the computer basics and programming in python languages and their applications in solving simple physical problems involving interpolations, differentiations, integrations, differential equations as well as finding the roots of equations.

(ii) Broad contents of the course:

- Calculus
- Vector Calculus
- Orthogonal Curvilinear Coordinates
- Dirac Delta function and its properties
- Introductory theory of probability

iii) Skills to be learned

- Training in calculus will prepare the student to solve various mathematical problems.
- He / she shall develop an understanding of how to formulate a physics problem and
- solve given mathematical equation risen out of it.

CC2-: MECHANICS (Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

After going through the course, the student should be able to

• Understand laws of motion and their application to various dynamical situations, notion• of inertial frames and concept of Galilean invariance. He / she will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.

- Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.

- Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.
- Understand the phenomena of collisions and idea about center of mass and laboratory• frames and their correlation.
- Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.
- Understand simple principles of fluid flow and the equations governing fluid dynamics.
- Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation.
- Explain the phenomena of simple harmonic motion and the properties of systems• executing such motions.
- Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in• a merry-go-round experiences an outward pull.
- Describe special relativistic effects and their effects on the mass and energy of a moving object.
- appreciate the nuances of Special Theory of Relativity (STR)

In the laboratory course, the student shall perform experiments related to mechanics (compound pendulum),determination of "g" by various method, rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (Poiseuille`s formula varification Searle method) etc.

(ii) Broad contents of the course:

•Fundamental of Dynamics• Work and Energy• Collisions• Rotational Dynamics• Elasticity• Fluid Motion• Gravitation and cathode force Motion• Oscillation• Non-inertial Systems• Special Theory of Relativity.

(iii) Skills to be learned

Learn basics of the kinematics and dynamics linear and rotational motion.• Learn the concepts of elastic in constant of solids and viscosity of fluids.• Develop skills to understand and solve the equations of Newtonian Gravity and central• force problem. Acquire basic knowledge of oscillation.• Learn about inertial and non-inertial systems and essentials of special theory of• relativity.

CC3: ELECTRCITY AND MAGNETISM
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

After going through the course, the student should be able to

- Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of• point charges as well as line, surface, and volume distributions of charges.

- Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric• potential, electric potential energy) formalisms of electrostatics.

- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electric• field and electric potential.

- Demonstrate a working understanding of capacitors.

- Describe the magnetic field produced by magnetic dipoles and electric currents.

- Describe how magnetism is produced and list examples where its effects are observed.
- Understand different law related to Magnetic field and current.

- Understand the dielectric properties, magnetic properties of materials and the phenomena of electromagnetic induction.

- Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
- Understand how phenomenon in electricity and magnetism are describe by mathmatical equation known as Maxwell`s equation.

- Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series• combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.

- Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,• Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.

- In the laboratory course the student will get an opportunity to verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments.
- Should be able to verify of various circuit laws, network theorems elaborated above,• using simple electric circuits.

(ii) Broad contents of the course

•Electric Field and Electric Potential• Conservative nature of Electrostatic Field• Electrostatic energy of system of charges• Dielectric Properties of Matter• Magnetic Field• Magnetic Properties of Matter• Electromagnetic Induction• Electrical Circuits• Network Theorems.

(iii) Skills to be learned

This course will help in understanding basic concepts of electricity and magnetism and• their applications. Basic course in electrostatics will equips the student with required prerequisites to• understand electrodynamics phenomena.

CC4-: WAVES AND OPTICS
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

This course will enable the student to

- Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems.
- Apply basic knowledge of principles and theories about the behaviour of light and the physical environment to conduct experiments.
- Understand the principle of superposition of waves, so thus describe the formation of standing waves.
- Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.
- Use the principles of wave motion and superposition to explain the Physics of interference diffraction and polarization.
- Understand the working of selected optical instruments like biprism, interferometer,• diffraction grating, and holograms.

• **In the laboratory course,** student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt firsthand. The motion of coupled oscillators, study of Lissajous figures and behaviour of transverse, longitudinal waves can be learnt in this laboratory course.

(ii) Broad contents of the course

Superposition of Two Collinear Harmonic Oscillations

- Superposition of Two Perpendicular Harmonic Oscillations
- Waves Motion – General
- Velocity of Waves
- Superposition of Two Harmonics Waves
- Wave Optics
- Interference
- Michelson's Interferometer
- Diffraction
- Fraunhofer Diffraction
- Fresnel Diffraction
- Holography

(iii) Skills to be learned

•He / she shall develop an understanding of various aspects of harmonic oscillations and• waves specially.

(i) Superposition of collinear and perpendicular harmonic oscillations.

(ii) Various types of mechanical waves and their superposition.

• This course in basics of optics will enable the student to understand various optical• phenomena, principles, workings and applications optical instruments.

CC5: MATHEMATICAL PHYSICS-II
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

- Learn the Fourier analysis of periodic functions and their applications in physical problems such as vibrating strings etc.

- Learn about the complex representation of Fourier series and expansion of even odd & non-periodic functions and their application
- Learn about the differentiation and integration of Fourier Series.
- Learn about the special functions, such as the Hermite polynomial, the Legendre polynomial, the Laguerre polynomial and Bessel functions and their differential equations and their applications in various physical problems such as in quantum mechanics which they will learn in future courses in detail.
- Learn the beta, gamma and the error functions and their applications in doing integrations.
- Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics.

- Understand basic principal related to extremization of action in mechanics and also Cyclic coordinates and conservation theories.

- Solve the equations of motion for simple mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.
- Understand Legendre transform and canonical equation of motion.

- In the laboratory course, learn the basics of the Scilab software, their utility, advantages• and disadvantages. Apply the Scilab software in curve fittings, in solving system of linear equations,• generating and plotting special functions such as Legendre polynomial and Bessel functions, solving first and second order ordinary and partial differential equations.

(ii) Broad contents of the course:
- Fourier Series
- Frobenius Method and Special Functions
- Special Integrals• Partial Differential Equation
- Variational Calculus in Physics

(iii) Skills to be learned

- **Training in mathematical tools like calculus, integration, series solution approach , special function will prepare the student to solve ODE, PDE's which model physical phenomena.**
- **He / she shall develop an understanding of how to model a given physical phenomena such as pendulum motion, rocket motion, stretched string, etc., into set of ODE's, PDE's and solve them.**
- **These skills will help in understanding the behavior of the modeled system/s.**
- **They also become efficient in doing calculations with the 'calculus of variation'.**

CC6: THERMAL PHYSICS
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

- Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.
- Learn about Maxwell's thermodynamic relations.

- Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.

- Learn about the real gas equations, Van der Waal equation of state, the Joule-Thompson effect.

- In the laboratory course, the students are expected to do some basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity, temperature coefficient of resistant, variation of thermo-emf of a thermocouple with temperature difference at its two junctions and calibration of a thermocouple.

(ii) Broad contents of the course:

- Zeroth and First Law of Thermodynamics
- Second Law of Thermodynamics
- Entropy
- Thermodynamic Potentials
- Maxwell's Thermodynamic Relations
- Kinetic Theory of Gases :
  Distribution of Velocities
  Molecular Collisions
  Real Gases

(iii) Skills to be learned

- This basic course in thermodynamics will enable the student to understand various thermo dynamical concepts, principles.

CC7: DIGITAL SYSTEMS AND APPLICATIONS (Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

As the successful completion of the course the student is expected to be conversant with the following.

- Secure first-hand idea of different components including both active and passive components to gain a insight into circuits using discrete components and also to learn about integrated circuits.
- About analog systems and digital systems and their differences, fundamental logic gates, combinational as well as sequential and number systems.
- Synthesis of Boolean functions, simplification and construction of digital circuits Such as combinational logic circuit like Arithmetic circuit, Data processing circuit etc by employing Boolean algebra.

Gain knowledge and evaluate the Boolean expressions, combinational logic circuits and simplifications using karnaugh maps.

Analyze the operation of decoders, encoders, multiplexers, adders and subtractors.

Understand the working of latches, flip-flops, designing registers, counters, a/d and d/a converters.

Design and Analyze synchronous and asynchronous sequential circuits.

- Sequential systems by choosing FlipFlop as a building bock- construct multivibrators, counters to provide a basic idea about memory including RAM,ROM and also about memory organization addressing and interfacing.

・ In the laboratory he is expected to construct both combinational circuits and sequential circuits by employing NAND as building blocks and demonstrate Adders, Subtractors, Shift Registers, and multivibrators using 555 ICs.

(ii) Broad contents of the course:

・ Active and passive filters
・ Fundamental logic gates, combinational as well as sequential and number systems.
・ Synthesis of Boolean functions, simplification and construction of digital circuits by employing Boolean algebra.
・ Sequential systems by choosing Flip Flop as a building bock- construct multivibrators, counters to provide a basic idea about memory including RAM,ROM and also about memory organization. Memory addressing and interfacing.

(iii) Skills to be learned

・ Learn the basics of IC and digital circuits, familiear with transistor diode and difference between analog and digital circuits.
・Varification of Various logic GATES and their realization using diodes and transistor and NAND gates.
・ Learn fundamental of Bolean algebra and their role in constructing digital circuits.
・ Learn about combinatorial and sequential systems by building block circuits to construct multivibrators and counters.

CC8: MATHEMATICAL PHYSICS-III (Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

- Learn about the complex numbers and their properties, functions of complex numbers and their properties such as analyticity, poles and residues. The students are expected to learn the residue theorem and its applications in evaluating definite integrals.

- Learn about the Fourier transform, the inverse Fourier transform, their properties and their applications in physical problems. They are also expected to learn the Laplace transform, the inverse Laplace transforms, their properties and their applications in solving physical problems.
- Learn the basic properties of matrices, different types of matrices viz., Hermitian, skew Hermitian, orthogonal and unitary matrices and their correspondence to physical quantities, e.g, operators in quantum mechanics. They should also learn how to find the eigenvalues and eigenvectors of matrices.

・ In the laboratory course, the students should apply their C++/Scilab programming language to solve the following problems:

(i) Solution first- and second- order ordinary differential equations with appropriate boundary conditions,
(ii) Evaluation of the Gaussian integrals,
(iii) Evaluation of a converging infinite series up to a desired accuracy,
(iv) Evaluation of the Fourier coefficients of a given periodic function,
(v) Plotting the Legendre polynomials and the Bessel functions of different orders and interpretations of the results,
(vi) Least square fit of a given data to a graph,
(vii) Computing nth root ogf unity for n=2,3 and 4,
(viii) Finding two square root of a complex number,
(ix) FFT of e^{-x2}

(ii) Broad contents of the course:

- Complex Analysis
- Integrals Transforms
- Matrices
- Eigen values and eigen vectors.

(iii) Skills to be learned

- Knowledge of various mathematical tools like complex analysis, integral transform and matrices will

equip the student with reference to solve a given ODE, PDE.

- These skills will help in understanding the behavior of the modeled system/s.

CC9: ELEMENTS OF MODERN PHYSICS (Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

- Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and ability to discuss and interpret experiments that reveal the dual nature of matter.
- Understand the theory of quantum measurements, wave packets and uncertainty principle.
- Understand the central concepts of quantum mechanics: wave functions, momentum and energy operator, the Schrodinger equation, time dependent and time independent cases, probability density and the normalization techniques, skill development on problem solving e.g. one dimensional rigid box, tunneling through potential barrier, step potential, rectangular barrier.
- Understanding the properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
- Ability to calculate the decay rates and lifetime of radioactive decays like alpha, beta, gamma decay. Neutrinos and its properties and role in theory of beta decay.
- Understand fission and fusion well as nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.
- Understand various interactions of electromagnetic radiation with matter. Electron

positron pair creation.

- Understand the spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in details. Basic lasing.

- **In the laboratory course, the students will get opportunity to perform the following experiments**

- Measurement of Planck's constant by more than one method.
- Verification of the photoelectric effect and determination of the work Function of a metal.
- Determination of the charge of electron and e/m of electron.
- Determination of the ionization potential of mercury atoms.
- Determine the wavelength of the H-α emission lines in the spectrum of Hydrogen atom.
- Determine the absorption lines in the rotational spectrum of molecules.
- Determine the wavelength of Laser sources by single and Double slit experiments
- Determine the wavelength and angular spread of He-Ne Laser using plane diffraction grating.
- To setup the Millikan oil drop apparatus and determine the charge of an electron.
- To show the tunneling effect in tunneling diode using I-V characteristics.

(ii) Broad contents of the course:

- One dimensional potential problem of bound states and scattering.
- Elementary introduction of nuclear physics with emphasis on
  - (i) Nuclear Structure
  - (ii) Nuclear Forces
  - (iii) Nuclear Decays
  - (iv) Fission and Fusion
- Introduction to Lasers.

