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Ref. No   *Date:*

INDEX PAGE:
Programme Outcome (P.O) and Course Outcome (C.O)

Science Departments:
1. PHYSICS
2. MICROBIOLOGY
3. ZOOLOGY
4. BOTANY
5. CHEMISTRY
6. MATHEMATICS
7. GEOGRAPHY
8. FOOD AND NUTRITION

Humanities Departments:
1. BENGALI
2. ENGLISH
3. HISTORY
4. POLITICAL SCIENCE
5. EDUCATION
6. PHILOSOPHY
7. PHYSICAL EDUCATION
8. SANSKRIT

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Department of Physics :

The department runs Undergraduate Honours and General Courses under the Choice-Based Credit System (CBCS) introduced in 2018-19 session. Under the present CBCS curriculum of UG Physics programme, the students are expected to have the following expertise by the end of the degree program:

- As the present CBCS syllabus has invoked a lot of application-based knowledge area, such as current programming language: Python, scientific writing editor: Latex, etc., students should demonstrate an understanding of core knowledge in physics, with ready to be a part in academic, research, or IT based industries, with proficiency in language (skill enhancement course) communication.
- Students would be able to demonstrate written and oral communication skills in communicating physics-related topics.
- Students would be able to design and conduct an experiment or series of experiments, demonstrating their understanding of the scientific methods and processes.
- Students should demonstrate an understanding of the analytical methods required to interpret and analyze results and draw conclusions as supported by their data.
- Students should demonstrate proficiency in the acquisition of data using a variety of laboratory instruments and in the analysis and interpretation of such data.
- Students could utilize a wide range of printed and electronic resources and information technologies to support their research on physical systems and present those results in the context of the current understanding of physical phenomena.
- Students would be able to demonstrate understanding of the applications of numerical techniques for modelling physical systems for which analytical methods are inappropriate or of limited utility.
- Students will demonstrate a thorough understanding of the analytical approach to modeling of physical phenomena.
- Students will demonstrate an understanding of the impact of physics and science on society.

Subject Outcomes (Nos)	Subject Outcomes (SO)
SO 1	To prepare the students for a successful career in industry as well as to motivate them for higher education and to take research as a career
SO 2	To provide strong foundation in basic sciences and mathematics

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SO 3	To identify, formulate and analyze complex scientific problems reaching substantiated conclusions
SO 4	To develop individual and team work by functioning effectively as an individual or as a member in a group in laboratory classes
SO 5	Ability to use modern techniques, sophisticated instruments, current application softwares and to handle different types of electrical and electronic circuits
SO 6	To develop computational acumen in solving different analytical problems of Physics
SO 7	To develop communicating ability such as being able to comprehend and write effective laboratory notebooks and design documentation, prepare effective presentations, and give and receive clear instructions
SO 8	To develop an opportunity to work in interdisciplinary groups
SO 9	To develop the ability to engage in independent and life-long learning in the current context of technological change
SO 10	To inculcate scientific temperament in the young minds and outside the scientific community

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Physics Honours Course

SEM	Course	Subject	1	2	3	4	5	6	7	8	9	10
1	Core	Mathematical Physics I	X	X	X			X			X	X
1	Core	Mechanics		X	X							X
2	Core	Electricity & Magnetism		X	X						X	X
2	Core	Waves & Optics		X	X							X
3	Core	Mathematical Physics II	X	X	X			X			X	X
3	Core	Thermal Physics		X	X	X						X
3	Core	Modern Physics		X	X						X	
3	SEC-A1	Scientific Writing (Latex)	X			X	X	X			X	X
4	Core	Mathematical Physics III	X	X	X			X			X	X
4	Core	Analog Electronics	X			X	X			X	X	X
4	Core	Quantum Mechanics		X	X			X			X	X
4	SEC-B2	Electrical Circuits & Network Skills	X	X			X				X	X
5	Core	Electromagnetic Theory		X	X			X			X	X
5	Core	Statistical Physics	X	X	X			X			X	X
5	DSE-A1	Laser &Fibre Optics	X				X			X	X	X
5	DSE-B1	Nuclear & Particle Physics		X	X			X			X	X
6	Core	Digital Systems & Applications	X	X	X		X					X

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SEM	Course	Subject	1	2	3	4	5	6	7	8	9	10
6	Core	Solid State Physics	X	X		X						X
6	DSE-A2	Nanomaterials & Applications		X	X			X			X	X
6	DSE-B2	Communication Electronics	X			X	X				X	X

Physics General Course

SEM	Course	Subject	1	2	3	4	5	6	7	8	9	10
1	Core	Mechanics		X	X						X	X
2	Core	Electricity & Magnetism		X	X		X					X
3	Core	Thermal Physics & Statistical Mechanics		X	X	X						X
3	SEC-A1	Scientific Writing (Latex)	X			X	X	X				X
4	Core	Waves & Optics		X	X							X
4	SEC-B2	Electrical Circuits & Network Skills			X	X			X	X		
5	DSE-A	Analog Electronics					X	X	X	X		
5	SEC-A	Modern Physics		X	X		X	X				
6	DSE-B	Digital ELectronics					X	X	X	X		
6	SEC-B	Nuclear & Particle Physics		X	X						X	X

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MICROBIOLOGY UG CBCS SYLLABUS

POs AND COs OF

CORE COURSES, DISCIPLINE SPECIFIC ELECTIVES AND SKILL ENHANCEMENT COURSES

SEMESTER	COURSES
I	CORE COURSE 1 (CC-1) Introduction to Microbiology and Microbial Diversity
	CORE COURSE 2 (CC-2) Bacteriology
II	CORE COURSE 3 (CC-3) Biochemistry
	CORE COURSE 4 (CC-4) Cell Biology
III	CORE COURSE 5 (CC-5) Virology
	CORE COURSE 6 (CC-6) Microbial Physiology and Metabolism
	CORE COURSE 7 (CC-7) Molecular Biology
	SKILL ENHANCEMENT COURSE A1(SEC-A1) Microbial Quality Control in Food and Pharmaceutical Industries

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IV	CORE COURSE 8 (CC-8) Microbial Genetics
	CORE COURSE 9 (CC-9) Environmental Microbiology
	CORE COURSE 10 (CC-10) Recombinant DNA Technology
	SKILL ENHANCEMENT COURSE B2 (SEC-B2) Microbiological Analysis of Air and Water
V	CORE COURSE 11 (CC-11) Food and Dairy Microbiology
	CORE COURSE 12 (CC-12) Industrial Microbiology
	DISCIPLINE SPECIFIC ELECTIVE A1 (DSE-A1) Microbial Biotechnology
	DISCIPLINE SPECIFIC ELECTIVE B2 (DSE-B2) Microbes in Sustainable Agriculture and Development
VI	CORE COURSE 13 (CC-13) Immunology
	CORE COURSE 14 (CC-14) Medical Microbiology
	DISCIPLINE SPECIFIC ELECTIVE A3 (DSE-A3)

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	Plant Pathology
	DISCIPLINE SPECIFIC ELECTIVE B3 (DSE-B3) Instrumentation and Biotechniques

Programme Objectives:

➤ To help students gain knowledge about various basic concepts of Microbiology and develop experimental skills
➤ To develop their presentation and articulation skills
➤ To expose the candidates to industry and interaction with industry experts
➤ To help build research mind set among students

Programme Outcomes:

PO-1	**Knowledge of discipline**- Graduates will understand the basic concepts, underlying principles, scientific theories related to varied scientific phenomena and their relevance to day to day life.
PO-2	**Research Skills**- Student would be confident enough to handle laboratory instruments, designing and executing scientific experiments
PO-3	**Cognitive and communicative skills** – Students would be able to develop good reading, writing, speaking skills.
PO-4	**Problem solving**- Students would be able to identity and analyze course related problems
PO-5	**Critical thinking**-Graduates will imbibe good observation skill, analytical mind, logical thinking and systematic approach to make decision through this course
PO-6	**Analytical skill**-Students would be able to develop analytical skill through design of experiments, their execution and result analysis.
PO-7	**Team work and ethical values**-Graduates would be able to think as a team and execute community related awareness issues through the use of microbiological knowledge. They

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	would appreciate the role of social and ethical values in their lives.
PO-8	**Sustainability**-Students will be able to recognize the importance of environment and goals of sustainable development.
PO-9	**Entrepreneurship and employability**-Graduates would be able to build their career as an entrepreneur or employee.
PO-10	**Leadership quality**-Graduates would imbibe critical thinking, analytical skill, problem solving, decision making, innovative thinking along with social and ethical values – all these will make them leaders for future India.

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COURSE	LEARNING OBJECTIVE	COURSE OUTCOME
CC-1 THEORY	This course aims to generate deeper understanding of the development of microbiology as a discipline, diversity of the organisms and bird's eye view of the scope of the subject	➢ To understand and become familiar of core principles and experimental basis of the development of Microbiology discipline ➢ Ability to classify and diversify cellular and acellular forms according to their structure, reproduction, identification, ecological significance and economic importance ➢ Students will be acquainted with the scope of different fields of microbiology
CC-1 PRACTICAL	Learning of dos and don'ts of microbiology good laboratory practices. Study of principles and applications of basic microbiological laboratory instruments and identifying different class of microorganisms	➢ To build confidence in students while handling of laboratory instruments ➢ Ability to recognize microscopic characteristics of different class of microorganisms ➢ To develop practical skills to prepare and sterilize microbial growth media
CC-2 THEORY	To study cellular organization, growth, nutrition and reproduction of bacteria. To learn basic principles of microcopy and bacteriological techniques. To study bacterial systematics as well as important archaeal and eubacterial groups.	➢ To realize basic requirements like physical, chemical and nutritional parameters for microbial growth ➢ To understand basics of microscopy and aseptic techniques in Microbiology ➢ To understand bacterial systematic, important archaeal, gram-positive and gram negative eubacterial groups
CC-2 PRACTICAL	To get acquainted with tools and methods of Microbiology. To learn aseptic techniques in Microbiology as well as cultivation, isolation and preservation of microorganisms. To	➢ To master tools and methods of Microbiology ➢ To acquire skill in aseptic techniques in Microbiology as well as cultivation, isolation and preservation of microorganisms ➢ To understand the morphology of microorganisms

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	study the morphology of microorganisms	
CC-3 THEORY	To learn about the structure and function of biological macromolecules. To provide advanced understanding of the structure and mechanism of action of enzymes. To learn underlying principles of bioenergetics. To study the characteristics of vitamins.	➢ Understanding the role of biological macromolecules through their structure, function and interactions with other biomolecules ➢ To appreciate the importance of enzyme in metabolism ➢ To describe the relevance of energetics in biological systems specially in cellular events ➢ To understand the importance of vitamins
CC-3 PRACTICAL	To learn the concept of acid, base and buffer. To learn to analyze carbohydrate, protein and fats qualitatively and quantitatively. To study enzyme kinetics and the effect of temperature, pH and heavy metals on enzyme activity.	➢ To master the concepts of acid, base and buffers ➢ Ability to solve numerical problems on standard free energy change and equilibrium constant ➢ Developing skill to detect carbohydrates, protein and fats qualitatively and qualitatively ➢ To acquire skill in characterizing enzymes
CC-4 THEORY	To learn the structure and organization eukaryotic cell. To study the nuclear structure, sorting of proteins in endoplasmic reticulum and Golgi apparatus. To learn about the process of cell signaling, cell cycle, cell death and cell renewal.	➢ Ability to understand the structure and organization of cell ➢ Appreciate the importance of cellular organelles like nucleus, ER, Golgibodies and lysosomes etc. Role of organelles in protein sorting and transport. ➢ Understanding of cell signaling pathways ➢ Developing concept of regulation of cell cycle and its relation to cancer, idea of programmed cell death
CC-4	To study representative animal and	➢ To describe and characterize different

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PRACTICAL	plant cell. To study different stages of mitosis and meiosis. Learning to stain DNA, mitochondria.	subcellular organelles ➢ To develop skills to identify DNA and mitochondria through staining procedures ➢ To understand different stages of mitosis and meiosis
CC-5 THEORY	To learn about nature and properties of viruses. To study diversity and classification of viruses with special emphasis on viral transmission, features of nucleic acids and replication. To study the relationship between virus and cancer. To learn about control methods of virus and application of virus in therapy.	➢ Understanding characteristics of virus, its diversity, transmission and replication. ➢ To develop concept of oncogenic viruses ➢ To gain understanding of the control methodologies of virus and how virus can be applied in therapy.
CC-5 PRACTICAL	To study the structure of important animal, plant and bacterial viruses. Learning to isolate and enumerate bacteriophages. To study cytopathic effects of virus.	➢ Ability to identify electron micrograph of animal, plant and bacterial viruses. ➢ To develop skills to isolate and enumerate bacteriophages from environmental samples. ➢ Understanding the cytopathic effects of virus
CC-6 THEORY	Learning the concepts of microbial growth in response to environment, nutrition and energy. To study the process of nutrient uptake and transport in microorganisms. To study different anabolic and catabolic reactions in microbial cell in presence of oxygen (also absence), atmospheric nitrogen and photon.	➢ Generating in-depth knowledge of microbial growth, process of nutrient uptake and transport ➢ Developing concepts of microbial metabolic processes. ➢ Understanding energy generation processes in microorganisms
CC-6	To study the effect of environment on microbial growth. To determine growth curve of bacteria,	➢ Ability to plot microbial growth curve ➢ Building confidence in calculating generation time and specific growth rate of

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PRACTICAL	generation time and specific growth rate of bacteria.	microorganisms ➤ Ability to predict the effect of environment and nutrient on microbial growth
CC-7 THEORY	To study the detailed structure of nucleic acids. To learn underlying mechanism of central dogma of life both prokaryotic and eukaryotic. Learning principles of regulation of gene expression in prokaryotes and eukaryotes. To get clear concepts of post transcriptional processing in eukaryotes.	➤ Development of in-depth knowledge of genetic material ➤ Understanding salient features of replication, transcription and translation processes in prokaryotic and eukaryotic cells ➤ Developing concepts of underlying principles of transcriptional regulation in both microbial systems
CC-7 PRACTICAL	To study DNA, RNA and semi-conservative replication using micrograph and model/schematic representations. To isolate genetic materials from microbial cells. To estimate DNA and RNA using colorimeter/spectrophotometer. To resolute and visualize DNA and protein samples through gel electrophoresis.	➤ Ability to identify and characterize genetic materials through micrograph or models ➤ To develop skills to isolate DNA from microbial cells ➤ Ability to quantitate DNA/RNA of unknown samples from standard curve data ➤ Ability to interpret approximate sizes of DNA/protein bands
SEC-A1 THEORY	Learning good laboratory practices and microbiological practices. To know about biosafety cabinets and specifications of biosafety laboratory standards. To study microbial species present in food and pharmaceutical samples. To study detection methods of pathogenic microorganisms present in water and food. To learn concepts of HACCP and microbial	➤ Developing concepts of good laboratory and microbiological practices ➤ Generating idea of biosafety cabinets and specifications of standard biosafety laboratory ➤ Ability to predict the presence of microbial species in food and pharmaceutical samples ➤ Understanding the basis of detection methods of pathogenic microorganisms from water and food samples ➤ Developing in-depth concept of HACCP and microbial standards for food and water

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	standards for foods and water.	
CC-8 THEORY	To gain knowledge of genome organization and mutagenesis. To get familiar with plasmids and mechanism of genetic exchange. To learn about phage genetics and transposable elements.	➢ Be conversant in microbial genome organization and mutagenesis ➢ Ability to gain insight on the extra-choromosomal DNA and mechanism of natural competence ➢ Basic understanding of phage genetics and transposable elements
CC-8 PRACTICAL	To study the effect of mutagens on bacterial cells and their growth. To get familiar with different conformation of DNA. To learn about mechanism of natural competence in bacteria.	➢ To understand the effect of mutagens on cells ➢ Ability to predict conformations of DNA in gel ➢ To develop skill to isolate plasmid DNA from bacterial cells ➢ Ability to demonstrate natural genetic exchange methods in bacteria
CC-9 THEORY	To study the diversified habitat of microorganisms and how do they cope with them. To know about underlying interaction between microbes, microbes and plant as well as microbes and animal. To get familiar with major elemental cycles running in this planet's ecosystem. To gain knowledge of microbial role in waste management issues and bioremediation. To study methods and treatments for potable water.	➢ Gain understanding of microbial habitat diversity and associated coping mechanism ➢ Develop an insight of wide interactions happening between microbes and other producer and consumers of an ecosystem ➢ Able to articulate interconnected and interdisciplinary nature of environment through biogeochemical cycles of elements ➢ Deep understanding of the eminent role of microbes in sustainable management of waste ➢ Understanding the basic methods to detect potability of water and its necessary treatments
CC-9 PRACTICAL	To study the nature of the soil. To assess microbiological quality of water. To isolate bacteria and fungi from rhizospheric and rhizoplanar soil. To determine BOD of waste water sample. To study the	➢ Ability to analyze soil characteristics ➢ Ability to isolate bacterial and fungal species and *Rhizobium* species from different regions of soil ➢ Development of skill to assess microbial quality of water and determine BOD of

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	presence of microbial species in soil through detection of enzyme activity.	waste water ➤ Ability to detect different types of microbial species in soil with the help of specific enzymes
CC-10 THEORY	To get introduced to genetic engineering. To learn about tools, strategies and methods of molecular cloning. To appreciate the concepts of DNA amplification and sequencing. To get familiar with construction and screening of genomic and cDNA libraries. To translate the concepts to the areas of application.	➤ Understanding the basics of genetic engineering ➤ Developing in-depth concepts on tools, strategies and methods of molecular cloning ➤ Be conversant in DNA amplification and sequencing methods ➤ Get acquainted with the required skills to construct and screen genomic and cDNA libraries ➤ Ability to translate theoretical knowledge to
CC-10 PRACTICAL	To prepare competent cells. To calculate transformation efficiency. To digest DNA and analyze thereof. To screen recombinants through blue-white screening method. To design primers and amplify DNA through PCR.	➤ Ability to prepare competent cells ➤ Developing skills to transform them and determine transformation efficiency ➤ Get acquainted with restriction digestion of DNA and analyzing the fragments generated ➤ Able to screen recombinants ➤ Mastering suitable primer design and amplification of DNA using PCR
SEC-B2 THEORY	To comprehend basic concept of aeromicrobiology. To be familiar with collection of air samples and their analysis. To learn about controlling microbes through physical and chemical measures. To study water borne pathogens and related infections. To get acquainted with the methods to detect potability of water samples and related treatment processes.	➤ Developing concepts of microbiology relating to public health ➤ Get acquainted with air samplers and analyzing indoor and outdoor air samples ➤ Understanding role of water borne pathogens causing diseases ➤ Developing skills to detect potability of water and in-depth knowledge of treatment procedures

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CC-11 THEORY	To learn about foods as substrate of microorganisms. To study spoilage of various foods by microorganisms. To know about various food preservation methods and their working principle. To get familiar with fermented foods. To get acquainted with food borne diseases and different rapid and cultural methods to detect food borne pathogens. To study food sanitation and its indices.	➢ Understanding extrinsic and intrinsic parameters affecting microbial growth in food ➢ In-depth knowledge of different types of food spoilage ➢ Appreciation of different physical and chemical methods to preserve foods ➢ Ability to develop experimental skill to prepare different fermented foods ➢ Developing concept of food borne diseases and experimental skill to detect food borne pathogens ➢ Understanding food sanitation and its indices
CC-11 PRACTICAL	To analyze the quality of milk samples. To isolate food borne bacteria from food products. To isolate spoilage microorganisms from spoiled food, vegetable and bread. To prepare dahi.	➢ Ability to analyze quality of milk samples and efficiency of pasteurization of milk samples ➢ Ability to develop skill to isolate food borne bacteria from food products ➢ Development of skill to isolate spoilage bacteria and fungi from spoiled food, vegetables and bread ➢ Development of skill to prepare dahi
CC-12 THEORY	To get introduced to industrial microbiology. To get acquainted with production strains, their isolation and related fermentation media. To learn about fermenters, types of fermentation processes along with measurement and control of fermentation parameters. To study downstream processing. To appreciate microbial production of industrially useful products. To know about enzyme immobilization methods and their	➢ Ability to acknowledge role of production strains in industry ➢ Ability to develop experimental skills to isolate production strains ➢ Understanding of fermenters and fermentation media in depth ➢ To get acquainted with downstream processing of industrial products ➢ Developing concept of application of microbes for production of industrially useful materials ➢ Understanding of immobilization techniques of enzymes and their application thereof