(iii) Skills to be learned

- Comprehend the failure of classical physics and need for quantum physics.
- Grasp the basic foundation of various experiments establishing the quantum physics by doing the experiments in laboratory and interpreting them.
- Formulate the basic theoretical problems in one, two and three dimensional physics and solve them.
- Learning to apply the basic skills developed in quantum physics to various problems in
  - (i) Nuclear Physics
  - (ii) Atomic Physics
  - (iii)Laser Physics
- Learn to apply basic quantum physics to Ruby Laser, He-Ne Laser

CC10: ANALOG SYSTEMS AND APPLICATIONS (Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

At the end of the course the student is expected to assimilate the following and possesses basic knowledge of the following.

- N- and P- type semiconductors, mobility, drift velocity, fabrication of P-N junctions; forward and reverse biased junctions.
- Application of PN junction for different type of rectifiers and voltage regulators.
- NPN and PNP transistors and basic configurations namely common base, common emitter and common collector, and also about current and voltage gain, Field effect transistors.
- Biasing and equivalent circuits, Gain and input/output impedances of amplifiers, coupled amplifiers and feedback in amplifiers, and oscillators.
- Characteristics of Operational amplifiers and knowledge about different configurations namely inverting and non-inverting and applications of operational amplifiers in D to A and A to D conversions, integrator, differentiator, comperators oscillator and Schmidt triggers.

• In the laboratory students are expected to

- To characterize various devices namely PN junction diodes, LEDs, Zener diode, solar cells, PNP and NPN transistors.
- Design and construct amplifiers and oscillators using discrete components. Demonstrate gain and frequency response of inverting and non-inverting amplifiers using op-amps.
- Determine of the value of capacitance of capacitor using OP Amp as integrator and differentiator.

(ii) Broad contents of the course

- N- and P- type semiconductors,
- Fabrication of p-n junctions; forward and reverse biased junctions.
- Application of P N junction
- Rectifiers and voltage regulators.
- NPN and PNP transistors and
- Common base, common emitter and common collector and their application

- Current and voltage gain Input impedance and Output impedance of amplifiers.
- Biasing and equivalent circuits ,
- Coupled amplifiers and feedback in amplifiers and oscillators.
- Operational amplifiers and its applications in linear and non-linear circuits.

(iii) Skills to be learned

- Learn basic concepts of semiconductor diodes and their applications to rectifiers and regulators.
- Learn about junction transistor and their applications.
- Learn about biasing desiging of BJT and BJT amplifiers.
- Learn about gain and frequency response of different types of amplifiers including operational amplifier and their applications.
- Learn about sinusoidal oscillators of various types and A/D conversion.

CC11: QUANTUM MECHANICS
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

This course will enable the student to get familiar with quantum mechanics formulation.

- After an exposition of inadequacies of classical mechanics in explaining microscopic phenomena, quantum theory formulation is introduced through Schrodinger equation.
- The interpretation of wave function of quantum particle and probabilistic nature of its location and subtler points of quantum phenomena are exposed to the student.
- Through understanding the behavior of quantum particle encountering a i) barrier, ii) potential, the student gets exposed to solving non-relativistic hydrogen atom, for its spectrum and eigenfunctions.
- Study of influence of electric and magnetic fields on atoms will help in understanding Stark effect and Zeeman Effect respectively.
- Syudy of vector atom model for many electron atomic system and their spectral analysis.

- The experiments using Sci-lab will enable the student to appreciate nuances involved in the theory.
- This basic course will form a firm basis to understand quantum many body problems.
- In the laboratory course, with the exposure in computational programming in the computer lab, the student will be in a position to solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical onedimensional and three dimensional potentials.

(ii) Broad contents of the course:

- Time dependent Schrodinger equation
- Time independent Schrodinger equation
- General discussion of bound states in an arbitrary potential
- Quantum Theory of hydrogen-like atoms
- Atoms in Electric and Magnetic Fields
- Atoms in External Magnetic Fields
- Many electron atoms.

(iii) Skills to be learned

- This course shall develop an understanding of how to model a given problem such as particle in a box, hydrogen atom, hydrogen atom in electric fields.

- Many electron atoms, L-S and J-J couplings.
- These skills will help in understanding the different Quantum Systems in atomic and nuclear physics.

CC12: SOLID STATE PHYSICS
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

At the end of the course the student is expected to learn and assimilate the following.

- A brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, concept of Brillouin zones and diffraction of X-rays by crystalline materials.
- Knowledge of lattice vibrations, phonons and in depth of knowledge of Einstein and Debye theory of specific heat of solids.
- At knowledge of different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss.
- Secured an understanding about the dielectric and ferroelectric properties of materials.
- Understanding above the band theory of solids and must be able to differentiate insulators, conductors and semiconductors.
- Understand the basic idea about superconductors and their classifications.

- **To carry out experiments** based on the theory that they have learned to measure the magnetic susceptibility, dielectric constant, trace hysteresis loop. They will also employ to four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.

(ii) Broad contents of the course:

- Crystalline and amorphous substances, lattice, unit cell, miller indices, reciprocal lattice. Brillouin zones and diffraction of X-rays by crystalline materials.
- Lattice vibrations and phonons
- Different types of magnetism
- Dielectric and ferroelectric materials.
- Band theory of solids
- Insulators, conductors and semiconductors.
- Superconductors and their classifications.

(iii) Skills to be learned

- Learn basics of crystal structure and physics of lattice dynamics
- Learn the physics of different types of material like magnetic materials, dielectric materials, metals and their properties.
- Understand the physics of insulators, semiconductor and conductors with special emphasis on the elementary band theory of semiconductors.
- Comprehend the basic theory of superconductors. Type I and II superconductors, their properties and physical concept of BCS theory.

CC13: ELECTROMAGNETIC THEORY (Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

- Achieve an understanding of the Maxwells equations, role of displacement current, gauge transformations, scalar and vector potentials, Coulomb and Lorentz gauge, boundary conditions at the interface between different media.
- Apply Maxwell's equations to deduce wave equation, electromagnetic field energy, momentum and angular momentum density.
- Analyse the phenomena of wave propagation in the unbounded, bounded, vacuum, dielectric, guided and unguided media.
- Understand the laws of reflection and refraction and to calculate the reflection and transmission coefficients at plane interface in bounded media.
- Understand the linear, circular and elliptical polarisations of em waves. Production as well as detection of waves in laboratory.
- Understand propagation of em waves in anisotropic media, uni-axial and biaxial crystals phase retardation plates and their uses.
- Understand the concept of optical rotation, theories of optical rotation and their experimental rotation, calculation of angle rotation and specific rotation.
- Understand the features of planar optical wave guide and obtain the Electric field components, Eigen value equations, phase and group velocities in a dielectric wave guide.
- Understand the fundamentals of propagation of electromagnetic waves through optical fibres and calculate numerical apertures for step and graded indices and transmission losses.