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	application.	
CC-12 PRACTICAL	To study different parts of fermenter. To produce and estimate enzymes, organic acids, amino acid and alcohol using microorganisms. To learn about downstream processing through industrial visit.	➢ Understanding different parts of bioreactor ➢ Ability to develop experimental skill to produce and estimate enzymes, organic acids, amino acid and alcohol from suitable production strains/microorganisms ➢ Gaining insight to industrial processes and downstream processing operations through visit to educational institute/industry
DSE-A1 THEORY	To study applications of microorganisms in therapeutics, agriculture, environmental and food technology. To learn about microbial production of vaccines, polysaccharides, esters, biopesticides, bioplastics and biosensors. To get familiar with microbe based catalytic processes and their industrial application. To get introduced to the recovery methods of microbial products and role of microbes in energy production and bioremediation. To know about the applications of RNAi and its application areas.	➢ Developing concept of microbial production of vaccines, polysaccharides and other bio-based products ➢ Gaining insight of microbial catalytic processes for industrial material production ➢ To develop skills for their recovery ➢ Understanding microbial role in energy production and bioremediation ➢ In-depth knowledge in application of RNAi ➢ To get introduced to intellectual property rights specially Patents, Trademark and Copyright
DSE-A1 PRACTICAL	To study yeast cell and enzyme immobilization using alginate gels. To produce pigments from fungal species. To isolate xylanase/ lipase from suitable bacteria. To study about algal cell protein.	➢ Ability to develop skills to immobilize microbial cells and enzymes ➢ Developing skills to work with pigment producing fungal strains ➢ Developing skills to isolate enzyme producer bacteria specially xylanase/lipase ➢ Understanding algal single cell proteins
DSE-B2 THEORY	To get familiar with soil profile and mineralization of matters in soil. To study about production and control	➢ Developing concepts of soil profile and mineralization of organic and inorganic matters in soil

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	of green house gases in soil environment. To learn about biocontrol mechanisms of soil borne plant pathogens. To get acquainted with microbial biofertilizers and genetically modified crops.	➢ Ability to understand issues involving production and control of green house gases in soil ➢ Gaining insight of biocontrol mechanisms of soil borne plant pathogens ➢ Developing skills to prepare microbial biofertilizers ➢ Developing concepts of genetically modified crops
DSE-B2 PRACTICAL	To study soil profile and microflora of different soils. To prepare *Rhizobium* and *Azotobacter* as soil inoculants and their application. To learn about biogas plant. To isolate cellulose degrading microorganism.	➢ To develop skill to study soil profile and microflora of different soils ➢ Ability to develop experimental skill to prepare *Rhizobium* and *Azotobacter* as soil inoculants and also apply them ➢ Understanding basic design and functioning of biogas plant ➢ Developing skill to isolate cellulose degrading microorganism
CC-13 THEORY	To get introduced to the concept of immunity. To learn about immune cells and organs. To get familiar with structure and functions of antigens and antibodies. To know about major histocompatibility complexes and complement systems. To get the idea of immune response generation. To study different immunological disorders and principles of immunological techniques.	➢ Understanding the concept of immunity ➢ Developing in-depth knowledge of cells and organs of immune system, antigens and antibodies ➢ Realizing role of histocompatibility complexes and complement systems in immune response and building immunity ➢ Ability to conceptualize generation of immune response ➢ Gaining insight of different immunological disorders ➢ Ability to develop experimental skills of immunological techniques
CC-13 PRACTICAL	To identify human blood groups. To perform total and differential leukocyte count. To perform immunodiffusion by Ouchterlony method. To perform DOT ELISA	➢ Ability to identify human blood groups ➢ Developing experimental skills to count total and differential numbers of leukocytes ➢ Mastering immunodiffusion to predict types of antigenic epitope through Ouchterlony

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	and immunoeletroeletrophoresis.	method ➤ Gaining experimental skill to predict nature of antibody through immunoelectrophoresis ➤ Developing skills to perform DOT ELISA
CC-14 THEORY	To get the idea of normal microflora of human body. To learn about collection, transport and culturing of clinical samples. To get familiar with different bacterial, fungal, viral and protozoan diseases of various organs and their causative agents. To study about general characteristics and mode of action of several antimicrobial agents.	➤ Understanding normal microflora of human body and the concept of host pathogen interaction ➤ Ability to gather in-depth knowledge to collect, transport and culturing of clinical samples ➤ Appreciating general characteristics and mode of action of various antimicrobial agents ➤ Developing insight of bacterial, fungal, viral and protozoan diseases of various organs
CC-14 PRACTICAL	To identify several bacterial strains based on cultural, morphological and biochemical characteristics. To study composition and application of some differential media. To appreciate bacterial flora of human skin. To perform antibacterial sensitivity through Kirby-Bauer method. To determine minimum inhibitory concentration of antibiotics. To study symptoms of different diseases through photographs. To study various stages of malarial parasite in RBC using permanent mounts.	➤ Ability to identify bacterial species on the basis of cultural, morphological and biochemical characteristics ➤ Developing practical skill to prepare and use differential media ➤ Ability to characterize bacterial flora of skin ➤ Developing skill to determine antibacterial sensitivity by Kirby Bauer method ➤ Mastering experimental skill to determine MIC of antibiotics
DSE-A3	To get introduced to plant pathology. To learn about	➤ Understanding the concept of plant diseases and their epidemiology

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THEORY	development of plant diseases and disease epidemiology. To get familiar with plant and microbe interaction. To know about common plant diseases and their control mechanisms in general.	➤ To get acquainted with virulence factors of pathogens and effect of pathogens on host plants ➤ Gaining in-depth knowledge of some plant diseases specially their etiological agents, symptoms and epidemology ➤ Developing insight on principles of plant disease management
DSE-A3 PRACTICAL	To demonstrate Koch's postulate in fungal, bacterial and viral pathogens. To study several important crop diseases by cutting sections of infected plant material.	➤ Ability to develop experimental skill to demonstrate Koch's postulate in fungal and bacterial pathogens ➤ Developing experimental skill to identify several important crop diseases through sections of infected plant materials
DSE-B3 THEORY	To get introduced to the principles of various microscopic techniques. To get familiar with principle and applications of chromatographic techniques and spectrophotometry. To study electrophoresis processes and their application. To know about centrifugation procedures and their application.	➤ Understanding the concepts of microscopy and spectrophotometry ➤ Developing insight to principle and applications of various chromatographic techniques ➤ Gaining clear knowledge of various electrophoresis processes and centrifugation techniques along with their application

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DSE-B3 PRACTICAL	To study phase contrast and electron microscopy through ray diagram. To understand density gradient centrifugation with the help of pictures. To separate mixtures using TLC. To separate protein mixtures by chromatography and by PAGE. To determine wavelength maxima and calculate extinction coefficient. To separate components using lab scale centrifuge.	➢ Understanding concepts of phase contrast and electron microscopy using ray diagrams ➢ Gaining knowledge of density gradient centrifugation using pictures ➢ Ability to develop experimental skills to separate mixtures by TLC ➢ Developing skills to separate protein mixtures by column chromatography as well as PAGE ➢ Ability to experimentally determine wavelength maxima of unknown sample and calculate extinction coefficient ➢ Ability to separate components of a mixture using laboratory scale centrifuge

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DEPARTMENT OF ZOOLOGY

(Programme Outcome, Course Outcome, and Programme Specific Outcome) Prescribed in University of Calcutta Syllabus (2018-2019) within the CBCS

PROGRAMME OUTCOME

Department of Zoology

Programme Outcomes	
PO 1	Acquiring in-depth knowledge
PO 2	Analysis and corroboration
PO 3	Laboratory skills and Instrumentation
PO 4	Skill Enhancement
PO 5	Design and Performance of Experiments
PO 6	Analysis with statistical inference
PO 7	Building of Environmental ethics, Sustainability, and Conservation
PO 8	Communication, bonding, and learning through group activity

Programme Specific Outcome in Zoology

- **PSO 1**: Students will develop an understanding of key concepts of biology at organismic, ecological, behavioural, physiological, biochemical, and molecular levels.
- **PSO 2**: Students build a clear concept of genetic and molecular principles of traits from human and non-human organisms, including the description of several molecular events controlling gene expression in various physiological processes, including sex determination.
- **PSO 3**: Students gain knowledge of the internal structure of cells and their functions in controlling various metabolic pathways of an organism.
- **PSO 4**: Students become aware of animal-animal, animal-plant, and animal-microbe interactions and their consequences on the environment, with special emphasis on conservation, helping understand

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environmental conservation processes and the importance of pollution control, biodiversity, and protection of endangered species.

- **PSO 5**: Students gather knowledge of the internal structure of cells and their functions and control of various metabolic functions of organisms.
- **PSO 6**: Students gain understanding in medical entomology, apiculture, aquaculture, sericulture, medical diagnostics, animal cell biotechnology, and modern biotechnological tools.
- **PSO 7**: Students develop theoretical and practical knowledge in handling animals and their roles in the environment.
- **PSO 8**: Through this programme, students achieve high standards of learning in animal sciences and develop a multidisciplinary approach to work collaboratively, gaining a comprehensive knowledge of biological processes.

Course Outcome (Department of Zoology)

Programme-Honours (2018-2019, 2019-2020, 2020-2021)

Semester I

Course	Code	Outcome
Theory	CC-1-1-TH	CO 1: Students understand the non-chordate world through this module.
		CO 1.1: Learn the process of evolution in non-chordates from unicellular cells to complex multicellular organisms.
		CO 1.2: Identify invertebrates and classify them up to the class level based on systematics.
		CO 1.3: Learn the basis of life processes in non-chordates and recognize economically important invertebrate fauna.
Practical	CC-1-1-P	CO 1.4: Gain an understanding of general characters and classification of Acoelomates to Pseudocoelomates.
		CO 1.5: Identify animals through practical learning using models/charts/e-resources, helping students identify organisms.

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Course	Code	Outcome
Theory	CC-1-2-TH	CO 2: Get an idea of life at the molecular level.
		CO 2.1: Understand developments in molecular biology and its implications in human welfare.
		CO 2.2: Exposure to the emerging field of research in Molecular Biology.
Practical	CC-1-2-P	CO 2.3: Gain observational, analytical, and evaluation skills in molecular biology.

Semester II

Course	Code	Outcome
Theory	CC-2-3-TH	CO 3: Learn general characters and classification of coelomates and the affinities between different groups.
		CO 3.1: Understand the classification of whole phyla in Nonchordates with charts/models/pictures.
		CO 3.2: Gain knowledge about various internal systems like the digestive and nervous systems.
Practical	CC-2-3-P	CO 3.3: Acquaintance with general characters and classification of coelomates through charts, models, and e-resources.
Theory	CC-2-4-TH	CO 4: Develop a deeper understanding of life at the cellular level.
		CO 4.1: Learn about cellular membrane structure and function, and fine structure and function of cell organelles.
		CO 4.2: Perform a variety of molecular and cellular biology techniques.

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Course	Code	Outcome
Practical	CC-2-4-P	CO 4.3: Handle and adjust microscopes, observe chromosomal arrangements during cell division, and distinguish different chromosomal alterations in humans.

Semester III

Course	Code	Outcome
Theory	CC-3-5-TH	CO 5: Inculcate fascination for nature and learn the bionomics of vertebrates.
		CO 5.1: Learn the evolution, hierarchy, and classification of different classes of chordates.
		CO 5.2: Overview the morphology and physiology of typical examples.
		CO 5.3: Become familiar with adaptations and the economic importance of specific vertebrates.
Practical	CC-3-5-P	CO 5.4: Acquaintance with the systematic positions of animals, morphological features, and relations among different animals through charts, models, and e-resources.
Theory	CC-3-6-TH	CO 6: Gain knowledge about the function of various systems.
		CO 6.1: Overview the morphology and physiology of typical examples.
		CO 6.2: Familiarize with the physiology of the human body and learn precautionary measures to safeguard health.
Practical	CC-3-6-P	CO 6.3: Develop skill in simple biophysiological laboratory procedures.

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Course	Code	Outcome
Theory	CC3-7-TH	CO 7: Understand the structural arrangements and metabolism of carbohydrates, lipids, proteins, and nucleic acids.
		CO 7.1: Structural arrangements of carbohydrates and their application in metabolism and regulation.
		CO 7.2: Structural arrangements of lipids and their application in metabolism and regulation.
		CO 7.3: Structural arrangements of proteins and their application in metabolism and regulation.
		CO 7.4: Structure of nucleic acids and their metabolism and biosynthesis.
		CO 7.5: Enzyme classification, specificity, action mechanism, kinetics, and inhibition.
		CO 7.6: Mitochondrial respiratory chain, inhibitors, uncouplers, and mechanisms of oxidative phosphorylation.
Practical	CC3-7-P	CO 7.7: Qualitative analytical techniques to detect biomolecules like carbohydrates, proteins, and lipids.
		CO 7.8: Techniques to detect biomolecules like urea and uric acid.
		CO 7.9: Techniques to separate biomolecules by charge, molecular weight, size, and chemical nature.
		CO 7.10: Quantitative analysis techniques to detect biomolecules using optical density.

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Course	Code	Outcome
Theory	SEC(A)-3-1-TH	CO 8: Learn the morphology, social behaviour, and culture methods of honeybees.
		CO 8.1: Morphology and social behaviour of bees.
		CO 8.2: Modern instruments and methods in honeybee culture.
		CO 8.3: Diseases of honeybees and control measures.
		CO 8.4: Apiary products and their uses.
		CO 8.5: Modern methods to improve the bee industry.
Theory	SEC(A)-3-2-TH	CO 9: Learn taxonomy, morphology, and culture of silk moths.
		CO 9.1: Taxonomy, morphology, and distribution of silk moths.
		CO 9.2: Life history of Bombyx mori.
		CO 9.3: Culture of mulberry plants.
		CO 9.4: Pest and disease control in silk moths.

Semester IV

Course	Code	Outcome
Theory	CC-4-8-TH	CO 10: Understand comparative anatomy and physiology of vertebrates.
		CO 10.1: Comparative anatomy of integument, digestive, respiratory, circulatory, and excretory systems.
		CO 10.2: Comparative study of vertebrate skeletons, brain, and sense organs.

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Course	Code	Outcome
Practical	CC-4-8-P	CO 10.3: Comparative study of vertebrate skeletons through permanent slides/photographs.
		CO 10.4: Study of disarticulated skeletons of various vertebrates.
		CO 10.5: Comparative study of vertebrate hearts and brains.
Theory	CC-4-9-TH	CO 11: Understand the physiology of digestion, respiration, circulation, and excretion in vertebrates.
		CO 11.1: Physiology of digestion and absorption.
		CO 11.2: Mechanism of respiration and gas transport.
		CO 11.3: Physiology of circulation, cardiac cycle, and blood pressure regulation.
		CO 11.4: Thermal regulation and osmoregulation in vertebrates.
Practical	CC-4-9-P	CO 11.5: Blood grouping and hemoglobin estimation.
		CO 11.6: Observation of human and cockroach blood cells.
		CO 11.7: Measurement of blood pressure.
Theory	CC-4-10-TH	CO 12: Learn about the immune system, antigens, antibodies, and immune responses.
		CO 12.1: Cells and organs of the immune system.
		CO 12.2: Structure and function of immunoglobulins.
		CO 12.3: Antigen-antibody interactions and immunoassays.
Practical	CC-4-10-P	CO 12.4: Demonstration of lymphoid organs.

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Course	Code	Outcome
		CO 12.5: Histology of immune organs.
		CO 12.6: Techniques like ELISA.
Theory	SEC(B)-4-1-TH	CO 13: Learn aquarium fishery techniques and fish biology.
		CO 13.1: Biology of ornamental fishes.
		CO 13.2: Fish handling, transport, and packaging techniques.
		CO 13.3: Aquarium setup and budgeting.
Theory	SEC(B)-4-2-TH	CO 14: Learn pathological instruments and diagnostic methods.
		CO 14.1: Analysis of blood and urine samples.
		CO 14.2: Clinical features and prevention of diseases.
		CO 14.3: Antibiotics and their applications.
		CO 14.4: Tumors, diagnostic methods, and treatments.

Semester V

Course	Code	Outcome
Theory	CC-5-11-TH	CO 15: Understand ecology, population dynamics, and biodiversity.
		CO 15.1: Basic concepts of ecology and population ecology.
		CO 15.2: Characteristics of communities and ecosystems.

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Course	Code	Outcome
		CO 15.3: Biodiversity conservation strategies.
Practical	CC-5-11-P	CO 15.4: Population density and diversity indices.
		CO 15.5: Aquatic ecosystem studies and ecological parameters.
Theory	CC-5-12-TH	CO 16: Learn Mendelian genetics, linkage, mutations, and sex determination.
		CO 16.1: Principles of Mendelian genetics.
		CO 16.2: Gene linkage and mapping.
		CO 16.3: Types and mechanisms of mutations.
Practical	CC-5-12-P	CO 16.4: Chromosomal aberrations and pedigree analysis.
Theory	DSE(A)-5-1-TH	CO 17: Understand parasitology and medical entomology.
		CO 17.1: Life cycles, transmission, and control of parasites.
Practical	DSE(A)-5-1-P	CO 17.2: Study of parasites and their life cycles.
Theory	DSE(A)-5-2-TH	CO 18: Learn insect taxonomy, morphology, and behavior.
		CO 18.1: Taxonomy and morphology of insects.
		CO 18.2: Metabolic functions and social behavior of insects.
Practical	DSE(A)-5-2-P	CO 18.3: Life cycle and reproduction of insects.
Theory	DSE(B)-5-1-TH	CO 19: Understand endocrinology and hormone functions.
		CO 19.1: Morphology and function of endocrine glands.

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Course	Code	Outcome
Practical	DSE(B)-5-1-P	CO 19.2: Microtomy and histological slide preparation.

Semester VI

Course	Code	Outcome
Theory	CC-6-13-TH	CO 21: Understand animal development, gametogenesis, and embryogenesis.
		CO 21.1: Processes of fertilization, cleavage, and blastulation.
Practical	CC-6-13-P	CO 21.2: Study of embryonic development stages.
Theory	CC-6-14-TH	CO 22: Learn evolutionary concepts, speciation, and population genetics.
		CO 22.1: Origin of life, natural selection, and evolutionary theories.
Practical	CC-6-14-P	CO 22.2: Study of fossils and phylogenetic trees.
Theory	DSE(A)-6-1-TH	CO 23: Understand biotechnology concepts, gene manipulation, and animal cell culture.
Practical	DSE(A)-6-1-P	CO 23.1: Techniques for gene manipulation and cell culture.
Theory	DSE(A)-6-2-TH	CO 24: Learn genome concepts, genetic modifications, and molecular diagnostics.
Practical	DSE(A)-6-2-P	CO 24.1: Techniques for genetic analysis and molecular diagnostics.
Theory	DSE(B)-6-1-TH	CO 25: Understand ethology, biological rhythms, and animal behavior.