- In the laboratory course, the student gets an opportunity to perform experiments Demonstrating principles of
- Interference, Refraction and diffraction of light using monochromatic sources of light. Demonstrate interference, Refraction and Diffraction using microwaves.
- Determine the refractive index of glass and liquid using total internal reflection of light.
- Verify the laws of Polarisation for plane polarised light.
- Determine Polarisation of light by Reflection and determine the polarization angle off or air-glass surface
- Determine the wavelength and velocity of Ultrasonic waves in liquids using diffraction.
- Study specific rotation of sugar using Polarimeter.
- Analyze experimentally the Elliptically Polarised light using Babinet's Compensator
- Study Experimentally the angle dependence of radiation for a simple dipole antenna
- Verify the Stefan's law of radiationand to determine Stefan's constant.
- Determine the Boltzman constant using V-I characteristics of PN junction.

(ii) Broad contents of the course:

- Review of Maxwell's equations
- EM wave propagation in unbounded media of various types
- EM wave propagation in bounded media separated by two types of media
- Polarization of electromagnetic waves

- Wave guides
- Optical fibres

(iii) Skills to be learned

- Comprehend the role of Maxwell's equation in unifying electricity and magnetism.
- Derive expression for

(i) Energy density
(ii) Momentum density
(iii) Angular momentum density of the electromagnetic field

- Learn the implications of Gauge invariance in EM theory in solving the wave equations and develop the skills to actually solve the wave equation in various media like

(i) Vacuum
(ii) Dielectric medium
(iii) Conducting medium
(iv) Dilute plasma

- Derive and understand associated with the properties, EM wave passing through the interface between two media like

(i) Reflection
(ii) Refraction
(iii) Transmission
(iv) EM waves

- Learn the basic physics associated with the polarization of electromagnetic waves by doing various experiments for:

(i) Plane polarized light
(ii) Circularly polarized light
(iii) Circularly polarized light

- Learn the application of EM theory to

(i) Wave guides of various types
(ii) Optical fibers in theory and experiment

CC14: STATISTICAL MECHANICS
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

- Understand the concepts of microstate, macrostate, ensemble, phase space, thermodynamic probability and partition function.
- Understand the combinatoric studies of particles with their distinguishably or indistinguishably nature and conditions which lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation.
- Comprehend and articulate the connection as well as dichotomy between classical statistical mechanics and quantum statistical mechanics.
- Learn to apply the classical statistical mechanics to derive the law of equipartition of energy and specific heat.
- Understand the Gibbs paradox, equipartition of energy and concept of negative temperature in two level system.
- Learn to derive classical radiation laws of black body radiation. Wiens law, Rayleigh Jeans law, ultraviolet catastrophe. Saha ionization formula.
- Learn to calculate the macroscopic properties of degenerate photon gas using BE distribution law, understand Bose-Einstein condensation law and liquid Helium. Bose derivation of Plank's law
- Understand the concept of Fermi energy and Fermi level, calculate the macroscopic properties of completely and strongly degenerate Fermi gas, electronic contribution to specific heat of metals.
- Understand the application of F-D statistical distribution law to derive thermodynamic functions of a degenerate Fermi gas, electron gas in metals and their properties.
- Calculate electron degeneracy pressure and ability to understand the Chandrasekhar mass limit, stability of white dwarfs against gravitational collapse.

- In the laboratory course, the students gets an opportunity to verify Stefan's Law of radiation and determine Stefan's constant.
- Design and perform some experiments to determine Boltzmann' Constant.
- Use Computer simulations to study:

i. Planck's Black Body radiation Law and compare with the Wien's Law and Raleigh - Jean's Law in appropriate temperature region.
ii. Specific Heat of Solids by comparing, Dulong-Petit, Einstein's and Debye's Laws and study their temperature dependence

- Compare the following distributions as a function of temperature for various energies and the parameters of the distribution functions:

i. Maxwell-Boltzmann distribution
ii. Bose-Einstein distribution
iii. Fermi-Dirac distribution

- Do 3-5 assignments given by the course instructor to apply the methods of Statistical mechanics to simple problems in Solid State Physics and Astrophysics
- Do the regular weekly assignments of at least 2-3 problems given by the course instructor.

(ii) Broad contents of the course:

- Classical Statistics
- Classical Theory of Radiation
- Quantum Theory of Radiation
- Bose-Einstein Statistics and its Applications
- Fermi-Dirac Statistics and its Applications.

(iii) Skills to be learned

・ Learn the basic concepts and definition of physical quantities in classical statistics and classical distribution law.
・ Learn the application of classical statistics to theory of radiation.
・ Comprehend the failure of classical statistics and need for quantum statistics.
・ Learn the application of quantum statistics to derive and understand.
1. Bose Einstein statistics and its applications to radiation.
2. Ferm-Dirac statistic and its applications to quantum systems

DSE-I: ADVANCED MATHEMATICAL PHYSICS-I
(Credits: 06, Theory-04, Practicals-02)

(i) Course learning outcome:

- They are expected to learn the Laplace transform, the inverse Laplace transforms, their properties and their applications in solving physical problems.
- Learn the basic properties of the linear vector space such as linear dependence and independence of vectors, change of basis, isomorphism and homomorphism, linear transformations and their representation by matrices.
- Learn some basic properties tensors, their symmetric and antisymmetric nature, the Cartesian tensors, the general tensors, contravariant, covariant and mixed tensors and their transformation properties under coordinate transformations, physical examples of tensors such as moment of inertia tensor, energy momentum tensor, stress tensor, strain tensor etc.

・ In the laboratory course, the students are expected to solve the following problems using the Scilab/C++ computer language:
(i) Multiplication of two 3×3 matrices,
(ii) Diagonalization of a matrix,
(iii) Inverse of a matrix,
(iv) Solutions of differential equations satisfied by different orthogonal polynomials and special function,
(v) Determination of wave functions for stationary states as eigenfunctions of Hermitian differential operators and also the energy eigenvalues,
(vi) Lagrange formulation in classical mechanics with constrains.
(vii) Study of geodesics in Euclidean and other space (surface of a sphere, etc)
(viii) Estimation of ground state energy and wave function of a quantum system.