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Course	Code	Outcome
Practical	DSE(B)-6-1-P	CO 25.1: Field study of animal behavior.
Theory	DSE(B)-6-2-TH	CO 26: Learn fish biology, aquaculture, and fishery management.
Practical	DSE(B)-6-2-P	CO 26.1: Techniques for fish identification and aquacultural practices.

Programme-General (2018-2019, 2019-2020, 2020-2021)

Year	Semester	Paper	Course	Outcome
Part I	Sem I	CC1/GE1	CO 1	Learn general characteristics and classifications of Nonchordate and Chordate phyla.
Part I	Sem II	CC2/GE2	CO 2	Learn integumentary systems and early embryonic development.
Part II	Sem III	CC3/GE3	CO 3	Understand nerve and muscle physiology, digestion, and respiration.
Part II	SEC-A(1)		CO 4.	Learn the morphology and culture methods of honeybees
Part II	Sem IV	CC4/GE4	CO 5	Understand genetic inheritance and evolutionary theories.
Part II	SEC-B(1)		CO 6	Learn aquarium fishery techniques and biology of ornamental fishes.
Part III	Sem V	DSEA(1)	CO 7	Understand parasitology and the biology of economically important insects.
Part III	DSEB(1)		CO 8	Learn about aquatic ecosystems and pollution.
Part III	SECA(2)		CO 9	Understand the taxonomy and culture of silk moths.

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Year	Semester	Paper	Course	Outcome
Part III	Sem VI	DSEA(2)	CO 10	Learn about insect morphology, vectors, and disease control.
Part III	DSE B(2)		CO 11	Understand ecology and environmental conservation.
Part III	SEC B(2)		CO 12	Learn practical techniques in pathology and diagnostics.

Mapping of PO and CO

Programme Outcome	Courses
PO1: Acquiring in-depth knowledge	CO1, CO2, CO8, CO15, CO9
PO2: Analysis and corroboration	CO2, CO4, CO9, CO11, CO16, CO18, CO14
PO3: Laboratory skills and Instrumentation	CO3, CO15, CO6, CO13, CO15, CO25, CO15
PO4: Skill Enhancement	CO4, CO16, CO7, CO14, CO19, CO26
PO5: Design and Performance of Experiments	CO5, CO12, CO23, CO24
PO6: Analysis with Statistical Inference	CO6, CO23, CO24
PO7: Building of Environmental ethics, Sustainability, and Conservation	CO10, CO24
PO8: Communication, bonding, and learning through group activity	CO12

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Raidighi College Department of Botany

(Programme Outcome, Course Outcome and Program Specific Outcome) Prescribed in University of Calcutta Syllabus (2018-2019) within the CBCS

Core courses (CC-Total 14 courses to be studied in semesters. All theoretical papers i.e., BOT-A…TH

are of 4 credits each and the respective practical papers i.e., BOT-A….P of 2 credits each)

SEM I:

Phycology and Microbiology (BOT-A-CC-1-1-TH, BOT-A-CC-1-1-P)

Mycology and Phytopathology (BOT-A-CC-1-2-TH, BOT-A-CC-1-2-P)

SEM II

Plant anatomy (BOT-A-CC-2-3-TH, BOT-A-CC-2-3-P)

Archegoniate (BOT-A-CC-2-4-TH, BOT-A-CC-2-4-P)

SEM III

Palaeobotany and Palynology (BOT-A-CC-3-5-TH, BOT-A-CC-3-5-P)

Reproductive biology of Angiosperms (BOT-A-CC-3-6-TH, BOT-A-CC-3-6-P)

Plant systematic (BOT-A-CC-3-7-TH, BOT-A-CC-3-7-P)

SEM IV

Plant geography, Ecology and Evolution (BOT-A-CC-4-8-TH, BOT-A-CC-4-8-P)

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Economic Botany (BOT-A-CC-4-9-TH, BOT-A-CC-4-9-P)

Genetics (BOT-A-CC-4-10-TH, BOT-A-CC-4-10-P)

SEM V

Cell and Molecular biology (BOT-A-CC-5-11-TH, BOT-A-CC-5-11-P)

Biochemistry (BOT-A-CC-5-12-TH, BOT-A-CC-5-12-P)

SEM VI

Plant Physiology (BOT-A-CC-6-13-TH, BOT-A-CC-6-13-P)

Plant Metabolism (BOT-A-CC-6-14-TH, BOT-A-CC-6-14-P)

Skill enhancement courses (SEC- 2, two papers to be selected from the list taking 1 from SEC A in 3rd SEM and 1 from SEC B in 4th SEM. Both the papers of 2 credits each and theoretical only)

SEC A (SEM III)

Applied Phycology, Mycology and Microbiology (BOT-A-SEC-A-3-1)

Biofertilizers (BOT-A-SEC-A-3-2)

SEC B (SEM IV)

Plant Breeding (BOT-A-SEC-B-4-3)

Mushroom Culture Technology (BOT-A-SEC-B-4-4)

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Discipline specific elective courses (DSE, four courses to be selected from the 2 groups (A & B). A student shall choose any one paper from each of Group- A and Group- B in 5th AND 6th SEM. Each course comprises of theoretical component of 4 credits and practical ones of 2 credits)

DSE-A (Group- A) SEM-V Biostatistics (BOT-A-DSE-A-51TH, BOT-A-DSE-A-5-1-P)
1.
Industrial and Environmental Biology (BOT-A-DSE-A-5-2-TH, BOT-A-DSE-A-5-2-P) SEM VI

Medicinal and Ethnobotany (BOT-A-DSE-A-6-3-TH, BOT-A-DSE-A-6-3-P)

Stress Biology (BOT-A-DSE-A-6-4-TH, BOT-A-DSE-A-6-4-P) DSE-B (Group-B)

SEM V
1.
Plant Biotechnology (BOT-A-DSE-B-5-5-TH, BOT-A-DSE-B-5-5-P)

Horticultural practices and Post Harvest Technology (BOT-A-DSE-B-5-6-TH, BOT-A-DSE-B-5-6- P)

SEM VI
1.
Research Methodology (BOT-A-DSE-B6-7-TH, BOT-A-DSE-B-6-7-P)

Natural resource management (BOT-A-DSE-B-6-8-TH, BOT-A-DSE-B-6-8-P)

Programme Outcome:
•
Apply the knowledge of biology to make scientific quires and enhance the comprehension potential.

Convey and practice social, environmental and biological ethics.

Insist the significance of conserving a clean environment for perpetuation and sustainable development.

Study incessantly by self to cope with growing competition for higher studies and employment.

To provide adequate knowledge and skill to the students' which might be enabled them to pursue further studies in Botany and related areas or multidisciplinary areas that can be helpful for self-employment/entrepreneurship.

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To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A botany graduate in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.

B.Sc. Chemistry (Hons. and Gen.)

Program Outcome

Chemistry is the fundamental study of the structures, properties, and reactions of all matter in existence throughout the universe and underpins the central sciences of Biology and Physics. There are four main sub-disciplines of chemistry and the Honours course focuses on delivering a rigorous knowledge and understanding of all aspects of inorganic, organic, physical, and analytical chemistry:

- **Inorganic chemistry** studies materials such as metals and their salts.
- **Organic chemistry** involves the study of compounds containing primarily carbon.
- **Physical chemistry** measures the interaction of matter and energy.
- **Analytical chemistry** involves qualitative and quantitative observations and spectroscopy – study of a range of practical skills to understand and assess risks and work safely and competently in the laboratory.

The program outcome may be categorised as follows:

Program Outcomes (PO)	Description
PO 1	Students will be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical in all disciplines of Chemistry.
PO 2	Students can solve their subjective problems very methodically, independently, and finally draw a logical conclusion.
PO 3	Students can develop critical thinking and to design, carry out, record, and analyze the results of chemical reactions.
PO 4	Students will be able to get good laboratory practice with proper safety.

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Program Outcomes (PO)	Description
PO 5	Students can find out the green route for chemical reaction for sustainable development.
PO 6	Students will be capable of applying modern technologies, handling advanced instruments, and Chemistry-related software for chemical analysis, characterization of materials, and in separation technology.
PO 7	Students will be made aware of the impact of chemistry on the environment, society, and development outside the scientific community.
PO 8	To prepare the students for a successful career in industry and to motivate them for higher education and take up research as a career.
PO 9	To develop an opportunity to work in interdisciplinary groups.

Program Specific Outcome

Program Specific Outcomes (PSO)	Description
PSO 1	To apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories and in industries.
PSO 2	The students shall be made familiar with the different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymer, medicinal, and biochemistry.
PSO 3	Students shall acquire the ability to synthesize, separate, and characterize compounds using laboratory and instrumentation techniques.
PSO 4	To develop leadership and managerial skills promoting the need for lifelong learning as required for a competent professional.
PSO 5	To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.

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Program Specific Outcomes (PSO)	Description
PSO 6	To identify chemical formulae and solve numerical problems.
PSO 7	Students shall achieve the skills required to succeed in graduate school, professional school, and the chemical industry like Cement industries, Agro product, Paint industries, Rubber industries, Petrochemical industries, Food processing industries, Fertilizer industries, etc.
PSO 8	Students will be able to understand the importance of the elements in the periodic table including their physical and chemical nature and role in daily life.

Course Outcome

Based on University of Calcutta Syllabus for Honours (CBCS)

Semester	Course Code	Course Outcomes
SEM1	CC1-1-TH	**Inorganic Chemistry-1**
		CO1. To learn about the extra nuclear structure of atom and get a basic idea about Quantum Chemistry and its Application.
		CO2. Gives an idea about different types of acids, their definitions and also gives a clear concept about pH, buffer, and indicator.
		CO3. To get an idea of redox reaction – Oxidation and reduction reaction, oxidation number, competitive electron transfer reaction, electrode process.
SEM1	CC1-1-P	**Inorganic Chemistry: I (1) LAB**
		CO4. To study the estimation of ions or salts by acid-base titration method and oxidation-reduction titration method.
SEM1	CC1-2-	**Physical Chemistry-1**

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Semester	Course Code	Course Outcomes
	TH	
		CO1. To get some fundamental understanding of the concept of pressure, temperature, average velocity, average energy, etc. of gas molecules and able to derive the expressions of those properties using Kinetic Theory of gas.
		CO2. To get some ideas about various transport processes such as diffusion and viscosity and their measurements.
		CO3. Help the students to understand the basic concepts regarding rates of various chemical reactions, measurements of the order and rate of the reactions, dependence of rate constants and hence the rate of the reaction on temperature, catalysts, etc. and plausible mechanisms of the reactions.
SEM1	CC1-2-P	Physical Chemistry: P (1) LAB
		CO4. The laboratory course enables students to determine the viscosity of unknown liquid with respect to water by using an instrument like Viscometer, solubility of sparingly soluble salt in water and in presence of electrolyte with common ion and in presence of non-electrolyte. They will also study the kinetics of various chemical reactions.

Semester	Course Code	Course Outcomes
SEM2	CC2-3-TH	Organic Chemistry-2
		CO1. It provides an advanced idea on axial chirality, topicity, etc., and the conformational analysis of organic molecules.
		CO2. Students will learn the thermodynamics of organic reactions and basic concept reaction mechanism.

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Semester	Course Code	Course Outcomes
SEM2	CC2-3-P	**Organic Chemistry LAB**
		CO3. To get a detailed idea about the nucleophilic substitution reactions (SN1, SN2) along with NGP and SNi and stereochemical and regiochemical outcome of elimination reactions.
		CO4. The laboratory course enables students to get basic skill of organic synthesis through the preparation methodology.
SEM2	CC2-4-TH	**Inorganic Chemistry-2**
		CO1. To get an idea about Ionic bond and Covalent bond laws, rules and equations for the formation of chemical bonds, solubility, hybridization, and dipole moment of molecules.
		CO2. To develop a concept about MOT (Molecular orbital theory), LCAO (Linear combination of atomic orbitals), Metallic bond, and Weak Chemical Forces, etc.
		CO3. To understand the concept of radioactivity and radioactive compounds, nuclear reactions, artificial radioactivity, radiocarbon dating, hazards of radiation, and safety measures.
SEM2	CC2-4-P	**Inorganic Chemistry LAB**
		CO4. To know experimentally how to estimate the percentage of chlorine in bleaching powder; vitamin C; arsenic and antimony in a sample by iodimetric titration method. Students can also learn how to estimate Cu in brass, Cr and Mn in steel, and Fe in cement.
Semester	Course Code	Course Outcomes
SEM3	CC3-5-TH	**Physical Chemistry-2**
		CO1. Students will learn three-dimensional structure of organic molecules which is very much

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Semester	Course Code	Course Outcomes
		essential to visualize molecules.
		CO2. To get an idea about the structure and nature of intermediates like carbocations, carboanions, radicals, and carbenes.
SEM3	CC3-5-P	**Physical Chemistry LAB**
		CO3. The laboratory course helps students to develop laboratory training to use melting point and boiling apparatus.
SEM3	CC3-6-TH	**Inorganic Chemistry-3**
		CO1. To study in detail about the modern periodic table, physical and chemical properties of the elements along a group or period, factors influencing those properties, relativistic effects, and inert pair effect.
		CO2. To study the chemistry of s and p block elements and to get an elementary idea about occurrence, use of Noble gases, Nature of bonding of Noble gas compounds, and their preparations including noble gases and their compounds in detail.
		CO3. To learn about inorganic polymers with types, structural aspects, and their applications in detail.
		CO4. To get a basic idea about different types of coordination complexes, theory of coordination complexes, and their nature of bonding. To learn about the Werner's theory for complex formation, structural and stereoisomerism of coordination complexes.
SEM3	CC3-6-P	**Inorganic Chemistry LAB**
		CO5. To learn the complexometric and gravimetric estimation of different ions, chromatographic separation of (i) Ni (II) and Cu (II) ions, (ii) Fe (III) and Al (III) ions.

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Semester	Course Code	Course Outcomes
SEM3	CC3-7-TH	**Organic Chemistry-3**
		CO1. To get a detailed idea about the electrophilic addition reactions of organic molecules with stereochemistry.
		CO2. It informs about the preparation of different aromatic compounds using the idea of substitution reaction.
		CO3. To get a detailed idea about nucleophilic addition to carbonyl carbon 1,2- addition vs 1,4- addition by using organometallic compounds.
		CO4. The students learn the application of organic reaction and some tricks for qualitative and quantitative analysis of some organic compounds used in daily life.
SEM3	CC3-7-P	**Organic Chemistry LAB**
		CO5. The laboratory course enables students to perform the identification and synthesis of various organic compounds.
SEM3	SEC-1	**Mathematics and Statistics for Chemists**
		CO1. To get a basic idea of mathematical functions, differential equations, probability, vectors, matrices, and determinants.
		CO2. To learn about qualitative and quantitative aspects of analysis and helps to understand how to present data after analysis.
SEM3	SEC-A	**Analytical Clinical Biochemistry**
		CO1. To learn about the preparation, structures, reactions, and biological importance of carbohydrates, proteins, enzymes, lipids, and lipoproteins.

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Semester	Course Code	Course Outcomes
		CO2. To know the biochemistry of different diseases through a diagnostic approach by blood and urine analysis.
		CO3. To learn how to isolate proteins and how to perform the qualitative estimation of carbohydrates, proteins, and lipids.
		CO4. To study the quantitative estimation of carbohydrates, cholesterol, nucleic acids, determination of the iodine number of oil, and saponification number of oil.

Semester	Course Code	Course Outcomes
SEM4	CC4-8-TH	**Organic Chemistry-4**
		CO1. To get detailed ideas about preparations and applications of nitrogenous organic compounds.
		CO2. Students will learn Rearrangements of organic compounds in the presence of different reagents and learn the mechanism of rearrangement.
SEM4	CC4-8-P	**Organic Chemistry LAB**
		CO3. To get detailed ideas about synthesis strategy of the synthesis of organic compounds with the knowledge of organic reactions and mechanisms.
		CO4. Idea about the analysis of different organic compounds using different spectroscopic methods.
		CO5. The laboratory course enables students to get ideas about the detection of functional groups and preparation of derivatives using the knowledge of organic chemistry.
SEM4	CC4-9-	**Physical Chemistry-3**

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Semester	Course Code	Course Outcomes
	TH	
		CO1. Students will learn the thermodynamic basis of various colligative properties, its derivation, various applications, and its abnormal behavior. Students will also understand the background of phase transitions and the behavior of binary solutions.
SEM4	CC4-9-P	**Physical Chemistry LAB**
		CO2. To develop a concept about the fundamental quantum theories which help the students to understand wave-particle duality of matter and uncertainty relationship. Students will become familiar with the techniques to solve the translational motion of quantum mechanical system by modeling particle in box problem with the help of fundamental postulates of quantum mechanics.
		CO3. To understand about the various types of solids, lattices, laws of crystallography, representation of crystal planes, and able to solve the dilemma of classical picture of calculation of specific heat of solid.
		CO4. To know experimentally how to handle digital polarimeter and study the kinetics of inversion of cane sugar by using it. They will also learn to draw the phase diagram of binary solvents. They will also handle digital pH meter for pH metric titration of dibasic and tribasic acid against strong base.
SEM4	CC4-10-TH	**Inorganic Chemistry-4**
		CO1. To get an idea about elementary Crystal Field theory, MO concept, Magnetism, Colour, Magnetic moment, and Selection rules for electronic spectral transitions, etc.
SEM4	CC4-10-P	**Inorganic Chemistry LAB**
		CO2. To get a basic idea about transition elements (3d, 4d, and 5d) like their electronic

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Semester	Course Code	Course Outcomes
		configuration, oxidation states, and properties, etc. and also get a clear idea about Lanthanoids and Actinoids.
		CO3. To get an idea about various types of substitution reactions and their mechanisms, Thermodynamic and Kinetic stability-related problems.
		CO4. The laboratory course enables students to learn experimentally how to synthesize inorganic complexes and determine the λmax values of inorganic complexes. To calculate the 10Dq value by spectrophotometric method.
SEM4	SEC–B	**Pharmaceuticals Chemistry**
		CO1. To learn about the drug discovery, design, and development of representative drugs of the following classes: Analgesics, Antipyretic, Anti-inflammatory, Anti-bacterial, Antifungal, Antiviral, Antibiotics, Anti-leprosy, Central Nervous System agents, HIV-AIDS related drugs.
		CO2. To get an idea about aerobic and anaerobic fermentation.
		CO3. To learn experimentally the preparation of aspirin and its analysis.
		CO4. To learn experimentally the preparation of magnesium bisilicate (Antacid).
SEM4	SEC-4	**Pesticide Chemistry**
		CO1. To learn about the preparation, structures, properties, reactions, benefits, and adverse effects of representative pesticide of the following classes: Organochlorines, Organophosphates, Carbamates, Quinones.
		CO2. To learn to calculate acidity/ alkalinity in a given sample of pesticide formulations as per BIS specifications.
		CO3. To learn experimentally the preparation of organophosphates, phosphonates, and thiophosphates.

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Semester	Course Code	Course Outcomes
SEM5	CC5-11-TH	**Physical Chemistry-4**
		CO1. Students will learn to set up and solve the Schrödinger wave equations for vibrational motion of a system by modeling it as SHO, rotational motion of the system by modeling it as rigid rotor, and the real system hydrogen atom and hydrogen-like ions. This segment provides some quantum mechanical basis of chemical bonding with the help of VB theory and MO theory.
		CO2. Students will learn to set up some relations of various macroscopic properties with the properties of microscopic constituents of the system using statistical methods and the concept of partition function.
SEM5	CC5-11-P	**Physical Chemistry LAB**
		CO3. Help students to derive numerical methods of various mathematical operations such as differentiation, integrations, and the solutions of linear and nonlinear equations.
		CO4. The laboratory course enables students to become familiar with the computer program FORTRAN and by using this program they can evaluate numerical differentiation, numerical integrations, etc.
SEM5	CC5-12-TH	**Organic Chemistry-5**
		CO1. It provides knowledge about the detection and transformation of carbohydrates and their uses.
SEM5	CC5-12-P	**Organic Chemistry LAB**
		CO2. To get an idea about the preparation and different reactions of heterocyclic compounds.

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Semester	Course Code	Course Outcomes
		CO3. To get a general idea about pericyclic reactions, stereochemistry of cyclic organic compounds, and their reactions.
		CO4. Basic idea about preparations and applications of bio-molecules.
		CO5. The laboratory course helps students to learn about qualitative and quantitative separations and purifications of organic compounds. Helps to do qualitative analysis of organic compounds using IR and NMR spectroscopy.
SEM5	DSE	**Molecular Modelling & Drug Design**
		CO1. It introduces the students to the pharmaceutical aspect and importance of chemistry by molecular modeling and computer simulation.
SEM5	DSEA-1	**Applications of Computers in Chemistry**
		CO2. Students will learn to optimize C–C bond lengths and compare the shapes in different Organic molecules.
SEM5	DSEB-1	**Inorganic Materials of Industrial Importance**
		CO1. Students will learn the synthetic procedure and use of different commercially important materials like silicates, fertilizers, alloys, catalysts, surface coating materials, and batteries.
		CO2. To learn about the general principles, properties, classification, industrial use, deactivation, and regeneration of catalysis.
SEM5	DSEB-2	**Novel Inorganic Solids**
		CO1. Introduces students to advanced fields of chemistry like synthetic modification of different industrially important inorganic solids, synthesis of nano-materials, polymers, etc.
		CO2. To understand how to synthesize hydro-gel by co-precipitation method and silver and gold

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Semester	Course Code	Course Outcomes
		nanoparticles.
		CO3. Determination of ions by cation exchange method and total difference of solids in a composite material.

Semester	Course Code	Course Outcomes
SEM6	CC6-13-TH	**Inorganic Chemistry-5**
		CO1. Students get an idea about basic principles involved in qualitative analysis of cations and anions in various groups.
SEM6	CC6-13-P	**Inorganic Chemistry LAB**
		CO2. To study about the essential and beneficial elements of our life and various types of dioxygen management protein and their activity.
		CO3. To learn about inorganic polymers with types, structural aspects, and their applications in detail.
		CO4. To develop an idea about different types of organometallic compounds and their preparation and their applications as catalysis in various industrial processes.
SEM6	CC6-14-TH	**Physical Chemistry-5**
		CO1. To get a vast knowledge of the principles, experimental techniques, and broad chemical applications of Rotational, Vibrational, Electronic, and Raman spectroscopy.
SEM6	CC6-14-	**Physical Chemistry LAB**

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Semester	Course Code	Course Outcomes
	P	
		CO2. To learn about various photochemical and photophysical processes like fluorescence, phosphorescence, etc., various laws of photochemistry, and the concept of quantum yield. Students are also able to get knowledge regarding the detailed theoretical and mathematical treatment of reaction rate and the mechanism of unimolecular reactions.
		CO3. To get information about the origin of various surface properties such as surface tension, adsorption, etc., and molecular properties such as dipole moment and polarizability. They will also learn the various types of colloids, their stability, electro-kinetic phenomena, and the concept of micelle.
		CO4. The students will learn to handle very sophisticated instruments like Spectrophotometer to perform various spectroscopy-based experiments like verification of Lambert-Beer's law and measurement pH of unknown buffer solution, indicator constant of acid-base indicator, rate constants of chemical reactions. They will also be able to handle instruments like Stalagmometer for the determination of surface tension of liquid and CMC of micelle.
SEM6	DSE	**Green Chemistry and Chemistry of Natural Products**
		CO1. Students of undergraduate course are continuously being introduced and encouraged about the different possibilities in this field. It helps students to think and perform to design and develop environmentally benign methods for organic synthesis.
SEM6	DSEA-4	**Analytical Methods in Chemistry**
		CO1. Helps to learn about different analytical methods (Flame Atomic Absorption and Emission Spectrometry, Thermogravimetry, pH metric, Potentiometric, and Conductometric Titrations) to identify and separate the products formed during different chemical transformations.
		CO2. To study the fundamental laws of spectroscopy and selection rules.
		CO3. To learn the methods of separation of stereoisomers by spectral, chemical, and

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Semester	Course Code	Course Outcomes
		chromatographic data analysis (IC, GLC, GPC, TLC, and HPLC).
		CO4. To study experimentally how to separate and identify a mixture of monosaccharides by chromatography method.
		CO5. To learn experimentally how to separate a mixture of ions by solvent extraction technique; determination of pH of soil and estimation of Ca, Mg, and phosphate ion in soil.
		CO6. To determine the pKa values of an indicator, COD, and BOD using spectrophotometry.
SEM6	DSEB-3	**Polymer Chemistry**
		CO1. To learn about the history, functionality, and importance of polymeric materials.
		CO2. To study the kinetics of polymerization, crystallization, and crystallinity of polymers.
		CO3. To understand the nature and structure of polymers, determination of molecular weight of polymers, and Tg.
		CO4. To study the preparation, structure, properties, and application of different types of addition and condensation polymers.
		CO5. To learn experimentally the synthesis of polymers.
		CO6. To learn experimentally how to characterize and analyze a polymeric compound or material.
SEM6	DSEB-4	**Dissertation**
		CO1. Here students have immense opportunities to consult different national and international research papers. Thus, they can enhance their knowledge and prepare useful review work in their desired topic with the help of faculty members.

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Semester	Course Code	Course Outcomes
		CO2. To know how to handle the technical devices for presenting research works.

Based on University of Calcutta Syllabus for Generic Elective Course in Chemistry (CBCS)

Semester	Course Code [CEM-G]	Course Outcomes
SEM1	CC1/GE1	CO1. To learn about the Kinetic Theory of Gases and Real Gases. To get an idea about the liquid state of matter and chemical kinetics.
		CO2. To learn the basic concept of Atomic Structure, Chemical Periodicity, and Acids and Bases.
		CO3. To learn about the fundamentals of organic chemistry, stereochemistry, nucleophilic substitution, and elimination reactions.
		CO4. To learn experimentally the quantitative estimation of some compounds and ions in a solution by using iodometric titration, permanganate titration, and dichromate titration.
SEM2	CC2/GE2	CO1. To learn about Thermodynamics, Chemical Equilibrium, Solutions, Phase Equilibria, and Solids.
		CO2. To learn the basic concept of Aliphatic Hydrocarbons.
		CO3. To learn about Error Analysis and Computer applications.
		CO4. To understand the various types of Redox Reactions and their applications.
		CO5. To learn experimentally how to study the kinetics of some reactions, viscosity of unknown liquid, surface tension of a liquid, and solubility of sparingly soluble salt.
SEM3	CC3/GE3	CO1. To understand Chemical Bonding and Molecular Structure and also to learn about

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Semester	Course Code [CEM-G]	Course Outcomes
		the p-Block Elements, Transition Elements, and Coordination Chemistry.
		CO2. To learn the basic concept of Aromatic Hydrocarbons, Organometallic Compounds, and Aryl Halides.
		CO3. To get detailed knowledge of Electrochemistry.
		CO4. To study experimentally the qualitative detection of known and unknown radicals in a mixture.
SEM3	SEC-1	**Basic Analytical Chemistry**
		CO1. To get a basic idea of analytical chemistry, sampling, accuracy and precision, sources of errors in analytical measurements.
		CO2. To learn about the analysis of soil, cosmetics, water, and food products.
		CO3. To understand Chromatography and Ion-exchange phenomenon.
SEM3	SEC-A	**Analytical Clinical Biochemistry**
		CO1. To learn about the preparation, structures, reactions, and biological importance of carbohydrates, proteins, enzymes, lipids, and lipoproteins.
		CO2. To know the biochemistry of different diseases through a diagnostic approach by blood and urine analysis.
Semester	Course Code [CEM-G]	Course Outcomes
SEM4	CC4/GE4	CO1. To learn about Alcohols, Phenols, Ethers, Carbonyl Compounds, Amines, Diazonium Salts, Amino Acids, and Carbohydrates.

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Semester	Course Code [CEM-G]	Course Outcomes
		CO2. To learn the basic concept of Crystal Field Theory.
		CO3. To learn about the fundamentals of Quantum Chemistry and Spectroscopy.
		CO4. To learn experimentally the qualitative analysis of single solid organic compound(s) and identification of a pure organic compound.
SEM4	SEC-B	**Pharmaceuticals Chemistry**
		CO1. To learn about the drug discovery, design, and development of representative drugs of the following classes: Analgesics, Antipyretic, Anti-inflammatory, Anti-bacterial, Antifungal, Antiviral, Antibiotics, Anti-leprosy, Central Nervous System agents, HIV-AIDS related drugs.
SEM4	SEC-4	**Pesticide Chemistry**
		CO1. To learn about the preparation, structures, properties, reactions, benefits, and adverse effects of representative pesticide of the following classes: Organochlorines, Organophosphates, Carbamates, Quinones.

Semester	Course Code [CEM-G]	Course Outcomes
SEM5	DSE(A)	**Novel Inorganic Solids**
		CO1. Introduces students with advanced fields of chemistry like synthetic modification of different industrially important Inorganic solids, synthesis of nano-materials, polymers, etc.
		CO2. To understand how to synthesize hydro-gel by co-precipitation method and silver and gold nanoparticles.
		CO3. Determination of ions by cation exchange method and total difference of solids in a composite material.

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Semester	Course Code [CEM-G]	Course Outcomes
SEM5	DSE(A)	**Inorganic Materials of Industrial Importance**
		CO1. Students will learn the synthetic procedure and use of different commercially important materials like silicates, fertilizers, alloys, catalysts, surface coating materials, and batteries.
		CO2. To learn about the general principles, properties, classification, industrial use, deactivation, and regeneration of catalysis.
		CO3. To learn about the preparation and explosive properties of lead azide, PETN, RDX, and the basic idea of rocket propellant.
		CO4. The practical course helps to learn how to analyze the composition of dolomite, composition of percentage of metals in alloy, electroless metallic coatings on ceramic and plastic.
		CO5. To know how to determine free acidity in ammonium sulphate fertilizer, estimation of Calcium in Calcium ammonium nitrate fertilizer, and phosphoric acid in superphosphate fertilizer.
Semester	Course Code [CEM-G]	Course Outcomes
SEM6	DSE(B)	**Green Chemistry and Chemistry of Natural Products**
		CO1. Students of undergraduate course are continuously being introduced and encouraged about the different possibilities in this field. It helps students to think and perform to design and develop environmentally benign methods for organic synthesis.
		CO2. To know about the examples of green reactions and future trends in green reaction.
		CO3. To learn how to perform green synthesis of a number of organic compounds in the

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Semester	Course Code [CEM-G]	Course Outcomes
		laboratory.
SEM6	DSEB-2	**Analytical Methods in Chemistry**
		CO1. Helps to learn about different analytical methods (Flame Atomic Absorption and Emission Spectrometry, Thermogravimetry, pH metric, Potentiometric, and Conductometric Titrations) to identify and separate the products formed during different chemical transformations.
		CO2. To study the fundamental laws of spectroscopy and selection rules.
		CO3. To learn the methods of separation of stereoisomers by spectral, chemical, and chromatographic data analysis (IC, GLC, GPC, TLC, and HPLC).
		CO4. To study experimentally how to separate and identify a mixture of monosaccharides by chromatography method.
		CO5. To learn experimentally how to separate a mixture of ions by solvent extraction technique; determination of pH of soil and estimation of Ca, Mg, and phosphate ion in soil.
		CO6. To determine the pKa values of an indicator, COD, and BOD using spectrophotometry.

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COURSE & PROGRAM OUTCOMES

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DEPARTMENT OF MATHEMATICS

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COURSE & PROGRAM OUTCOMES OF MATHEMATICS HONOURS AND GENERAL (B.SC.) UNDER CBCS

Programme outcomes

PO1: Scientific temper will be developed in Students.

PO2: Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the science stream.

PO3: Students will become employable; they will be eligible for career opportunities in Industry, or will be able to opt for entrepreneurship.

PO4: Students will possess basic subject knowledge required for higher studies, professional and applied courses like Management Studies, Law etc.

PO5: Students will be aware of and able to develop solution oriented approach towards various Social and Environmental issues.

Programme specific outcomes

PSO1: A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations , terminology.

PSO2: A student should get adequate exposure to global and local concerns that explore them many aspects of mathematical sciences.

PSO3 : Student is equipped with mathematical modeling ability, problem solving skills, creative talent and power of communication necessary for various kinds of employment.

PSO4: Student should be able to apply their skills and knowledge that is translate information presented verbally into mathematical form, select and use

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appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.

PSO5: Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

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MATHEMATICS HONOURS COURSE OUTCOMES

❖ **Semester-1:**

Core Course-1 (Unit-1: Calculus, Unit-2: Geometry & Unit-3: Vector Analysis)

Paper Code (Theory): MTM-A-CC-1-1-TH

Paper Code (Tutorial): MTM-A-CC-1-1-TU

Unit-1: Calculus

Learning Outcomes: On completion of this area of the course, the student will be able to

- Understand the nature of Hyperbolic functions.
- Find higher order derivatives and apply the Leibnitz rule to solve problems related to such derivatives.
- Plot the graphs of polynomials of degree 4 and 5, the derivative graph, the second derivative graph and compare them.
- Apply the concept and principles of differential calculus to find the curvature, concavity and points of inflection, envelopes, rectilinear asymptotes (Cartesian & parametric form only) of different curves.
- Trace standard curves in Cartesian coordinates and polar coordinates.
- Sketch parametric curves (Ex. trochoid, cycloid, epicycloids, hypocycloid).
- Apply the concept and principles of differential calculus to solve different geometric and physical problems that may arise in business, economics and life sciences.
- Solve various limit problems using L' Hospital's rule·
- Derive Reduction formulae for some complex integrations and hence Integrate functions of a much higher degree which are applicable in real life situations.
- Apply the integral calculus to find arc length of a curve, arc length of parametric curves, area under a curve, surface area and volume of surface of revolution.
- Graphically obtain the surface of revolution of curves.

Unit-2: Geometry

Learning Outcomes: On completion of this area of the course, the student will be able to

- Transform the co-ordinate system especially by Rotation of axes, thus reducing different second-degree equations to their corresponding simplest forms and also classify the conics using the discriminant.
- Become familiar with the polar equations of conics & their tangents and normals

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- Understand the geometrical terminology and have a detailed clear-cut idea of the Planes, Straight lines in 3D, Spheres, Cylindrical surfaces, Central conicoids, Paraboloids, Plane sections of conicoids along with the Tangent and normals of the conicoids.
- Have an idea of classification of quadrics.
- Develop an idea of the generating lines.

- Be familiar with the illustrations of graphing standard quadric surfaces like cones, paraboloids, hyperboloids and ellipsoids.
- Visualize and graphically demonstrate geometric figures and classify different geometric solids using teaching aid - preferably free softwares :
  - ✔ Tracing of conics in cartesian coordinates/ polar coordinates.
  - ✔ Sketching ellipsoid ,hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using cartesian coordinates.
- Understand the basic applications of the analytical plane and solid geometry.

Unit-3: Vector Analysis
Learning Outcomes: On completion of this area of the course, the student will be able to

- Find the Triple product of Products and their Applications
- Deduce the Vector equations subject to different conditions.
- Understand the applications of vector algebra (particularly, vector products) to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces.
- Learn operations with vector-valued functions.
- Find the limits and verify continuity of vector functions.
- Differentiate and integrate vector functions of one variable.

Core Course-2 (ALGEBRA: Unit-1, 2 & 3)
Paper Code(Theory): MTM-A-CC-1-2-TH
Paper Code (Tutorial):MTM-A-CC-1-2TU

Learning Outcomes: On completion of this course, the student will have a clear-cut understanding of some important concepts of Classical Algebra, Abstract Algebra & Linear Algebra as follows:

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Unit-1

- Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of the complex variable.
- Theory of equations: Relation between roots and coefficients, transformation of the equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method).
- Inequality: The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality. ●
  Linear difference equations with constant coefficients (up to 2nd order).

Unit-2
- Relation: equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation.
- Mapping: injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between the composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping
  $f: X \rightarrow Y$ and $B \subseteq Y$.
- Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di-visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as v, τ, σ and their properties.

Unit-3
- Rank of a matrix, inverse of a matrix, characterizations of invertible matrices.
- Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.

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❖ **Semester 2:**

Core Course-3 (Real Analysis: Unit-1,2,3)
Paper Code (Theory): MTM-A-CC-2-3-TH
Paper Code (Tutorial): MTM-A-CC-2-3-TU

Learning Outcomes:

After completion of this course, the students will be able to think about the basic proof techniques and fundamental definitions related to the real number system. They can demonstrate some of the fundamental theorems of analysis. The students will gradually develop Analysis skills in sets, sequences and infinite series of Real Numbers covered by the three respective units as follows:

Unit-1

- Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un-countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R.

- Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open interval.

Unit-2

- Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of convergent sequence. Uniqueness of limit. Algebra of limits.

- Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequences. Cauchy's first and second limit theorems.

- Subsequence, Subsequential limits. A bounded sequence $\{x_n\}$ is convergent if and only if $\lim \sup x_n = \lim \inf x_n$. Every sequence has a monotone subsequence.

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Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence.

Unit-3

Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence: comparison test, limit comparison test, ratio test, Cauchy's n-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence.

Graphical Demonstration (Teaching Aid-Preferably by computer softwares)
The students will gain hands on expertise in graphical demonstration of the following, using computer software or otherwise:
● Plotting of recursive sequences.
● Study the convergence of sequences through plotting.
● Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
● Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
● Cauchy's root test by plotting n-th roots.
● Ratio test by plotting the ratio of n-th and $(n + 1)$-th term.

Core Course-4 (Group Theory-I: Unit-1,2,3)
Paper Code (Theory): MTM-A-CC-2-4-TH
Paper Code (Tutorial): MTM-A-CC-2-4-TU

Learning Outcomes: On the completion of this course, the students will understand the basic concepts of Group Theory in Abstract/Modern Algebra covered by the following three units:
Unit-1
Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices),

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elementary properties of groups, examples of commutative and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.

Unit-2

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's Little theorem.

Unit-3

Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomorphisms, correspondence theorem and one-one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems.

❖ **Semester 3:**

Core Course-5 (Theory of Real Functions: Unit-1,2)
Paper Code (Theory): MTM-A-CC-3-5-TH
Paper Code (Tutorial): MTM-A-CC-3-5-TU

Learning Outcomes: After completion of this course, the students will be able to understand the concept of real-valued functions, limit, continuity, and differentiability in detail. They can find expansions of real functions in series forms. The students will become conversant with many of the important theorems of Differential Calculus after the completion of this Core Course which has been covered in the following two units:

Unit-1: Limit & Continuity of functions
● Limits of functions, sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limit. Infinite limits and limits at infinity. Some Important examples of limits.
● Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point.

   A function is continuous at x if and only if its oscillation at x is zero. Familiarity

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with the figures of some well-known functions: $y = x^a$ ($a = 2, 3, -1, -2$), $|x|$, sin x, cos x, tan x, log x, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions. Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point.

- Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and maintenance of the same sign. Continuous function on [a, b] is bounded and attains its bounds. Intermediate value theorem.