(ii) Broad contents of the course:

・ Laplace transform
・ Linear Vector Spaces
・ Cartesian Tensors
・ General Tensors

(iii) Skills to be learned

- In this course, the students should learn the skills of doing calculations with the laplace transform, linear vector space, matrices, their eigenvalues and eigenvectors, tensors, real and complex fields, linear and multilinear transformations in various physical situations, e.g., the Lorentz transformations etc.
- In the laboratory course, the students should acquire the skills of applying the the C++/ SCILAB/MATLAB/MATHEMATICA software in solving standard physical problems

DSE2: CLASSICAL DYNAMICS
(Credits: 06)

(i) Course learning outcome:

- Revise the knowledge of the Newtonian, the Lagrangian and the Hamiltonian formulations of classical mechanics and their applications in appropriate physical problems.
- Formulate the problem of small amplitude oscillation and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems.
- Recapitulate and learn the special theory of relativity- postulates of the special theory of relativity, Lorentz transformations on space-time and other four vectors, four-vector notations, space-time invariant length, length contraction, time dilation, mass-energy relation, Doppler effect, light cone and its significance, problems involving energy momentum conservations.
- Learn the basics of fluid dynamics, streamline and turbulent flow, Reynolds's number, coefficient of viscosity and Poiseuille's equation.

(ii) Broad contents of the course:

- Classical mechanics of point particles.
- Lagrangian and Hamiltonians of simple systems and derivations of equation of motion.
- Small amplitude oscillations
- Special theory of relativity
- Relativistic kinematics of one and two particle system.
- Basics of fluid dynamics

(iii) Skills to be learned

- Learn to define generalised coordinates, generalised velocities, generalised force and write Lagrangian for mechanical system in terms of generalised coordinates.
- Learn to derive Euler-Lagrange equation of motion and solve them for symmetrical top motion.

- Learn to write Hamiltonian for mechanical systems and derive and solve Hamilton's equation of motion for simple mechanical systems.
- Formulate the problem of small amplitude oscillation and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems.
- Develop the basic concepts of special theory of relativity and its applications to dynamical systems of particles.
- Develop the methods of relativistic kinematics of one and two particle system and its application to two particle decay and scattering.
- Develop and understand the basic concepts of fluid dynamics and its applications to

simple problems in liquid flow.

DSE3: ADVANCED MATHEMATICAL PHYSICS-II
(Credits: 06)

(i) Course learning outcome:

After the successful completion of the course, the students shall be able to

- Understand variational principle and apply it to calculate:
  Euler Lagrange Equation and apply it to symmetrical top motion
- Acquire basic concept of symmetry and conservation law in classical mechanics to formulate Hamiltonian, Hamilton's principle and Hamiltonian equation of motion, Poisson and Lagrange brackets.
- Learn elementary group theory, i.e., definition and properties of groups, subgroups, Homomorphism, isomorphism, normal and conjugate groups, representation of groups, Reducible and Irreducible groups. Examples and exercises.
- Learn the theory of probability, Random varialbles and probability distributions, Expectation values and variance. Various examples of probability distributions used in physics. The principle of least squares.

(ii) Broad contents of the course:

- Calculus of variations and Euler's equation of motion of symmetrical top motion.
- Lagrangian and Hamiltonian equations of motion. Canonical variables. Legendre transformation, Poisson and Lagrange brackets and their properties.
- Elements of Group Theory.
- Theory of Probability and Probability Distributions.

(iii) Skills to be learned

- Ability to learn variational principle and do simple application to one, two and three dimensions.
- Ability to derive Euler equations of motion and apply it to symmetrical top motion.
- Learn basics of group theory
- Learn the basics of the theory of probability and ability to calculate probability in simple problems.
- Derive various probability distributions and their application to different types of physical problems.
- Learn the principle of least squares and apply it to some cases of analyzing physical experiments.

DSE4: NUCLEAR & PARTICLE PHYSICS

(Credits: 06)

(i) Course learning outcome:

・ Learn the ground state properties of a nucleus – the constituents and their properties, mass number and atomic number, relation between the mass number and the radius and the mass number, average density, range of force, saturation property, stability curve, the concepts of packing fraction and binding energy, binding energy per nucleon vs. mass number graph, explanation of fusion and fission from the nature of the binding energy graph.

・ Know about the nuclear models and their roles in explaining the ground state properties of the nucleus –(i) the liquid drop model, its justification so far as the nuclear properties are concerned, the semi-empirical mass formula, (ii) the shell model, evidence of shell structure, magic numbers, predictions of ground state spin and parity, theoretical deduction of the shell structure, consistency of the shell structure with the Pauli exclusion principles.

・ Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays, the properties of the constituents of these rays and the mechanisms of the emissions of these rays, outlines of Gamow's theory of alpha decay and Pauli's theory of beta decay with the neutrino hypothesis, the electron capture, the fine structure of alpha particle spectrum, the Geiger-Nuttall law, the radioactive series.

・ Learn the basic aspects of nuclear reactions, the Q-value of such reaction and its derivation from conservation laws, The reaction cross-sections, the types of nuclear reactions, direct and compound nuclear reactions, Rutherford scattering by Coulomb potential.

・ Learn some basic aspects of interaction of nuclear radiation with matter- interaction of gamma ray by photoelectric effect, Compton scattering and pair production, energy loss due to ionization, Cerenkov radiation.

・ Learn about the detectors of nuclear radiations- the Geiger-Mueller counter, the scintillation counter, the photo-multiplier tube, the solid state and semiconductor detectors.

・ The students are expected to learn about the principles and basic constructions of particle accelerators such as the Van-de-Graff generator, cyclotron, betatron and synchrotron. They should know about the accelerator facilities in India.

・ Gain knowledge on the basic aspects of particle Physics the fundamental interactions, elementary and composite particles, the classifications of particles: leptons, hadrons (baryons and mesons), quarks, gauge bosons. The students should know about the quantum numbers of particles: energy, linear momentum, angular momentum, isospin, electric charge, colour charge, strangeness, lepton numbers, baryon number and the conservation laws associated with them.

(ii) Broad contents of the course:

・ General properties of nuclei
・ Nuclear models
・ Radioactive decays
・ Nuclear reactions
・ Interaction of nuclear radiation with matter
・ Detectors for nuclear interaction
・ Particle accelerators
・ Elementary particles and their properties

(iii) Skills to be learned

・ Skills to describe and explain the properties of nuclei and derive them from various models of nuclear structure.

・ To understand, explain and derive the various theoretical formulation of nuclear disintegration like α decay, β decay and ・ decays.

・ Develop basic understanding of nuclear reactions and decays with help of theoretical formulate and laboratory experiments.