- Discontinuity of functions, type of discontinuity. Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have at most countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous.

- Uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous. A necessary and sufficient condition under which a continuous function on a bounded open interval will be uniformly continuous. A sufficient condition under which a continuous function on an unbounded open interval will be uniformly continuous (statement only). Lipschitz condition and uniform continuity.

Unit-2: Dierentiability of functions

- Differentiability of a function at a point and in an interval, algebra of differentiable functions. Meaning of sign of derivative. Chain rule.

- Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy — as an application of Rolle's theorem. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Expansion of e^x, log $(1 + x)$, $(1 + x)^m$, sin x, cos x with their range of validity (assuming relevant theorems). Application of Taylor's theorem to inequalities.

- Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems.

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Core Course-6: Ring Theory & Linear Algebra-I
Paper Code (Theory): MTM-A-CC-3-6-TH
Paper Code (Tutorial): MTM-A-CC-3-6-TU

Learning Outcomes:
After completion of this course, the students will mainly be able to

- Develop a concept on Ring Theory of Abstract Algebra in details.
- Understand vector spaces over a field and subspaces and apply their properties.
- Understand linear independence and dependence.
- Find the basis and dimension of a vector space, and understand the change of basis.
- Compute linear transformations, kernel and range, and inverse linear transformations, and find matrices of general linear transformations.
- Find eigenvalues and eigenvectors of a matrix and of linear transformation.
- The Cayley-Hamilton Theorem and its use in finding the inverse of a matrix
- Understand various concepts of Abstract & Linear Algebra covered in details by the following units:

Unit-1: Ring theory
Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. First isomorphism theorem, second isomorphism theorem, third iso-morphism theorem, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring.

Unit-2: Linear algebra-I
- Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear

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combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Subspaces of R^n, dimension of subspaces of R^n. Geometric significance of subspace.

- Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix. Algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms. Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

Core Course-7: Ordinary Differential Equation & Multivariate Calculus-I

Paper Code (Theory): MTM-A-CC-3-7-TH

Paper Code (Tutorial): MTM-A-CC-3-7-TU

Unit-1: Ordinary differential equation

Learning Outcomes:

On completion of this course, the student will be able to identify the type of a given differential equation and select and apply the appropriate analytical technique for finding the solution. The students will be well conversant with the following types of differential equations:

- First order differential equations: Exact differential equations and integrating factors, special integrating factors and transformations, linear equations and Bernoulli equations, the existence and uniqueness theorem of Picard (Statement only).
- Linear equations and equations reducible to linear form. First order higher degree equations solvable for *x, y* and *p*. Clairaut's equations and singular solution.
- Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.
- Linear differential equations of second order, Wronskian: its properties and applications, Euler equation, method of undetermined coefficients, method of variation of parameters.
- System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant

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coefficients.

- Planar linear autonomous systems: Equilibrium (critical) points, Interpretation of the phase plane and phase portraits.
- Power series solution of a differential equation about an ordinary point, solution about a regular singular point (up to second order).

Unit-2: Multivariate Calculus-I

Learning Outcomes:

On completion of this course, the student will be able to

- Understand the concept of neighbourhood of a point in R^n (n > 1), interior point, limit point, open set and closed set in R^n (n > 1).

- Identify functions from $R^n (n > 1)$ to $R^m (m \geq 1)$

- Develop concepts on limit and continuity of functions of two or more variables, their partial derivatives, total derivative and differentiability, along with the sufficient condition for differentiability, Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

- Find Extrema of functions of two variables & understand the use of the method of Lagrange multipliers & solve constrained optimization problems.

❖ **Semester 4:**

Core Course-8 (Riemann Integration & Series of Function: Unit-1,2,3)

Paper Code (Theory): MTM-A-CC-4-8-TH

Paper Code (Tutorial): MTM-A-CC-4-8-TU

Unit-1: Riemann integration

Learning Outcomes:

On completion of this unit of the course, the student will be able to

- Understand Partition and refinement of partition of a closed and bounded interval.
- Conceptualise Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral.
- Understand Darboux's theorem along with Darboux's definition of

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integration over a closed and bounded interval.

- Learn Riemann's definition of integrability and its Equivalence with Darboux definition of integrability along with the Necessary and sufficient condition for Riemann integrability.
- Conceptualize negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small, Examples of negligible sets: any subset of a negligible set, finite set, countable union of negligible sets.
- Learn that a bounded function on a closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible.

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- Develop the capacity to integrate, while understanding the examples of Riemann integrable functions.
- Develop the concept of Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions & properties of Riemann integrable functions arising from the above results.
- Have an idea of the functions defined by definite integral and its properties, Antiderivative (primitive or indefinite integral) and also the properties of Logarithmic function defined as the definite integral.
- Understand the Fundamental theorem of Integral Calculus & First Mean Value theorem of integral calculus.

Unit-2: Improper integral

Learning Outcomes:

On completion of this unit of the course, the student will be able to

- Understand well the Range of integration-finite or infinite and learn the Necessary and sufficient condition for convergence of improper integral in both cases.
- Learn the Tests of convergence: Comparison and M-test, Absolute and non-absolute convergence and inter-relations.
- Understand the Statement of Abel's and Dirichlet's test for convergence on the integral of a product.
- Develop an idea of convergence and working knowledge of Beta and Gamma and their interrelation.
- Compute different integrals when they exist (using Beta and Gamma function).

Unit-3: Series of functions

Learning Outcomes:

On completion of this unit of the course, the student will be able to develop a clear-cut idea on sequence and series of functions defined on a set after covering the following:

- Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence.
- Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence.

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- Power series: Fundamental theorem of power series. Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function.

- Fourier series: Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on $[-\pi, \pi]$. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.

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Core Course-9 (Partial differential equation & Multivariate Calculus-II)

Paper Code(Theory): MTM-A-CC-4-9-TH

Paper Code (Tutorial):MTM-A-CC-4-9-TU

Unit-1: Partial dierential equation
Learning Outcomes:

On completion of this unit of the course, the student will be able to understand, derive and solve different types of partial differential equations which may arise in real life problems:

● Partial differential equations of the first order, Lagrange's solution, non- linear first order partial differential equations, Charpit's general method of solution, some special types of equations which can be solved easily by methods other than the general method.

● Derivation of heat equation, wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order linear equations to canonical forms.

● The Cauchy problem, Cauchy-Kowalewskaya theorem, Cauchy problem of finite and infinite string. Initial boundary value problems. Semi-infinite string with a fixed end, semi-infinite string with a free end. Equations with non-homogeneous boundary conditions. Non-homogeneous wave equation. Method of separation of variables, solving the vibrating string problem. Solving the heat conduction problem.

Unit-2: Multivariate Calculus-II
Learning Outcomes:

After completion of this unit of the course which covers the following topics on multiple integrals, line integrals etc., the student will be able to apply these concepts to solve many real-life problems that may arise in different fields:

● Multiple integral: Concept of upper sum, lower sum, upper integral, lower-integral and double integral (no rigorous treatment is needed). Statement of existence theorem for continuous functions. Iterated or repeated integral, change of order of integration. Triple integral. Cylindrical and spherical coordinates. Change of variables in double integrals and triple integrals. Transformation of double and

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triple inte-grals (problems only). Determination of volume and surface area by multiple integrals (problems only). Differentiation under the integral sign, Leibniz's rule (problems only).

- Definition of vector field, divergence and curl. Line integrals, applications of line integral: mass and work. Fundamental theorem for line integrals, conservative vector fields, independence of path.
- Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

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Core Course-10 (Mechanics)
Paper Code (Theory): MTM-A-CC-4-10-TH
Paper Code (Tutorial): MTM-A-CC-4-10-TU

Learning Outcomes: After completion of this course, the students will be able to learn and explain different concepts on Mechanics including Statics covered by the following units:

Unit-1
● Coplanar forces in general: Resultant force and resultant couple, Special cases, Varignon's theorem, Necessary and sufficient conditions of equilibrium. Equilibrium equations of the first, second and third kind.
● An arbitrary force system in space: Moment of a force about an axis, Varignon's theorem. Resultant force and resultant couple, necessary and sufficient conditions of equilibrium. Equilibrium equations, Reduction to a wrench, Poinsot's central axis, intensity and pitch of a wrench, Invariants of a system of forces. Statically determinate and indeterminate problems.
● Equilibrium in the presence of sliding Friction force: Contact force between bodies, Coulomb's laws of static Friction and dynamic friction. The angle and cone of friction, the equilibrium region.

Unit-2
● Virtual work: Workless constraints - examples, virtual displacements and virtual work. The principle of virtual work, Deductions of the necessary and sufficient conditions of equilibrium of an arbitrary force system in plane and space, acting on a rigid body.
● Stability of equilibrium: Conservative force field, energy test of stability, condition of stability of a perfectly rough heavy body lying on a fixed body. Rocking stones.

Unit-3
● Kinematics of a particle: velocity, acceleration, angular velocity, linear and angular momentum. Relative velocity and acceleration. Expressions for velocity and acceleration in case of rectilinear motion and planar motion - in Cartesian and polar coordinates, tangential and normal components. Uniform circular motion.
● Newton laws of motion and law of gravitation: Space, time, mass,

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force, inertial reference frame, principle of equivalence and g. Vector equation of motion.

Work, power, kinetic energy, conservative forces - potential energy. Existence of potential energy function. Energy conservation in a conservative field. Stable equilibrium and small oscillations: Approximate equation of motion for small oscillation. Impulsive forces

Unit-4

- Problems in particle dynamics: Rectilinear motion in a given force field - vertical motion under uniform gravity, inverse square field, constrained rectilinear motion, vertical motion under gravity in a resisting medium, simple harmonic motion, Damped and forced oscillations, resonance of an oscillating system, motion of elastic strings and springs.

- Planar motion of a particle: Motion of a projectile in a resisting medium under gravity, orbits in a central force field, Stability of nearly circular orbits. Motion under the attractive inverse square law, Kepler's laws of planetary motion. Slightly disturbed orbits, motion of artificial satellites. Constrained motion of a particle on smooth and rough curves. Equations of motion referred to a set of rotating axes.

- Motion of a particle in three dimensions: Motion on a smooth sphere, cone, and on any surface of revolution.

Unit-5 (Many particles system)

- The linear momentum principle: Linear momentum, linear momentum principle, motion of the centre of mass, conservation of linear momentum.
- The angular momentum principle: Moment of a force about a point, about an axis. Angular momentum about a point, about an axis. Angular momentum principle about centre of mass. Conservation of angular momentum (about a point and an axis). Impulsive forces.
- The energy principle: Configurations and degrees of freedom of a multi-particle system, energy principle, energy conservation.
- Rocket motion in free space and under gravity, collision of elastic bodies. The two-body problem.

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❖ **Semester 5:**

Core Course-11 (Probability & Statistics)

Paper Code (Theory): MTM-A-CC-5-11-TH

Paper Code (Tutorial): MTM-A-CC-5-11-TU

Learning Outcomes: After completion of this course, the students will be able to understand & apply the concepts of probability & statistics covered in the following Units:

Unit-1

- Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probability space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function,

  probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions: uniform, normal, exponential.

Unit-2

- Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution.

Unit-3

- Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.

Unit-4

- Sampling and Sampling Distributions: Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with

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and without replacement. Sample characteristics. Sampling Distributions: Statistic, Sample moments. Sample variance, Sampling from the normal distributions, Chi-square, t and F -distributions and some other sampling distributions Estimation of parameters: Point estimation. Interval Estimation-Confidence Intervals for mean and variance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency, sufficiency, Minimum-Variance Unbiased Estimator (MVUE).

- Method of Maximum likelihood: likelihood function, ML estimators for discrete and continuous models.

Unit-5

- Statistical hypothesis: Simple and composite hypotheses, null hypotheses, alternative hypotheses, one-sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, level of significance. Power function of a test, most powerful test. The p-value (observed level of significance), Calculating p-values.
- Simple hypothesis versus simple alternative: Neyman-Pearson lemma (Statement only).
- Bivariate frequency Distribution: Bivariate data, Scatter diagram, Correlation, Linear Regression, principle of least squares and fitting of polynomials and exponential curves.

Graphical Demonstration (Teaching Aid Preferably by free softwares (e.g. R/ Python / SageMath etc.) but can be taught through black board/white board / square sheet etc. in case of unavailability.)

- Graphical representation of data - how to load data, plot a graph viz. histograms (equal class intervals and unequal class intervals), frequency polygon, pie chart, gives graphical summaries of data.
- Measures of central tendency and measures of dispersion, moments, skewness and kurtosis.
- Karl Pearson correlation coefficient.
- Correlation coefficient for a bivariate frequency distribution.
- Lines of regression, angle between lines and estimated values of variables.

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- Fitting of polynomials, exponential curves by method of least squares.
- Confidence interval for the parameters of a normal distribution (one sample and two sample problems).

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Core Course-12 (Group Theory-II & Linear Algebra-II)

Paper Code(Theory): MTM-A-CC-5-12-TH

Paper Code (Tutorial):MTM-A-CC-5-12-TU

Learning Outcomes: After completion of this course, the students will be able to demonstrate the mathematical maturity of understanding the advance aspects of Group Theory and Linear Algebra

Unit-1: Group theory

- Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.
- External direct product and its properties, the group of units modulo n as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.

Unit-2: Linear algebra

- Inner product spaces and norms, Gram-Schmidt orthonormalization process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its basic properties.
- Bilinear and quadratic forms, Diagonalization of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature.
- Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).

❖ **Semester 6:**

Core Course-13 (Metric Space & Complex Analysis)

Paper Code (Theory): MTM-A-CC-6-13-TH

Paper Code (Tutorial): MTM-A-CC-6-13-TU

Unit-1: Metric space

Learning Outcomes: On successful completion of the course students will be able to develop conceptual understanding of the following:

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- Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.

- Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. R is a complete metric space. Q is not complete.
- Continuous mappings, sequential criterion of continuity. Uniform continuity.
- Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.
- Concept of connectedness and some examples of connected metric space, connected subsets of R, C.
- Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.

Unit-2: Complex analysis

Learning Outcomes: After completion of this course, the students will be able to demonstrate understanding of the basic concepts and fundamental definitions underlying complex analysis. They can prove and explain concepts of series and integration of complex functions and clearly understand problem-solving using complex analysis techniques after covering the following topics:

- Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variables.
- Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic functions. M¨obius transformation.
- Power series: Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series.

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Analytic functions represented by power series. Uniqueness of power series.

- Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.

Core Course-14 (Numerical Methods)
Paper Code (Theory): MTM-A-CC-6-14-TH

Learning Outcomes: After completion of this course, the students will be able to: • Apply numerical methods to obtain approximate solutions to mathematical problems. • Solve the nonlinear equations, system of linear equations and interpolation problems using numerical methods. • Examine the appropriate numerical differentiation and integration methods to solve problems.

• Apply the numerical methods to solve algebraic as well as differentialequations. The course will be covered in the following units:

Unit-1
- Representation of real numbers, Machine Numbers - floatingpoint and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.

Unit-2
- Approximation: Classes of approximating functions, Types of approximations- polynomial approximation, The Weierstrass polynomial approximation theorem (statement only).
- Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton (Gregory) forward and backward difference interpolation.
- Central Interpolation: Stirling's and Bessel's formulas. Different interpolation zones, Error estimation. Hermite interpolation.

Unit-3
- Numerical differentiation: Methods based on interpolations; methods based on finite differences.
- Numerical Integration: Newton Cotes formula, Trapezoidal rule,

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Simpson's 1/3-rd rule, Simpson's 3/8-th rule, Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's 1/3-rd rule, composite Weddle's rule. Gaussian quadrature formula.

Unit-4

- Transcendental and polynomial equations: Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method. Numerical solution of a system of nonlinear equations - Newton's method.

Unit-5

System of linear algebraic equations:
- Direct methods: Gaussian elimination and Gauss Jordan methods, Pivoting strategies.
- Iterative methods: Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LU decomposition method (Crout's LU decomposition method).
- Matrix inversion: Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts).
- The algebraic eigen value problem: Power method.

Unit-6

- Ordinary differential equations: Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

Core Course-14 Practical (Numerical Methods Lab)

Paper Code (Practical): MTM-A-CC-6-14-P

Learning Outcomes: For any of the CAS (Computer aided software), students are introduced to Data types-simple data

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types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays. The students become expert in solving different numerical problems (listed below) by using computer programming techniques *of C/ C++/ FORTRAN 90*

- Calculate the sum $1+\frac{1}{2}+1/3+$ -------- $+1/N$
- Enter 100 integers into an array and sort them in an ascending order.

- Solution of transcendental and algebraic equations by

  i) Bisection method

  ii) Newton Raphson method (Simple root, multiple roots, complex roots).

  iii) Secant method.

  iv) Regula Falsi method.

- Solution of system of linear equations

  i) LU decomposition method

  ii) Gaussian elimination method

  iii) Gauss-Jacobi method

  iv) Gauss-Seidel method

- Interpolation

  i) Lagrange Interpolation

  ii) Newton's forward, backward and divided difference interpolations

- Numerical Integration

  i) Trapezoidal Rule

  ii) Simpson's one third rule

  iii) Weddle's Rule

  iv) Gauss Quadrature

- Method of finding Eigenvalue by Power method (up to 4×4)

- Fitting a Polynomial Function (up to third degree)

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- Solution of ordinary differential equations

  i) Euler method
  ii) Modified Euler method
  iii) Runge Kutta method (order 4)
  iv) The method of successive approximations (Picard)

Skill Enhancement Courses-SEC (Semester-3 & 4)

Learning Outcomes:

After the completion of these courses the students will acquire skills in thinking more logically in Mathematics, as well as they will understand the importance of C programming or object-oriented programming C++, both of which are very good programming tools for solving many real-life problems. The students can also acquire the skill of scientific computing using the software SageMath / R. The students will be introduced to the fundamental commands and structure of Sage Math/R.The course covers the basic syntax and semantics of SageMath & R , including basic data types, variables, control structures and functions or similar concepts, and visualization of results and processed data.

The course will be covered in the following:

C Programming Language (Semester-3)
Paper Code (Theory) : MTM-A-SEC-A-TH

- An overview of theoretical computers, history of computers, overview of architecture of computer, compiler,assembler, machine language, high level language, object oriented language, programming language and importance of C programming.

- Constants, Variables and Data type of C-Program : Character set. Constants and variables data types, expression, assignment statements, declaration.

- Operation and Expressions : Arithmetic operators, relational operators, logical operators.
- Decision Making and Branching : decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement.
- Control Statements : While statement, do-while statement, for statement.
- Arrays : One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.
- User-defined Functions : Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, Nesting of functions, passing of

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arrays to functions, Recurrence of function.
* Introduction to Library functions: stdio.h, math.h, string.h stdlib.h, time.h etc.

Or Object Oriented Programming in C++ (Semester-3)

Paper Code(Theory): MTM-A-SEC-A-TH

Unit-1
• Programming paradigms, characteristics of object oriented programming languages, brief history of C++,structure of C++ program, differences between C and C++, basic C++ operators, Comments, working with variables, enumeration, arrays and pointer.
Unit-2
• Objects, classes, constructor and destructors, friend function, inline function, encapsulation, data abstraction, inheritance, polymorphism, dynamic binding, operator overloading, method overloading, overloading arithmetic operator and comparison operators.
Unit-3
• Template class in C++, copy constructor, subscript and function call operator, concept of namespace and exception handling.
• **List of hands on examples (using C++)**
1. Calculate the sum $1/1 + 1/2 + 1/3 + \cdots + 1/N$
2. Enter 100 integers into an array and sort them in an ascending order.
3. HCF and LCM of three positive integers.
4. Separate even and odd numbers from first N natural numbers.
5. Find all the prime numbers between 1 and N (N being a positive integer).
6. Find the binary representation of a decimal number (up to 3 digits).
7. Addition , subtraction, multiplication of two matrices (order up to 4×4).
8. Compute the value of the determinant of a square matrix (order up to 4×4).

Mathematical Logic (Semester-4)
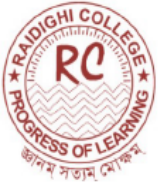
Paper Code (Theory): MTM-A-SEC-B-TH
Unit-1
• Introduction, propositions, truth table, negation, conjunction and disjunction. Implications,

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biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

• General Notions : Formal language, object and meta language, general definition of a Formal Theory/ Formal Logic.

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Unit-2

• Propositional Logic : Formal theory for propositional calculus, derivation, proof, theorem, deduction theorem, conjunctive and disjunctive normal forms, semantics, truth tables, tautology, adequate set of connectives, applications to switching circuits, logical consequence, consistency, maximal consistency, Leindenbaum lemma, soundness and completeness theorems, algebraic semantics.

Unit-3

• Predicate Logic : First order language, symbolizing ordinary sentences into first order formulae, free and bound variables, interpretation and satisfiability, models, logical validity, formal theory for predicate calculus, theorems and derivations, deduction theorem, equivalence theorem, replacement theorem, choice rule, Prenex normal form, soundness theorem, completeness theorem, compactness theorem, First Order

Theory with equality, examples of First Order Theories (groups, rings, fields etc.).

Or Scientific computing with SageMath & R (Semester-4)

Paper Code (Theory): MTM-A-SEC-B-TH

• Introduction to SageMath and R , Installation Procedure, Use of SageMath & R as a Calculator, Numerical and symbolic computations using mathematical functions such as square root, trigonometric functions, logarithms, exponentiations etc.

• Graphical representations of few functions through plotting in a given interval, like plotting of polynomial functions, trigonometric functions, Plots of functions with asymptotes, superimposing multiple graphs in one plot like plotting a curve along with a tangent on that curve (if it exists), polar plotting of curves.

• SageMath & R commands for differentiation, higher order derivatives, plotting $f(x)$ and $f0(x)$ together, integrals, definite integrals etc.

• Introduction to Programming in SageMath & R , relational and logical operators, conditional statements, loops and nested loops, without using inbuilt functions write programs for average of integers, mean, median, mode, factorial, checking primes, checking next primes, finding all primes in an interval, finding gcd, lcm, finding convergence of a given sequence, etc.

• Use of inbuilt functions that deal with matrices, determinant, inverse of a given real square matrix (if it exists), solving a system of linear equations, finding roots of a given polynomial, solving differential equations.

Discipline Specific Electives (DSE): (Semester 5 & 6)

DSE-A(1)	DSE-B(1)	DSE-A(2)	DSE-B(2)

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For Semester -5	For Semester -5	For Semester-6	For Semester-6
Advanced Algebra	Discrete Mathematics	Differential Geometry	Point Set Topology
Bio Mathematics	Linear Programming & Game Theory	Mathematical Modelling	Astronomy & Space Science
Industrial Mathematics	Boolean Algebra & Automata Theory	Fluid Statics & Elementary Fluid Dynamics	Advanced Mechanics

A student has to opt for any one of the subjects in DSE-A(1) and any one in DSE-B(1) in Semester 5. The student has to opt for any one of the subjects in DSE-A(2) and any one in DSE-B(2) in Semester 6.

Advanced Algebra

Paper Code(Theory):MTM-A-DSE-A-5-1-TH

Paper Code(Tutorial):MTM-A-DSE-A-5-1-TU

Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Explain the fundamental concepts of advanced algebra such as groups and rings and their role in modern mathematics and applied contexts

2. Demonstrate accurate and efficient use of advanced algebraic techniques

3. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from advanced algebra

4. Apply problem-solving using advanced algebraic techniques applied to diverse situations in physics, engineering and other mathematical contexts

The course will be covered in the following units:

Unit-1: Group Theory

• Group actions, stabilizers, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem.

• Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, p-groups,Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for $n \geq$

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5, non-simplicity tests.

Unit-2: Ring Theory
• Principal ideal domain, principal ideal ring, prime element, irreducible element, greatest common divisor (gcd), least common multiple (lcm), expression of gcd, examples of a ring *R* and a pair of elements *a, b* ε *R* such that gcd(*a, b*) does not exist, Euclidean domain, relation between Euclidean domain and principal ideal domain.

• Polynomial rings, division algorithm and consequences, factorization domain, unique factorization domain, irreducible and prime elements in a unique factorization domain, relation between principal ideal domain, unique factorization domain, factorization domain and integral domain, Eisenstein criterion and unique factorization in Z[*x*].

• Ring embedding and quotient field, regular rings and their examples, properties of regular ring, ideals in regular rings.

Bio Mathematics

Paper Code(Theory):MTM-A-DSE-A-5-1-TH
Paper Code(Tutorial):MTM-A-DSE-A-5-1-TU

Learning Outcomes

By the end of this course, students will be able to:
• Gain an improved understanding of mathematical models as they are used in biology.
• Derive and interpret the results of models of population growth, species interactions, demography, natural selection, and disease dynamics.
 • Determine the behaviour of a dynamical system using a combination of mathematical approaches and simulations.
 • Gain an introductory understanding of matrix theory and probability theory.
• Use a mathematical software package to analyse and simulate equations describing biological phenomena.
• Practise translating a biological question into a mathematical model and analysing the equations using a student-developed model.
The course will be covered in the following units:

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Unit-1

• Mathematical biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, bacterial growth in a chemostat, harvesting a single natural population, Prey predator systems and Lotka-Volterra equations,

populations in competitions, epidemic models (SI, SIR, SIRS, SIC)

Unit-2

• Activator-inhibitor system, insect outbreak model: Spruce Budworm. Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria. Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario. Spatial models: One species model with diffusion. Two species model with diffusion, conditions for diffusive instability, spreading colonies of microorganisms, Blood flow in circulatory system, travelling wave solutions, spread of genes in a population.

Unit-3

• Discrete models : Overview of difference equations, steady state solution and linear stability analysis. Introduction to discrete models, linear models, growth models, decay models, drug delivery problem, discrete prey-predator models, density dependent growth models with harvesting, host-parasitoid systems (Nicholson- Bailey model), numerical solution of the models and its graphical representation. case studies.

Optimal exploitation models, models in genetics, stage structure models, age structure models.

Graphical Demonstration (Teaching Aid)[using any software]

• Growth model (exponential case only).

• Decay model (exponential case only).

• Lake pollution model (with constant/seasonal flow and pollution concentration).

• Case of single cold pill and a course of cold pills.

• Limited growth of population (with and without harvesting).

• Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator).

• Epidemic model of influenza (basic epidemic model, contagious for life,disease with carriers).

• Battle model (basic battle model, jungle warfare, long range weapons).

Industrial Mathematics

Paper Code(Theory):MTM-A-DSE-A-5-1-TH
Paper Code(Tutorial):MTM-A-DSE-A-5-1-TU
Learning Outcomes

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By the end of the module, students should be able to:

- Understand the difference between forward problems and inverse problem
- Derive the loss functional for specific applications
- Apply the direct method to establish the existence of solutions of regularised inverse problems
- Understand the principles of image formation, including the basic principles and the components of X-ray imaging and CT, MRI, USG, CR, DR and Nuclear medicine imaging

The course will be covered in the following units:

Unit-1

• Medical Imaging and Inverse Problems. The content is based on Mathematics of X-ray and CT scan based on the knowledge of calculus, elementary differential equations, complex numbers and matrices.

Unit-2

• Introduction to Inverse problems: Why should we teach Inverse Problems? Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations. Geological anomalies in Earth are interior from measurements at its surface (Inverse problems for Natural disaster) and Tomography.

Unit-3

• X-ray: Introduction, X-ray behavior and Beers Law (The fundamental question of image construction) Lines in the place

Unit-4

• Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom – Mathematical phantoms).

Unit-5

• Back Projection: Definition, properties and examples.

Unit-6

• CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

Discrete Mathematics
Paper Code(Theory):MTM-A-DSE-B-5-1-TH
Paper Code(Tutorial):MTM-A-DSE-B-5-1-TU

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Learning Outcomes

After completing the course, the students will be able to

- Understand and explore the basics of graph theory.
- Analyse the significance of graph theory in different engineering disciplines
- Demonstrate algorithms used in interdisciplinary engineering domains.
- Evaluate or synthesize any real world applications using graph theory.
- The students should be able to define the main concepts related to primality, divisibility, congruences, and number-theoretic functions. The students should be able to formulate main results proved in the course, in particular, the Euclidean Algorithm, Euclid's Lemma, the Chinese Remainder Theorem, Fermat's Little Theorem, Euler's Theorem, and the Quadratic Reciprocity Law.
- Solve many different problems related to the material covered. Understand how Number Theory plays an important role in Cryptography

The course will be covered in the following units:

Unit-1 : Graph Theory

• Definition of undirected graphs, Using of graphs to solve different puzzles and problems. Multigraphs. Walks, Trails, Paths, Circuits and cycles, Eulerian circuits and paths. Eulerian graphs, example of Eulerian graphs. Hamiltonian cycles and Hamiltonian graphs.

• Weighted graphs and Travelling salespersons Problem. Dijkstra's algorithm to find shortest path.

• Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.

• Partial Order relations and lattices, Chains and antichains. Pigeon hole Principle.

Unit-2 : Number Theory

• Application of techniques of groups and rings to prove some theorems in number theory : Fermat's Theorem, Euler's Theorem, Willson's Theorem, Chinese Remainder Theorem.

• The Arithmetic of Zp, p a prime, pseudo prime and Carmichael Numbers, Fermat Numbers, Perfect Numbers, Mersenne Numbers.

• Primitive roots, the group of units Zn, the existence of primitive roots, applications of primitive roots, the algebraic structure of Zn.

• Quadratic residues and non quadratic residues, Legendre symbol, proof of the law of quadratic reciprocity,Jacobi symbols.

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• Arithmetic functions, Multiplicative functions, definitions and examples.

Linear Programming & Game Theory
Learning Outcomes
On completion of the course, a student will be able to
(a) analyse and solve linear programming models of real life situations;
(b) provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points;
(c) apply the simplex method to solve LPP's;
(d) describe the relationships between the primal and dual problems;
(e) describe the applications of transportation, assignment and two-person zero-sum game problems.

The course will be covered in the following units:
Unit-1
• Definition of Linear Programming Problem (L.P.P.). Formation of L.P.P. from daily life involving inequations. Graphical solution of L.P.P. Basic solutions and Basic Feasible Solution (B.F.S) with reference to L.P.P. Matrix formulation of L.P.P. Degenerate and Non-degenerate B.F.S.
• Hyperplane, Convex set, Cone, extreme points, convex hull and convex polyhedron. Supporting and Separating hyperplane. The collection of a feasible solutions of an L.P.P. constitutes a convex set. The extreme points of the convex set of feasible solutions correspond to its B.F.S. and conversely. The objective function has its optimal value at an extreme point of the convex polyhedron generated by the set of feasible solutions (the convex polyhedron may also be unbounded). In the absence of degeneracy, if the L.P.P. admits of an optimal solution then at least one B.F.S. must be optimal. Reduction of a F.S. to a B.F.S.
Unit-2
• Slack and surplus variables. Standard form of L.P.P. theory of simplex method. Feasibility and optimality conditions.
• The algorithm. Two phase method. Degeneracy in L.P.P. and its resolution.
Unit-3
• Duality theory: The dual of dual is the primal. Relation between the objective values of dual and the primal problems. Relation between their optimal values. Complementary slackness, Duality and simplex method and their applications.
Unit-4
• Transportation and Assignment problems. Mathematical justification for optimality criterion. Hungarian method. Traveling Salesman problem.
• Concept of game problem. Rectangular games. Pure strategy and Mixed strategy. Saddle point and its existence. Optimal strategy and value of the game. Necessary and sufficient condition for

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a given strategy to be optimal in a game. Concept of Dominance. Fundamental Theorem of rectangular games. Algebraic method. Graphical method and Dominance method of solving Rectangular games. Inter-relation between theory of games and L.P.P.

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Boolean Algebra & Automata Theory
Paper Code(Theory):MTM-A-DSE-B-5-1-TH
Paper Code(Tutorial):MTM-A-DSE-B-5-1-TU
Learning Outcomes
On completion of the course, a student will be able to
 (a) convert numbers into different systems and perform arithmetic operations there;
(b) identify various methods for representing characters in a computer;
(c) design circuits for simple Boolean expressions, and implement basic logic gates using universal gates; (d) define Automata;
(e) discuss the acceptability of a string by finite automation;
(f) construct non-deterministic finite state machine.

The course will be covered in the following units:
Unit-1
• Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle,lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.
Unit-2
• Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal and maximal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, Logic gates, switching circuits and applications of switchingcircuits.
Unit-3
• Introduction : Alphabets, strings, and languages. Finite automata and regular languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.
Unit-4
• Context free grammars and pushdown automata : Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language acceptedby PDA, deterministic PDA, Non-deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.
Unit-5
• Turing Machines : Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.
Unit-6
• Undecidability : Recursively enumerable and recursive languages, undecidable problems about

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Turing machines: halting problem. Post correspondence problem, and undecidability problems about CFGs

Differential Geometry
Paper Code(Theory):MTM-A-DSE-A-6-2-TH
Paper Code(Tutorial):MTM-A-DSE-A-6-2-TU
Learning Outcomes   On completion of the course, a student will be able to
(a) describe various properties of curves including Serret-Frenet formulae and their applications;
(b) describe the interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae;
(c) describe the role of Gauss's Theorem a Egregium and its consequences;
(d) apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.

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The course will be covered in the following units:

Unit-1
• Tensor : Different transformation laws, Properties of tensors, Metric tensor, Riemannian space, Covariant ,Differentiation, Einstein space.
Unit-2
• Theory of space curves : Space curves. Planer curves, curvature, torsion and Serret-Frenet formula. Osculating circles, osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.
• Theory of surfaces : Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula. Conjugate and asymptotic lines.
Unit-3
• Developables : Developable associated with space curves and curves on surfaces. Minimal surfaces. Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem.

Mathematical Modelling
Paper Code(Theory):MTM-A-DSE-A-6-2-TH
Paper Code(Tutorial):MTM-A-DSE-A-6-2-TU
Learning Outcomes
By the end of the course, students will be able to:
  • to handle freely the concepts using in mathematical modeling;
  • to analyze a simple physical phenomena in order to create a mathematical model;
  • Apply mathematical strategies and techniques to solve real-world problems.
  • Develop and use computer software for mathematical modelling.

The course will be covered in the following units:
Unit-1
• Power series solution of Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.
Unit-2
• Monte Carlo simulation modelling: simulating deterministic behavior (area under a curve, volume under a surface), generating random numbers: middle square method, linear congruence, queuing models: harbor system, morning rush hour, Overview of optimization modelling. Linear programming model: geometric solution algebraic solution, simplex method, sensitivity analysis

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Fluid Statics & Elementary Fluid Dynamics
Paper Code(Theory):MTM-A-DSE-A-6-2-TH
Paper Code(Tutorial):MTM-A-DSE-A-6-2-TU
Learning Outcomes
By the end of the course, students will be able to:

- **solve hydrostatic problems.**
- **describe the motion of fluids.**
- **identify derivation of basic equations of fluid mechanics and apply**

The course will be covered in the following units:

Unit-1

• Introduction and Fundamental Concepts:
Definition of Fluid, Distinction Between Solid and Fluid, Concept of Continuum, Fluid Properties : Density, Specific Weight, Specific Volume, Specific Gravity. Stress field [(Normal stress: $\_n = lim\_An!0(\_Fn/\_An)$ and Shear stress: $\_n = lim\_An!0(\_Ft/\_An)$)], Viscosity, Vapor pressure,. Newtonian fluid, Non-Newtonian Fluids. Ideal Fluid, Compressibility, Distinction between an Incompressible and a Compressible Flow, Surface Tension of Liquids.

Forces on Fluid Elements: Definition of Fluid Elements, Body Force, Surface Force, Normal Stress in a Stationary Fluid, Pascal's Law of Hydrostatics, Fundamental Equation of Fluid Statics: $\~r\, p = \_ \~F$, Fundamental Fluid Static Equations in Scalar Form: $@p$
$@z = \_g$, Constant Density Solution.

Unit-2

• Hydrostatics
Hydrostatic Thrusts on Submerged Plane Surface: Centre of pressure, determination of coordinates of centre of pressure. Hydrostatic Thrusts on Submerged Curved Surfaces. Buoyancy: Center of the buoyancy.
Archimedes principle. Stability of Unconstrained Submerged Bodies in Fluid: Stable Equilibrium, Unstable Equilibrium, Neutral Equilibrium. Stability of Floating Bodies in Fluid:

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Metacentre, Metacentric height.
• **Gas**
Pressure of gases, The Atmosphere, Relation between pressure, density and temperature, Pressure in an isothermal atmosphere, Atmosphere in convective equilibrium.

Unit-3
• **Kinematics of Fluid:**
Scalar and Vector Fields, flow field, Description of Fluid Motion: Lagrangian Method, Eulerian Method, Relation between Eulerian and Lagrangian Method, Variation of Flow Parameters in Time and Space: Steady and Unsteady Flow, Uniform and Non-uniform Flows. Material Derivative and Acceleration: temporal derivative, convective derivative
Unit-4
• **Conservation Equations:**
Control Mass System, Control Volume System, Isolated System. Conservation of Mass - The Continuity Equation: Differential Form and Vector Form, Integral form. Conservation of Momentum: Momentum Theorem, Reynolds Transport Theorem. Conservation of energy.

Point Set Topology
Paper Code(Theory):MTM-A-DSE-B-6-2-TH
Paper Code(Tutorial):MTM-A-DSE-B-6-2-TU

On completion of the course, a student will be able to
(a) demonstrate knowledge and understanding of concepts such as open and closed sets, interior, closure and boundary;
(b) create new topological spaces by using subspace, product and quotient topologies;
(c) use continuous functions and homeomorphisms to describe the structure of a topological space;
(d) develop idea about and di_erent de_nitions of compactness.
(e) develop idea about connectedness, path-connectedness.

The course will be covered in the following units:
Unit-1
• Topological spaces, basis and subbasis for a topology, neighbourhoods of a point, interior points, limit points, derived set, boundary of a set, closed sets, closure and interior of a set, dense subsets, subspace topology, finite Product topology, Continuous functions, open maps, closed maps, homeomorphisms, topological invariants, metric topology, isometry and metric invariants.
Unit-2

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• First countability, $T1$ and $T2$ separation axioms of topological spaces, convergence and cluster point of a sequence in topological spaces and some related concepts on first countable as well as on $T2$ spaces. Heine's continuity criterion.

Unit-3

• Connected spaces, connected sets in R, components, Compact spaces, compactness and $T2$, compact sets in R, Heine-Borel Theorem for Rn, real valued continuous function on connected and compact spaces, the concept of compactness in metric space, sequentially compactness of a metric space X and the Bolzano- Weiertrass property of X are equivalent.

Astronomy & Space Science
Paper Code(Theory):MTM-A-DSE-B-6-2-TH
Paper Code(Tutorial):MTM-A-DSE-B-6-2-TU

Upon successful completion, students will have the knowledge and skills to:
1. Appreciate and communicate traditional Indigenous understandings of astronomy.
2. Apply astronomical research techniques and the scientific method to conceptually solve astronomical puzzles.
3. Understand and communicate the nature and origins of the Sun, stars and our solar system.
4. Identify and communicate the ways in which space technology can and will affect the modern and future world.