・ Skills to develop basic understanding of the interaction of various nuclear radiation with matter in low and high energy …….

Course Outcomes
of
Annual 1+1+1 System

Session 2018-19:
English (Hons.)
Part - I
Paper –I: History of English language initiates the students of literature to the origin and development of it that enlivens the journey of this language, gaining steam and sustenance out of the influences of so many other European languages. While tracing this trajectory, the course material enjoins the old English period with the age of the internet.
This paper also entails the history of Old and Middle English literature marked by references made to heroic poetry, Christian poetry, beginning of prose and drama etc. And also shows the evolution of different literary genres with reference to tragedy, comedy, the lyrics and its variants.
The inclusion of the rhetoric and prosody sections explore and establish the subtle nuances of English language and how that shapes the body of literature by adding colour and gaiety.
Paper- II: The European Renaissance marked the epistemological break with the past and emerged with tremendous power and energy to influence the world of literature in general and laid its imprints on the arena of English literature in particular. A profound mapping of the most productive Elizabethan age literary figures like Spenser, Sidney, Drayton followed by the Metaphysical school of poetry and specific contribution of Shakespeare, Marlowe and Kyd in the field of drama enamours the students of English literature to keep abreast with the fast pace of changing literary trends.
Part - II
Paper – III: A discourse on Restoration and the Eighteenth century English literature documents both epical and satirical expositions of two different mindsets. Journeys and colonial expansions characterize this era. This was the time of geographical explorations which later led to empire-building. Poetry moved with Milton, Pope, Gray. Novel saw the exponents like Defoe, Fielding, Congreve and Swift. And this age of reason inter alia the age of decadence was qualified by the emergence of new strains of drama t the hands of Goldsmith, Sheridan, Otway et al.
Paper- IV: This paper leads the students to the imaginary of the Romantic literature beginning with the French revolution. The Romantic aesthetics of the poets like Blake, Wordsworth, Coleridge, Byron, Shelley and Keats; the imaginative prose of Lamb and Hazlitt; and the emergence of women novelists like Austen et al.

Part – III
Paper – V: This paper introduces the students to the world of Victorian literature as a product of Industrial revolution, and the proven prime mover of contextual markers like colonialism and Imperialism and shaped by the contradictory hegemonic sways of science and religion. The romantic revival in the poetic afflatus of such giants like Tennyson, Browning, Arnold and Rossetti and the realistic take on life and society in the novels of Dickens and Hardy remained the precursor of the modernist trends in English literature.
It also strengthens the analytical interpretations of literary texts by providing the theoretical tools of Structuralism, post- structuralism, Feminism and Post-Colonialism, leading to the enigmatic age of modernist literature.

Paper – VI: This important paper ushers in the twentieth century literature as it swells and sweeps away everything past by the thrust of the literary/art movement namely modernism. Modernism as a movement and theory is an essential component of literary studies. Early 2oth century life was characterized by dissonance and fragmentation. Artists sought to capture this in their art leading to experimentation and innovation in art forms. In every field of literature writers explored new art forms which completely revolutionized writing. The course reveals how everyday life gives rise to new art forms and thus provides inspiration to young writers. Poets like Yeats, Eliot, Auden, Dylan Thomas; novelists like Forster, Woolf, Henry James, James Joyce; Dramatists like Shaw, Synge, Eliot (poetic drama) and short stories of Conrad, Mansfield, Maugham remain the stalwarts to move with the turns and twists of this age.

Paper – VII: Under the heading of **Other Literature in English** this paper unfolds the translated poems of two celebrated Indian poets like Tagore and Kamala Das along with Margaret Atwood and Emily Dickinson. It offers also a bouquet of novels of R.K.Narayan, V.S. Naipaul, Hemingway and Ngugi marking the ever expanding vistas of translated texts and plays of Wole Soyinka, Mahasweta Devi and Edward Albee – a combination of concrete and the abstract elements in life.

Paper – VIII: This paper puts a varied choice before the matured students of English literature. Marked as a special paper it contains classical literature in translation, Indian English Literature and American literature to choose any one from the many.

Any study of Western literature begins with Greek tragedy. Tragedians like Aeschylus, Sophocles, Euripides and the comedies of Aristophanes followed with the ancient Roman playwrights like Seneca and Virgil captured eternal human emotions in perfectly constructed literary works. A grounding in these texts enables the students to understand and interpret later writings with the right perspective. Any comparison with literary works written across time proves the heavy indebtedness of writers to these Greek and Roman dramatists and poets.

Indian English Literature provides an anthology of modern Indian poets, novels and plays that make the student readers aware of their national roots and cultural diversity.

American literature unveils the novelty and uniqueness of American Dreams and consequent footmarks of frustrations. The common strand that runs through the literary works produced in America at a diverse time-space compendium can be related to the pressures of a capitalist/consumerist society which made unrealistic demands upon human beings leading to psychological and emotional disintegration. Studying the nationalistic poems, thoughtful essays and most importantly plays give the students an insight into the the world of American history/politics / economics.

COURSE OUTCOMES (CBCS)

(2018 -19)

1ST AND 2ND SEMESTER HONOURS :

CC1: English language: overview and usage ; Literary types.

To trace the history of the English language and the varied components of the linguistic structures of the language.

CC2: European Classical literature :

It introduces students to the development of the various literary genres of the continent. Through discussion and analysis of various literary genres and elements, this course seeks to enhance students' awareness and appreciation of European Literature, as a whole.

CC 3: Indian classical literature and Indian writing in English :

It helps the student to gain an understanding of the Indianness in Indian literature in English and analyse the strengths and constraints of Indian English as a literary genre.

CC 4: British Literature: Old English to 14th century:

It helps to acquire a sound comprehension of literary, social, cultural, biographical and historical background of the greatest writings in British Literature.

PROGRAMME COURSE:

G.E PAPER 1: SELECTIONS FROM INDIAN LITERATURE:
The course attempts to explore issues of contemporary Indian English . The aim is to expose the students to the varieties of social and literary provocations at work, in the texts prescribed, and at the same time traces the changes in style, themes and its ideologies, drawing variations in the contemporary Indian English Writings.

G.E PAPER 2: SELECTIONS FROM EUROPEAN LITERATURE :
The course attempts to explore issues of classical European literature. The aim is to expose the students to the varieties of social and literary provocation at work, in the texts prescribed, and at the same time trace the changes in style, themes and its ideologies, drawing variations in European Literature.