The course will be covered in the following units:

Unit-1

• Celestial Sphere, various Coordinate Systems, transformation formulae among various coordinate systems, formulae of spherical triangle : cosine formula, sine formula, four parts formula , analogous cosine formula, hour angle, sidereal day, sidereal time, equation of time. Exercises.

Unit-2

• Light and its properties, Optical , absorption, emission and continuous spectra, radio and Hubble Space Telescopes (HST), Photometry, Spectrometry, Spectrophotometry (definitions only), magnification, resolution, f/a ratio , refractors and reflectors. Exercises.

Unit-3

• Various magnitudes of stars: apparent, absolute, photovisual, photographic, bolometric etc. Distance measurements of stars: Parallax method, Statistical Palallax Method, Moving Cluster Method. Radial and proper motion. Exercises.

• Morphological structure of Sun, solar cycles, sunspots, solar corona, solar wind, solar neutrino

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puzzle (Merely descriptive models). Solar system.

Unit-4

• Interstellar matter, elastic collisions and kinetic equilibrium, Jeans Mass for gravitational collapse, radiative process (statement only).

Unit-5

• Morphological classification of galaxies, rotation curves and mass modelling, missing mass and dark matter, distance determination by various methods. Our Galaxy. Exercises.

Unit-6

• Space agencies around the world – The history of space agencies – Indian space exploration – First missions – Remarkable achievements.

• Rocket Propulsion; Rocket Equation and Staging, Optimal Rocket. Element of Aerodynamics; Aerodynamics Force and Moment, Fluid dynamics (Governing equations: Interpretations and Statements only), Flow regime, Continuum Flow, Continuum Viscous Flow and Boundary Layer, Rarefied Flow. Airbreathing Propulsion; Ideal Momentum Theory, Propeller Engine, Jet Engine.

Advanced Mechanics

Paper Code(Theory):MTM-A-DSE-B-6-2-TH

Paper Code(Tutorial):MTM-A-DSE-B-6-2-TU

On completion of the course, a student will be able to

(a) describe necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body;

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(b) determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight;

(c) solve problems about the kinematics and kinetics of the rectilinear and planar motions of a particle including the constrained oscillatory motions of particles;

(d) learn that a particle moving under a central force describes a plane curve and know the Kepler's laws of the planetary motions.

The course will be covered in the following units:

Unit-1

• Degrees of freedom, reactions due to constraints. D' Alembert's principle; Lagranges first kind equations;Generalized coordinates; Generalized forces; Lagrangian; Second kind Lagrange's equations of motion; cyclic coordinates; velocity dependent potential; Principle of energy; Rayleigh's dissipation function.

Unit-2

• Action Integral; Hamilton's principle; Lagrange's equations by variational methods; Hamilton's principle for non-holonomic system; Symmetry properties and conservation laws; Noether's theorem. Canonically conjugate coordinates and momenta; Legendre transformation; Routhian approach; Hamiltonian.

Unit-3

 • Hamilton's equations from variational principle; Poincare-Cartan integral invariant; Principle of stationary action; Fermat's principle;

Unit-4

• Canonical transformation; Generating function; Poisson Bracket; Equations of motion; Action-angle variables; Hamilton-Jacobi's equation; Hamilton's principal function; Hamilton's characteristics function; Liouville's theorem.

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Course Outcomes of Mathematics Generic Elective B.A. & B.Sc under CBCS

[For students having Honours in subjects other than Mathematics]

❖ **First Semester:**

Core Course-1 / Generic Elective-1 (Unit-1,2,3,4)

Paper Code (Theoretical) : MTM-G-CC-1-1-TH /MTM-G-GE-1-1-TH

Paper Code (Tutorial): MTM-G-CC-1-1-TU /MTM-G-GE-1-1-TU

Unit-1 : Algebra-I

Learning Outcomes: On completion of this course, the student will have understanding of some important concepts of Classical Algebra & Linear follows:

- Complex Numbers : De Moivre's Theorem and its applications. Sine, Cosine and Logarithm of a complex number. Definition of Inverse circular and Hyperbolic functions.

- Polynomials : Fundamental Theorem of Algebra (Statement only). with real coefficients, the n-th degree polynomial equation has exa Nature of roots of an equation (surd or complex roots occur in pairs of Descarte's rule of signs and its applications.

- Statements of : (i) If a polynomial $f(x)$ has opposite signs for two r and b of x, the equation $f(x) = 0$ has an odd number of real roots be b. If $f(a)$ and $f(b)$ are of the same sign, either no real root or an eve roots lies between a and b.

  (ii) Rolle's Theorem and its direct applications.

- Relation between roots and coefficients, symmetric func-tions transformations of equations. Cardan's method of solution of a cubic

- Rank of a matrix : Determination of rank either by considering minors out process. Consistency and solution of a system of linear equations w than 3 variables by matrix method.

Unit-2 : Dierential Calculus-I

Learning Outcomes: On completion of this area of the course, the student will be

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able to develop a clear concept of the following:

- Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included).

- Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity.

- Derivative-its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and decreasing functions. Relation between continuity and derivability. Diffierential - application in finding approximation.

- Successive derivative - Leibnitz's theorem and its application.

- Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact diffierentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

- Applications of Diffierential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of a family of straight lines and of curves

(problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).
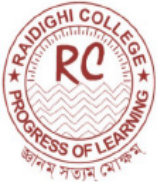
Unit-3 : Dierential Equation-I
problems:

• Order, degree and solution of an ordinary diffierential equation (ODE) in presence of arbitrary constants, Formation of ODE.

• First order equations : (i) Exact equations and those reducible to such equation.

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(ii) Euler's and Bernoulli's

equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

• Second order linear equations : Second order linear diffierential equation with constant coefficients. Euler's Homogeneous equations.

• Second order diffierential equation :
(i) Method of variation of parameters, (ii) Method of undetermined coefficients.

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Unit-4 : Coordinate Geometry

Learning Outcomes: After completion of this part of the course, the students will be able to understand the basic applications of coordinate geometry.

• Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants.

• General equation of second degree in x and y : Reduction to canonical forms. Classification of conic.

• Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by
$ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic.

• Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola.

• Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equation of chord joining two points. Equations of tangent and normal.

• Sphere and its tangent plane. Right circular cone.

❖ Second Semester

Core Course-2 / Generic Elective-2 (Unit-1,2,3,4)
Paper Code (Theoretical) : MTM-G-CC-2-2-TH /MTM-G-GE-2-2-TH
Paper Code (Tutorial):MTM-G-CC-2-2-TU /MTM-G-GE-2-2-TU

Unit-1 : Dierential Calculus-II

Learning Outcomes: On completion of the course, the student will be able to apply the concept and principles of differential calculus to solve geometric and physical problems.

• Sequence of real numbers : Definition of bounds of a sequence and

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monotone sequence. Limit of a sequence. Statements of limit theorems. Concept of convergence and divergence of monotone sequences- applications of the theorems, in particular, definition of e. Statement of

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Cauchy's general principle of convergence and its application.

•   Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms: Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications.

•   Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, $\sin x$, $\cos x$, $(1 + x)^n$, $\log(1 + x)$ with restrictions wherever necessary.

•   Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

•   Application of the principle of Maxima and Minima for a function of a single variable in geometrical, physical and to other problems.

•   Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.

Unit-2 : Dierential Equation-II

Learning Outcomes: On completion of this course, the student will be able to identify the type of a given ordinary as well as partial differential equation and select and apply the appropriate analytical technique for finding the solution.

•   Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The method of variation of parameters, TheCauchy-Euler equation, Simultaneous differential equations, Simple eigen-value problem.

•   Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

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Unit-3: Vector Algebra

Learning Outcomes: On completion of this course, students will be able to manipulate vectors to perform geometrical calculations in three dimensions as well as calculations that may arise in solving mechanical problems.

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- Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equation of plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).

Unit-4 : Discrete Mathematics

Learning Outcomes: On successful completion of the course students will be able to develop conceptual understanding of

- Integers : Principle of Mathematical Induction. Division algorithm. Representation of integers in an arbitrary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Euclid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Representation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers, Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show howto find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation & some applications.

- Congruences : Congruence relation on integers, Basic properties of this relation. Linear congruences,Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence , to show it is an equivalence relation, to prove some of its properties.
Linear Congruence, to show how to solve these congruences, Chinese remainder theorem Statement and proof and some applications. System of linear congruences, when solution exists with some applications.

- Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers such as International standard book number, universal product code etc. Theorem regarding error detecting capability.

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- Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes,properties of Congruence classes, addition and multiplication,

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existence of inverse. Fermat's little theorem.Euler's theorem. Wilson's theorem - Statement, proof and some applications.

• Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.

❖ Third Semester:

Core Course-3 / Generic Elective-3 (Unit-1,2,3)
Paper Code (Theoretical) : MTM-G-CC-3-3-TH/MTM-G-GE-3-3-TH
Paper Code (Tutorial):MTM-G-CC-3-3-TU /MTM-G-GE-3-3-TU

Unit-1 : Integral Calculus
Learning Outcomes: On completion of the following topics of the course in this unit, the student will be able to apply the concept and various principles of integral calculus to integrate the functions which are applicable in real life situations:

• Evaluation of definite integrals.
• Integration as the limit of a sum (with equally spaced as well as unequal intervals).
• Reduction formulae for integrals.
• Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test - Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed).
• Working knowledge of double integral.
• Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only.

Unit-2 : Numerical Methods
Learning Outcomes: After completion of this unit of the course, the students will be able to apply numerical methods to obtain approximate solutions to various mathematical problems. The student will get an overall idea of
• Approximate numbers, Significant figures, Rounding offi numbers. Error
  : Absolute, Relative and percent-age.

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- Definitions of some Operators and some relations among them.

- Interpolation : The problem of interpolation Equispaced arguments Diffierence Tables,   Deduction of New-ton's Forward Interpolation

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Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments.

• Numerical Integration : Trapezoidal and Simpson's one-third formula (statement only). Problems on Numerical Integration.

• Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca-tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)

Unit-3 : Linear Programming

Learning Outcomes: After completion of this unit of the course, the students will be able to Formulate the LPP, Conceptualize the feasible region, Solve the LPP using different methods & understand the importance of LPP in daily life. In details, the student will be able to understand and visualize the

• Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

• The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions.

• Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one

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constraint of equality. Transportation and Assignment problem and their optimal solutions.

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❖ **Fourth Semester:**

Core Course-4 / Generic Elective-4 (Unit-1,2,3)
Paper Code (Theoretical) : MTM-G-CC-4-4-TH /MTM-G-GE-4-4-TH
Paper Code (Tutorial):MTM-G-CC-4-4-TU /MTM-G-GE-4-**4**-TU

Unit-1 : Algebra-II (20 Marks)

Learning Outcomes: After completion of this unit of the course, the students will be able to demonstrate the mathematical maturity of understanding a group, a ringand **a** field in Abstract Algebra. In Linear Algebra, the students will understand vector spaces over a field and subspaces and apply their properties. Students will get **an** overall understanding of the following concepts**:**

• Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 ×2 real matrices**,** non singular **r**eal matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications.

• Definitions and examples of (i) Ring, (ii) Field**,** (iii) Sub-ring, (iv) Sub- field.

• Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependence and independence of a finite number of vectors, **S**ub- space, Concepts of generators and basis of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).

• Real Quadratic Form involving not more than **t**hree variables (problems only).

• Characteristic equation of square matrix of order not more than three. Determination of Eigen Values and Eigen **V**ectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.

Unit-2 : Computer Science & Programming *Learning Outcomes:*

After completing this unit**,** the students will have a practical

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outlook   and understanding of the computers, use computers in their daily life for better efficiency, represent their knowledge with the help of the computers and various programming languages.

Students will learn the basic concepts of computer science from the following:

- Computer Science and Programming : Historical Development, ComputerGeneration, Computer Anatomy Diffierent Components of a computersystem. Operating System, hardware and Software.

• Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc.

• Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc.

• Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo-rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.

Unit-3 : Probability & Statistics

Learning Outcomes: On completion of this unit of the course, the student will be able to understand basic probability axioms and rules as well as different statistical methods for solving and analyzing different types of real-life problems. The students will be able to develop a clear-cut idea in the following:

• Elements of probability Theory : Random experiment,

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Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con-ditional probability and Statistical Independence. Baye's Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat-ical expectation. Joint distribution of two random variables.

• Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.

• Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc.Frequency Distribution Ungrouped and grouped cumulative

frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis.

• Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal:

(i) standard Normal Distribution, (ii) Chi-square distribution (iii) Student's distribution (iv) Snedecor's F- distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems.

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•   Bivariate Frequency Distribution. Scatter Diagram, Correlation co-efficient Definition and properties. Regression lines.

Skill Enhancement Courses in Mathematics (SEC)

Skill Enhancement Course (Semester 3)-SEC A C Programming Language
Skill Enhancement Course (Semester 4)-SEC B Mathematical Logic
Skill Enhancement Course (Semester 5) -SEC A Object Oriented Programming in C++
Skill Enhancement Course (Semester 6)-SEC B Boolean Algebra

C Programming Language
Paper Code (Theory) : MTM-G-SEC-A-TH

Course Learning Outcomes:
1) To provide complete knowledge of C language
2) To develop logic which will be helpful to create programs
3) To learn basic porgamming constructs
4) After the completion of this course, the students will be able to develop applications.
The course will be covered in the following:
Unit-1
• An overview of theoretical computers, history of computers, overview of architecture of computer, compiler, assembler, machine language, high level language, object oriented language, programming language and importance of C programming.
• Constants, Variables and Data type of C-Program : Character set. Constants and variables data types, expression, assignment statements, declaration.

• Operation and Expressions : Arithmetic operators, relational operators, logical operators.
• Decision Making and Branching : decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement.
• Control Statements : While statement, do-while statement, for statement.
• Arrays : One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.
• User-defined Functions : Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, Nesting of functions, passing of arrays to functions, Recurrence of function.

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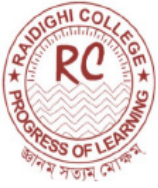
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• Introduction to Library functions: stdio.h, math.h, string.h stdlib.h, time.h etc.

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Mathematical Logic

Paper Code (Theory) :MTM-G-SEC-B-TH

Course Learning Outcomes:

- Recognize Aristotelian logics, tautology, absurdity, contingency, propositional calculus.

- Prove the deduction theorem for propositional calculus - Completeness and consistency of propositional calculus

- Provide a link between logic and set theory and then provide some related questions with table.

- Describe First-order theorems - Consistency of first order predicate calculus - Completeness theorem for predicate logic. The normal and canonical form of the propositions.

- The students will explain and interpret a general knowledge of mathematical logics

- Enable students to analyses the mathematical problems.

- Ability to understand and analyze the mathematical problems

The course will be covered in the following:

Unit-1
• Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.
• General Notions : Formal language, object and meta language, general definition of a Formal Theory/Formal Logic.
Unit-2
• Propositional Logic : Formal theory for propositional calculus, derivation, proof, theorem, deduction theorem, conjunctive and disjunctive normal forms, semantics, truth tables, tautology, adequate set of connectives, applications to switching circuits, logical consequence, consistency, maximal consistency, Leindenbaum lemma, soundness and completeness theorems, algebraic semantics.

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Unit-3

• Predicate Logic : First order language, symbolizing ordinary sentences into first order formulae, free and bound variables, interpretation and satisfiability, models, logical validity, formal theory for predicate calculus, theorems and derivations, deduction theorem, equivalence theorem, replacement theorem, choice rule, Prenex normal form, soundness theorem, completeness theorem, compactness theorem, First Order Theory with equality, examples of First Order Theories (groups, rings, fields etc.).

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Object Oriented Programming in C++ Paper Code (Theory): MTM-G-SEC-A-TH

Course Learning Outcomes:

After competing this course, you will be able to:

- Describe OOPs concepts
- Use functions and pointers in your C++ program
- Understand tokens, expressions, and control structures
- Explain arrays and strings and create programs using them
- Describe and use constructors and destructors
- Understand and employ file management
- Demonstrate how to control errors with exception handling

The course will be covered in the following:

Unit-1

• Programming paradigms, characteristics of object oriented programming languages, brief history of C++, structure of C++ program, differences between C and C++, basic C++ operators, Comments, working with variables, enumeration, arrays and pointer.

Unit-2

• Objects, classes, constructor and destructors, friend function, inline function, encapsulation, data abstraction, inheritance, polymorphism, dynamic binding, operator overloading, method overloading, overloading arithmetic operator and comparison operators.

Unit-3

• Template class in C++, copy constructor, subscript and function call operator, concept of namespace and exception handling.

Boolean Algebra

Paper Code (Theory) : MTM-G-SEC-B-TH

Course Learning Outcomes:

On completion of the course, a student will be able to

(a) convert numbers into different systems and perform arithmetic operations there;

(b) identify various methods for representing characters in a computer;

(c) design circuits for simple Boolean expressions, and implement basic logic gates using universal gates;

The course will be covered in the following:

• Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle,maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and

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properties of modular and distributive lattices, Boolean algebras.

• Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and minimization of switching circuits using Boolean algebra

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Discipline Specific Electives DSE-A & B (Mathematics)

DSE-A: (Semesters 5/6)	DSE-B: (Semesters 5/6)
Particle Dynamics	Advanced Calculus
Graph Theory	Mathematical Finance

A student has to opt for at least one of the subjects available under each category

Particle Dynamics
Paper Code (Theory): MTM-G-DSE-A-TH
Paper Code (Tutorial)MTM-G-DSE-A-TU
Course Learning Outcomes:

After studying this course, you should be able to:

- understand and use basic terms for the description of the motion of particles, vector functions and the fundamental laws of Newtonian mechanics

- solve mechanics problems in one dimension that involve one or more of the forces of gravity, friction and air resistance

- understand the concept of terminal speed, and use it in solving mechanics problems in one dimension

- apply Newton's second law in vector form to problems in more than one dimension

- solve problems relating to the motion of a projectile in the absence of air resistance.

The course will be covered in the following:
• Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve.
• Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy.Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane.
• Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.
• Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.
• Central orbit. Kepler's laws of motion. Motion under inverse square law.

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Graph Theory
Paper Code (Theory): MTM-G-DSE-A-TH
Paper Code (Tutorial):MTM-G-DSE-A-TU

Course Learning Outcomes:
At the end of the course students will be able to
1. Construct examples for different types of graphs
2. Observe and generalise certain properties of given collection of graphs
3. Apply appropriate theories, principles and concepts relevant to graph theory
4. Analyse the planarity and colouring of a given graph
5. Construct appropriate matrices corresponding to a given graph and use them in identifying certain properties of the graph

The course will be covered in the following:
Unit-1
• Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs
• Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.
• Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs

Advanced Calculus
Paper Code (Theory): MTM-G-DSE-B-TH
Paper Code (Tutorial)MTM-G-DSE-B-TU
Course Learning Outcomes:
This course will enable the students to learn :
1) Students will be able to know the use of Laplace transform in system modeling, digital signal processing, process control.
2) Solve an initial value problem for an nth order order ordinary differential equation using the

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Laplace transform.
3) Find the Fourier series representation of a function of one variable.

The course will be covered in the following:
• Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement ofWeierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary functions such as *ex,* sin *x,* log(1+*x*), (1+*x*)*n*. Simple problems.
• Periodic Fourier series on $(-\_, \_)$: Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.

• Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients.

Mathematical Finance
Paper Code (Theory): MTM-G-DSE-B-TH
Paper Code (Tutorial)MTM-G-DSE-B-TU
Course Learning Outcomes:
The course will enable the students to;
1) Describe and explain the fundamental features of financial instruments.

2) Demonstrate a clear understanding of financial research planning, methodology and implementation.