AECC (PAPER 2): (English Communication).
To expand the learner's use of grammatically correct and appropriate language in speaking and writing for effective communication in a variety of interpersonal and academic situations.

DEPARTMENT OF SOCIOLOGY
B. A. Honours in Sociology
Programmes and Outcome

Programme Outcome	To develop basic knowledge on the basic concepts and develop knowledge on sociology, rural and urban societies, especially on Indian perspective. Besides theories, it was tried to develop knowledge on different societies, culture, tribes of India for the students. Research methodology is another thirst area of the students.
Programe Specific Outcome	a. In the programme students will gather basic knowledge on basic sociological concepts and rural society, especially from Indian perspective.
	b. Indian society and its cultural aspects are to be studied here in brief but to get sound knowledge. Besides sociological theories are given importance for a brief study including Indian thoughts.
	c. Different communities and societies are designed here for the introductory knowledge. A comparative study on urban and industrial societies is given priority for the students. Population and their problems will give a highlight over here. Theoretical and practical knowledge of research is also framed for the student.

COURSE OUTCOMES

COURSES	***OUTCOMES***
Paper I for 1st year hons in Sociology ***Basic concepts on Sociology***	The main thrust area of the paper is the basic concepts on Sociology. The course aims to provide fundamental knowledge on Sociology at the beginning.
Paper II for 1st year hons in Sociology ***Rural Sociology in India***	The paper aims to provide some basic concepts on rural society and development agencies and programmes that are adapted by both State and Union Government.
Paper III for 2nd year hons in Sociology ***Society and Culture in India***	The paper is designed to know the society and culture of India from different aspects including different religions.
Paper IV for 2nd year hons in Sociology ***Sociological Thoery***	The paper is designed to give basic knowledge on Sociological theories and side by side Indian thoughts are added to the students.
Paper V for 3rd year hons in Sociology ***Sociology of Tribes, Minorities and other weaker sections***	The paper is dealt with the brief note on tribes and minority groups and communities and their problems.
Paper VI for 3rd year hons in Sociology ***Urban and Industrial society in India***	This paper is comprises with the basic concepts of urban and industrial society.
Paper VII for 3rd year hons in Sociology ***Social Demography and Social Problems in India***	To gain knowledge on Indian population and some of the Indian social problems and to provide the actual scenario of these aspects.

Paper VIII for 3rd year hons in Sociology ***Social Research methods, Field Work and Viva Voce***	To obtain knowledge on fundamental research techniques and research methodologies.

DEPARTMENT OF SOCIOLOGY
UNDER CBCS
B. A. Honours in Sociology
Programmes and Outcome

COURSE OUTCOMES

COURSES	*OUTCOMES*
CORE COURSE- 01 **Introduction to Sociology-I**	*The course is intended to introduce the students to a sociological way of thinking. It also provides a foundation for the other more detailed and specialized courses in sociology*.
CORE COURSE- 02 **INDIAN SOCIETY-I**	*This paper introduces the processes and modes of construction of knowledge of India. Further, it aims to draw attention to the key concepts and institutions which are useful for the understanding of Indian society.*
CORE COURSE- 03 **INTRODUCTION TO SOCIOLOGY-II**	*This course aims to provide a general introduction to sociological thought. The focus is on studying from the original texts to give the students a flavour of how over a period of time thinkers have conceptualized various aspects of society. This paper also provides a foundation for thinkers in the other papers.*
CORE COURSE- 04 **INDIAN SOCIETY-II**	*This paper aims to draw attention to the variety of ideas and debates about India. Further, it critically engages with the multiple socio-political forces and ideologies which shape the terrain of the nation.* Course Content:
CORE COURSE- 05 **RETHINKING DEVELOPMENT**	*This paper examines the ideas of development from a sociological perspective. It introduces students to different approaches to understanding development and traces the trajectory of Indian experience with development from an interdisciplinary perspective.*
CORE COURSE- 06 **SOCIOLOGY OF RELIGION**	*The course lays primacy to the understanding of the importance of religion in society. Drawing heavily from classical writings on the subject it reinforces importance of the positions developed in these texts. Implicitly numerous interconnections can be attempted between various themes, manifestly the overarching concern of the paper is to follow up the linkage between social and religious issues through different registers mentioned in the outline.*
CORE COURSE- 07 **SOCIOLOGY OF GENDER**	*This course introduces gender as a critical sociological lens of enquiry in relation to various social fields It also interrogates the categories of gender, sex, sexuality, gender role, inequalities, theories of feminism and initiatives taken for development.*

CORE COURSE- 08 **RURAL SOCIOLOGY IN INDIA**	*Rural sociology is a specialised branch of sociology. It analyses the nature and dynamics of village society and rural areas. In the context of India rural sociology occupies a unique position. This paper is designed to bring out the distinctive features, their structures, changing features, rural problems and development programmes in rural society in India.*
CORE COURSE- 09 **SOCIOLOGY OF KINSHIP**	*This course aims to introduce general principles of kinship and marriage by reference to key terms and theoretical statements substantiated by ethnographies. The course looks at the trajectories and new directions in kinship studies.*
CORE COURSE- 10 **SOCIAL STRATIFICATION**	*This course introduces students to sociological study of social inequalities. It acquaints students with principal theoretical perspectives on and diverse forms of social inequalities in articulation with each other. This course discusses major sociological approaches to the study of social stratification and inequality. It introduces the students with concepts of social stratification social inequality, with an emphasis on the major dimensions and forms of stratification in India and global society.*
Core Course- 11: **SOCIOLOGICAL THINKERS-I**	*The course introduces the students to the classics in the making of the discipline of sociology through selected texts by the major thinkers.*
Core Course- 12 **SOCIOLOGICAL RESEARCH METHODS-I**	*This course is a general introduction to the methodologies of sociological research methods. It will provide the student with some elementary knowledge of the complexities and philosophical underpinnings of research.*
CORE COURSE- 13 **SOCIOLOGICAL THINKERS-II**	*To introduce students to post-classical sociological thinking through some original texts.*
CORE COURSE- 14: **SOCIOLOGICAL RESEARCH METHODS-II**	*The course is an introductory course on how research is actually done. With emphasis on formulating research design, methods of data collection, and data analysis, it will provide students with some elementary knowledge on how to conduct both, quantitative and qualitative research.*
SEC-01 **SOCIOLOGY OF MEDIA**	The purpose of this paper is to introduce the students to certain major themes of outlining the interconnections between media and society. The focus specifically is on the transmission and reception of media content and thus the various sections in this paper study the *production*, *control* and *reception* of media and its *representations*.

SEC-02: VISUAL SOCIOLOGY	*This course focuses on doing sociology through forms other than the written in particular Visual object; Visual sociology is an area of sociology concerned with the visual dimensions of social life. It is the use of sociological imagination to tell a story visually about social phenomena such as gender, social status, cultural forms and other social interactions in spatial contexts. Students learn to create sociological portraits, to study sociological landscapes, to do studies on socials traumas and to study signs and representations. Students utilize digital cameras and other recording technology to collect data*
DSE-01: **URBAN SOCIOLOGY**	*This course provides an exposure to key theoretical perspectives for understanding urban life in historical and contemporary contexts. It also reflects on some concerns of urban living while narrating the subjective experiences of urban communities. With case studies from India and other parts of the world this course will help students relate to the complexities of urban living.*
DSE-02 : **AGRARIAN SOCIOLOGY**	*This course explores the traditions of enquiry and key substantive issues in agrarian sociology. It is comparative in nature but pays attention to Indian themes. It also introduces emerging global agrarian concerns*
DSE- 03 ***Sociology of Health and Medicine***	*The course introduces students to the sociology of health, illness and medical practice by highlighting the significance of socio-cultural dimensions in the construction of illness and medical knowledge. Theoretical perspectives examine the dynamics shaping these constructions. Negotiations of health and illness are explored through ethnographies.*
DSE-04: **FIELD WORK**	*This paper aims to equip students with empirical field data collection, analysis and writing analytical and standard dissertation or research report writing in sociology. For the purpose of data collection students require to undertake a field visit of neighbouring /area/ village/ town individually or in a group for 10 days. Students must conduct survey of at least 30 households (for individual independent research) and adequate sample of households in case of survey in a group (Household Census to be provided by the provided by the Department). The interview schedule (Interview Schedule to be attached in the appendix) be prepared under the supervision of departmental faculty. The dissertation would be approximately 30 pages. The same pattern of dissertation be followed in every college.*
DSE-06 : **INDIAN SOCIOLOGICAL TRADITIONS**	*Traditions in Indian Sociology can be traced with the formal teaching of sociology as a subject in Bombay University way back in 1914 while the existence of sociology in India and "Sociology of India "have been largely debated in terms of whether it has been influenced by western philosophy, is there a need for indigenization etc. sociologists in India primarily been engaged with issue of tradition and modernity, caste,*

	tribe, and gender. This paper primarily provides perspectives of key Indian Sociologists on some of these issues.
Generic Elective GE- 01 a. GENDER AND VIOLENCE	*Gendered violence is routine and spectacular, structural as well as situated. This course attempts to provide an understanding of the logic of that violence, awareness of its most common and tries to equip the students with a sociologically informed basis for making pragmatic, ethical and effective choices while resisting or intervening in the context of gendered violence.*
GE- 01 b. SOCIOLOGY OF EDUCATION	*This course intends to familiarize the students with perspectives on the social meaning of education and the relationship between education and society. This includes issues of knowledge, comprehension, empowerment and contestation to sites and practices of education.*
G E -02 a. POPULATION AND SOCIETY	*This course provides a critical understanding of the interface between population and society. It analyses the role of fertility, mortality and migration on the composition, size, and structure of population. The course addresses the issue of domestic and international population movements and their economic, political and social implications.*
G E- 02 b. SOCIOLOGY OF WORK	*The course introduces the idea that though work and production have been integral to societies through time, the origin and spread of industrialisation made a distinct rupture to that link. This rupture can also be seen mirrored in the coming of sociology as a discipline that considered work as central to the study of society. It familiarises the students with different types and problems of workers in the changing nature of work, problems of security and risks and hazards facing the workers.*

DEPARTMENT OF SOCIOLOGY
UNDER CBCS
B. A. Progmme in Sociology
Programmes and Outcome

COURSE OUTCOMES

COURSES	*OUTCOMES*
CORE-01 **Introduction to Sociology**	This course is a broad introduction to the discipline of sociology. It familiarizes the students with the origin and history, fundamental concepts and concerns of the disciplines.
CORE-02: **Sociology of India**	This paper aims to provide an outline of the institutions and processs of Indian society. The central objective is to encourage students to view the Indian reality through a sociological lens.
CORE-03: **Sociological Theories**	This course introduces the students to the classical sociological thinkers Whose theories, thought, work has shaped the discipline of sociology.
CORE - 04: **Techniques of Social Research**	This course aims to enhance the skills of students to understand and use techniques employed by social scientists to investigate social phenomena. With emphasis on formulating research design, methods of data collection, and data analysis, it will provide students with some elementary knowledge on how to conduct both, quantitative and qualitative research. The focus is on understanding through suggested exercises.
SEC-01 **Sociology of Media**	The purpose of this paper is to introduce the students to certain major themes of outlining the interconnections between media and society. The focus specifically is on the transmission and reception of media content and thus the various sections in this paper study the *production*, *control* and *reception* of media and its *representations*.
SEC-02 **VISUAL SOCIOLOGY**	*This course focuses on doing sociology through forms other than the written in particular Visual object; Visual sociology is an area of sociology concerned with the visual dimensions of social life. It is the use of sociological imagination to tell a story visually about social phenomena such as gender, social status, cultural forms and other social interactions in spatial contexts. Students learn to create sociological portraits, to study sociological landscapes, to do studies on socials traumas and to study signs and representations. Students utilize digital cameras and other recording technology to collect data.*

DSE – 01a **Religion and Society**	This course acquaints the student with a sociological understanding of religion. It examines some forms of religions in India and its role in modern society.
DSE 01b **Marriage, Family and Kinship**	This course aims to highlight and critically examine contemporary concerns in the fields of marriage, family and kinship. It considers theoretical issue and ethnographies with particular emphasis on diversity of practices.
DSE-02a **Social Stratification**	The Course introduces the students the various ideas of social inequality and their socio0logical study. The different forms and institutional manifestations of social stratification are explored here both theoretically and through case studies.
DSE-02b **Gender and Sexuality**	This course aims to introduce students to a basic understanding of gender by interrogating the categories of gender, sex and sexuality. The complexity of gender relations in contemporary societies are further explored by looking in the areas of work and family.
GE- 01 a. **Gender and Violence**	*Gendered violence is routine and spectacular, structural as well as situated. This course attempts to provide an understanding of the logic of that violence, awareness of its most common and tries to equip the students with a sociologically informed basis for making pragmatic, ethical and effective choices while resisting or intervening in the context of gendered violence.*
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