3) Demonstrate understanding of basic concepts in linear algebra, relating to linear equations, matrices and optimization.

4) Demonstrate understanding of concepts relating to functions and annuities

The course will be covered in the following:
Unit-1
• Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound,

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discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods)

• Comparison of NPV and IRR. Bonds, bond prices and yields. Floating-rate bonds, immunization. Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints).

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DEPARTMENT OF GEOGRAPHY

RAIDIGHI COLLEGE

Course Outcomes/Programme Outcomes

B.A./B.Sc. Geography (Honours/General)

Under CBCS System

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COURSE & PROGRAM OUTCOMES OF
GEOGRAPHY HONOURS (B.A. & B.Sc.) UNDER CBCS

Geography is the study of p l a c e s and t h e relationships between people and their environments. Geographers explore both the physical properties of Earth's surface and the human societies spread across it. They also examine how human culture interacts with the natural environment and the way those locations and places can have an impact on people. Geography seeks to understand where things are found, why they are there, and how they develop and change over time. The study of the diverse environments, places, and spaces of Earth's surface and their interactions. It seeks to answer the questions of why things are as they are where they are. The modern academic discipline of geography is rooted in ancient practice, concerned with the characteristics of places, in particular their natural environments and peoples, as well as the relations between the two.

Choice Based Credit System (CBCS): Syllabus in Geography

INTRODUCTION:

In compliance with recent directives from the University Grants Commission, the undergraduate syllabus for Geography is reframed into Choice Based Credit System largely following the model syllabus prepared by the West Bengal State Council of Higher Education.

The main objective of this new curriculum is to give the students a holistic understanding of the subject, putting equal weightage to the core content and techniques used in Geography. The syllabus tries to give equal importance to the two main branches of Geography: Physical and Human.

The principal goal of the syllabus is to enable the students to secure a job at the end of the undergraduate programme. Keeping this in mind and in tune with the changing nature of Geography, adequate emphasis is rendered on applied aspects of the subject such as emerging techniques of mapping and field-based data generation, especially in the honours course. The syllabus emphasizes on development of basic skills of the subject, so that everyone need not go for higher studies in search of professional engagement or employment.

LEARNING OUTCOMES:

This syllabus is designed to impart basic knowledge on geography as a spatial science and train the undergraduates to secure employment in the sectors of geospatial analysis, development and planning, mapping and surveying.

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Honours Course: Core Subjects

GEO-A-CC-1-**01**-TH/P – Geotectonic and Geomorphology

GEO-A-CC-1-**02**-TH/P – Cartographic Techniques

GEO-A-CC-2-**03**-TH/P – Human Geography

GEO-A-CC-2-**04**-TH/P – Cartograms, Thematic Mapping and Surveying

GEO-A-CC-3-**05**-TH/P – Climatology

GEO-A-CC-3-**06**-TH/P – Hydrology and Oceanography

GEO-A-CC-3-**07**-TH/P – Statistical Methods in Geography

GEO-A-CC-4-**08**-TH/P – Economic Geography

GEO-A-CC-4-**09**-TH/P – Regional Planning and Development

GEO-A-CC-4-**10**-TH/P – Soil and Biogeography

GEO-A-CC-5-**11**-TH/P – Research Methodology and Fieldwork

GEO-A-CC-5-**12**-TH/P – Remote Sensing, GIS and GNSS

GEO-A-CC-6-**13**-TH/P – Evolution of Geographical Thought

GEO-A-CC-6-**14**-TH/P – Disaster Management

Honours Course: Choices for Four Discipline Specific Electives

GEO-A-DSE-A-5-**01**-TH/P – Fluvial Geomorphology

GEO-A-DSE-A-5-**02**-TH/P – Climate Change: Vulnerability and Adaptations

GEO-A-DSE-A-5-**03**-TH/P – Environmental Issues in Geography

GEO-A-DSE-A-5-**04**-TH/P – Resource Geography

GEO-A-DSE-B-6-**05**-TH/P – Cultural and Settlement Geography

GEO-A-DSE-B-6-**06**-TH/P – Social Geography

GEO-A-DSE-B-6-**07**-TH/P – Urban Geography

GEO-B-DSE-B-6-**08**-TH/P – Geography of India

Honours Course: Choices for Two Skill Enhancement Courses

GEO-A-SEC-A-3-**01**-TH – Coastal Management

GEO-A-SEC-A-3-**02**-TH – Tourism Management

GEO-A-SEC-B-4-**03**-TH – Rural Development

GEO-A-SEC-B-4-**04**-TH – Sustainable Development

General Course: Core Subjects

GEO-G-CC-1-**01**-TH/P – Physical Geography

GEO-G-CC-2-**02**-TH/P – Environmental Geography

GEO-G-CC-3-**03**-TH/P – Human Geography

GEO-G-CC-4-**04**-TH/P – Cartography

General Course: Choices for Two Discipline Specific Electives

GEO-G-DSE-A-5-**01**-TH/P – Regional Development

GEO-G-DSE-A-5-**02**-TH/P – Geography of Tourism

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GEO-G-DSE-B-6-**03**-TH/P – Agricultural Geography

GEO-G-DSE-B-6-**04**-TH/P – Population Geography

General Course: Choices for Two Skill Enhancement Courses

GEO-G-SEC-A-3/4-**01**-TH – Coastal Management

GEO-G-SEC-B-5/6-**03**-TH – Rural Development

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COURSE OUTCOMES

[B.A./B.Sc. Geography Honours]

The course outcomes of the different papers offered are presented below. After completion of the course the student will be able to:

SEMESTER – I - HONOURS COURSE
[(4+2) +(4+2) =12 Credits]

OBJECTIVES:

☐ **CC 01 GEOTECTONICS & GEOMORPHOLOGY**
is about all endogenetic forces, tectonic activities, Earth's structural evolution and evolution of landforms (coastal, glacial, aeolian). This section also includes theories on landscape evolution. The practical course encompasses Megascopic identification of rocks and minerals and extraction and interpretation of geomorphic, geomorphic information from topographical sheets.

☐ **CC 02 CARTOGRAPHIC TECHNIQUES**
covers Components and classification of maps, concept and application of scales, Representation of data: primary, secondary. The practical course includes construction of scales and map projections, preparation of thematic maps.

COURSE OUTCOMES

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This section will enlighten the students with global tectonic mechanism, earth surface features, geology, concept and measuring of distance. i.e.

CC 01 GEOTECTONICS & GEOMORPHOLOGY

- Understand the theories and fundamental concepts of Geotectonic and Geomorphology. Understand earth's tectonic and structural evolution. Gain knowledge about earth's interior. Develop an idea about concept of plate tectonics, and resultant landforms.
- Acquire knowledge about types of folds and faults and earthquakes, volcanoes and associated landforms.
- Understanding crustal mobility and tectonics; with special emphasis on their role in landform development.
- Overview and critical appraisal of landform development models.
- Ability to record temperature, pressure, humidity and rainfall
- Develop the skills of identification of features and correlation between them.

CC 02 CARTOGRAPHIC TECHNIQUES

- Do field surveys using appropriate techniques. Identification of rocks and minerals.
- Understand and prepare different kinds of maps.
- Recognize basic themes of map making.
- Development of observation skills.

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SEMESTER – II - HONOURS COURSE
[(4+2) +(4+2) =12 Credits]

OBJECTIVES:

CC 03 HUMAN GEOGRAPHY
Elements of human geography, concept of race and ethnicity, evolution of human society, population, demographic transition and rural – urban settlements. The practical course includes presentation of spatial and temporal variation of population data.

CC 04 CARTOGRAMS, THEMATIC MAPPING & SURVEYING
Preparation and interpretation of geological and weather maps, land use land cover maps and basic concepts of surveying and surveying equipment. Practical course includes surveying using instruments and preparation of geological maps.

COURSE OUTCOMES

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☐   This section will provide an idea about the evolution of human society and culture, settlements, spatial & temporal distribution of population. How to prepare & interpret the geological & weather map & will also help to learn the use of surveying instruments. i.e.

☐

CC 03 HUMAN GEOGRAPHY
- Gain knowledge about major themes of human Geography.
- Acquire knowledge on the history and evolution of humans.
- Understand the approaches and processes of Human Geography as well as the diverse patterns of habitat and adaptations.
- Develop an idea about space and society

CC 04 CARTOGRAMS, THEMATIC MAPPING & SURVEYING

☐
- Comprehend the concept of scales and representation of data through cartograms.
- Interpret geological and weather maps.
- Learn the usages of survey instruments.
- Brings direct interaction of different types of surveying instruments like Dumpy level and Theodolite with environment.
- Develop an idea about different types of thematic mapping techniques.

☐

SEMESTER – III - HONOURS COURSE
[(4+2) + (4+2) + (4+2) + 2] =20 Credits

OBJECTIVES:

CC 05 CLIMATOLOGY
This section describes the interrelationship between different elements of weather, overview of climate change. Also includes the atmospheric disturbances and climatic classification. Practical course is about the measurement of weather elements using analogue instruments and interpretation of weather map (pre-monsoon, monsoon and post-monsoon).

CC 06 HYDROLOGY & OCEANOGRAPHY

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This section is about surface and groundwater hydrology. The oceanography part describes physical and chemical properties of ocean water, reefs, marine resources and sea-level change. Practical course analyses the hydrographs and climatic water budget.

CC 07 STATISTICAL METHODS IN GEOGRAPHY

This portion of the course state the significance of statistics in geography. Data collection, sampling and numerical data analysis. Practical course is about data analysis and interpretation of the findings.

SEC Coastal Management / Tourism Management

Coastal management is about the coastal morphodynamics, environmental impacts of mining in coastal areas, management strategies to combat the coastal hazards and principals of coastal management. Tourism management discusses about scope and issues regarding tourism, information to plan destination marketing, tourism impact assessment and global tourism.

COURSE OUTCOMES

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This section will enlighten the students with the interrelationship between different elements of weather, atmospheric disturbances, climate change phenomenon. It will also help to know about surface & groundwater hydrology, oceanic features, coastal morpho dynamics, coastal hazards & management and also the use of statistical techniques to measure different parameters.

CC 05 CLIMATOLOGY

- Understand the elements of weather and climate, different atmospheric phenomena and climate change.
- Learn to associate climate with other environmental and human issues. Approaches to climate classification.
- To analyze the dynamics of the Earth's atmosphere and global climate. Assessing the role of man in global climate change.
- Prepare various climatic maps and charts and interpret them.
- Learn to use of various meteorological instruments.
- Learn the interaction between the atmosphere and the earth's surface. Understand the importance of the atmospheric pressure and winds.
- Understand how atmospheric moisture works.

CC 06 HYDROLOGY & OCEANOGRAPHY

- Analyze the concepts of Hydrology and Oceanography
- Emphasizing the significance of groundwater quality and its circulation
- Evaluate the role of the global hydrological cycle.
- Studying the behavior and characteristics of the global oceans.
- Realize the importance of water conservation.
- Identify marine resources and characteristics of ocean waters.
- Interpret hydrological and rainfall dispersion graphs and diagrams.

CC 07 STATISTICAL METHODS IN GEOGRAPHY
- To Learn the significance of statistics in geography. Understand the importance of use of data in geography
- Recognize the importance and application of Statistics in Geography
- Interpret statistical data for a holistic understanding of geographical phenomena.
- Know about different types of sampling.

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- Develop an idea about theoretical distribution.
- Learn to use tabulation of data.
- Gain knowledge about association and correlation.

SEC Coastal Management / Tourism Management

- Learn Scope and Nature: Concepts and issues, tourism, recreation and leisure inter-relations; Factors influencing tourism, Types of Tourism: Ecotourism, cultural tourism, adventure tourism, medical tourism, pilgrimage, international, national.
- Use of information on factors (Historical, natural, socio-cultural and economic; motivating factors for pilgrimages) to plan destination marketing; tourism products; niche tourism planning; Tourism impact assessment, Sustainable tourism, Information Technology and Tourism, Tour operations planning and guiding.
- Increasing Global tourism; Tourism in India: Tourism infrastructure, access, planning for different budgets for case study sites of Western Himalayas, Goa, Chilka / Vembanad, Jaipur

SEMESTER – IV - HONOURS COURSE
[(4+2) + (4+2) + (4+2) + 2] =20 Credits

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OBJECTIVES:

CC 08 ECONOMIC GEOGRAPHY
This section discusses about the sectors of economy, locational theories, international trade and WTO. Practical course describes GDP, temporal analysis of production and transport network analysis.

CC 09 REGIONAL PLANNING & DEVELOPMENT
It gives the glimpse of principles and objectives of regional planning, multilevel planning, concept of growth and development, models on regional development and underdevelopment. Practical course includes measuring inequality, delineation of formal and functional regions.

CC 10 SOIL & BIOGEOGRAPHY
This portion discusses about physical and chemical properties of soil, problems of soil erosion. Biogeography discusses about biosphere, ecosystem, biomes, deforestation and biodiversity. Practical course is about determination of soil pH and salinity, textural plotting and determination of plant species diversity.

SEC Rural Development / Sustainable Development
Rural development describes about concept and basic elements and measures of level of rural development, areal approach and rural governance. Sustainable development describes about concept, background, components and limitations of such development.

COURSE OUTCOMES

☐   This section will provide the idea about sectors of economy, the significance of location in economic benefits, GDP, objectives & significance of regional planning, Physical & Chemical properties of soil, problems of soil erosion, detailed discussion on Biosphere and sustainable approach to the environment.

☐ **CC 08 ECONOMIC GEOGRAPHY**
- Understand the concept of economic activity, factors affecting location of economic activity.
- Gain knowledge about different types of Economic activities
- Assess the significance of Economic Geography, the concept of economic man and

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theories of choice.
* Analyze the factors of location of agriculture and industries.
* Understand the evolution of varied types of economic activities.
* Map and interpret data on production, economic indices, transport network and flows.

CC 09 REGIONAL PLANNING & DEVELOPMENT
* Understand and identify regions as an integral part of geographical study.
* Appreciate the varied aspects of development and regional disparity, in order to formulate measures of balanced development.
* Analyzing the concept of regions and regionalization.
* Studying typical physiographic, planning, arid and biotic regions of India. Understanding the detailed geography of India.
* Gain knowledge about definition of region, evolution and types of regional planning.
* Develop an idea about choice of a region for planning.
* Build an idea about theories and models for regional planning. Know about measuring development indicators.
* They can know about delineation of formal regions by weighted index method and also delineation of functional regions by breaking point analysis.
* Gain knowledge about measuring inequality by
* Location Quotient, and also measuring regional disparity by Sopher Index

CC10 SOIL & BIOGEOGRAPHY

* Have knowledge about the character and profile of different soil types.
* Understand the impact of man as an active agent of soil transformation, erosion and degradation.
* Recognize land capability and classify it.
* Explaining the Pedological and Edaphological Approaches to Soil Studies - Processes of soil formation, types of soil, and principles of soil and land classification; and management.
* Understand the varied ecosystems and classify them.
* Recognize the significance of biogeochemical cycles and biodiversity.
* Comprehend the devastating impact of deforestation.
* Identify soil types and derive their pH.

SEC RURAL DEVELOPMENT / SUSTAINABLE DEVELOPMENT

* It provides the basic concept of Rural Development and its components with several levels

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of development.

- This also provides the knowledge of paradigm shifting of rural development and comparative study of traditional model to modern concept of development by the eminent scientists.

- Understanding the regional approach to rural development with different Govt. & Non-Govt. schemes like Drought prone area programmes, PMGSY, SJSY, MNREGA, Jan Dhan Yojana.

- This knowledge provides the concept of Rural Governance like Panchayati Raj System and rural development policies and Programmes in India.

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SEMESTER – V- HONOURS COURSE

[(4+2) + (4+2) + (4+2) + (4+2)] =24 Credits

OBJECTIVES:

CC11 RESEARCH METHODOLOGY & FIELDWORK

This portion is about significance of study, formulation of research design, defining the problem, objectives and hypothesis, helps to learn the techniques of writing the report and plagiarism. Filed work is a hands-on course which incorporates the analysis of data obtained from both primary and secondary survey and the interpretation of the research findings and recommendations.

CC12 REMOTE SENSING, GIS and GNSS

The course is about image enhancement, classification of supervised data, data attachment and preparation of annotated thematic maps. The Practical course helps to application of IRS - LANDSAT data. Preparation of FCC images, GIS data analysis and GNSS positioning and waypoint collection.

DSE-A-5 CLIMATE CHANGE: VULNERABILITY & ADAPTATIONS

This portion provides a detailed study on climate change with time scale, causes and problems of climate change or climate change vulnerabilities & global and local level to climate change mitigation.

DSE-B-5 SETTLEMENT & CULTURAL GEOGRAPHY

It is about the cultural elements (cultural diffusion, diversity, realm, religion, language) & settlement (types and distribution). It also enlightens about world racial groups & cultural regions of India.

COURSE OUTCOMES

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The course helps to build the conceptual framework about the research design, significance of study and analytical ability for a student. Remote sensing, GIS & GNSS helps to enhance the skill to process & analyse data obtained through satellites.

CC11 RESEARCH METHODOLOGY & FIELDWORK
- Have expertise in identification of area of study, methodology, quantitative and quantitative analysis, and conclusions to be drawn about the area – fundamental to geographical research.
- Handle logistics and other emergencies on field.
- Develop skills in photography, mapping and video recording.

CC12 REMOTE SENSING, GIS and GNSS
- Have knowledge of the principles of remote sensing, sensor resolutions and image referencing schemes.
- Interpret satellite imagery and understand the preparation of false color composites from them.
- Training in the use Geographic Information System (GIS) software for contemporary mapping skills.
- Analyzing and interpreting remotely sensed satellite images and aerial photographs in order to understand topographical and cultural variations on the Earth's surface.
- Conducting field excursions and preparation of field report on research on problem in different areas of India
- Apply GIS to the preparation of thematic maps.
- Use GNSS.

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DSE-A-5 CLIMATE CHANGE: VULNERABILITY & ADAPTATIONS
- Understand climate change with reference to the geological time scale
- Assess the Origin Greenhouse gases and global warming Global climatic assessment and Impact of climate change: Agriculture and water; flora and fauna; human health and morbidity
- Learn Global initiatives to climate change mitigation: Kyoto Protocol, carbon trading, clean development mechanism, COP, climate fund.
- Analysis of trends of temperatures
- Analyze the rainfall variability of about three decades of climatic regions of India.
- Understand Climate change vulnerability assessment and adaptive strategies with particular reference to South Asia
- Analyse Role of urban local bodies, panchayats and educational institutions on climate change mitigation: Awareness and action programmes
- Develop concepts and skills regarding mitigation measures concerning climatic hazards.

DSE-B-5 SETTLEMENT & CULTURAL GEOGRAPHY
- Understand the scope and content of cultural geography
- Trace the development of cultural geography in relation to allied disciplines
- Understand the concept of cultural hearth and realm, cultural diffusion, diffusion of religion
- Develop an understanding of cultural segregation and cultural diversity, technology and development
- Learn about the various races and racial groups of the world
- Identify the cultural regions of India
- Acquire knowledge about Rural settlements- Definition, nature and characteristics
- Analyze the morphology of rural settlements
- Learn the rural house types, census categories of rural settlements and idea of social segregation
- Learn the census definition and categories of urban settlements
- Analyze the urban morphology models of Burgess, Hoyt, Harris and Ullman
- Differentiate between city-region and conurbation
- Analyze the functional classification of cities
- Develop the skill of mapping language distribution of India
- Learn to plot proportional squares to illustrate housing distribution
- Acquire the skill of identifying rural settlement types from topographical sheet
- Understand Social Area Analysis of a city based on Shevky and Bell

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SEMESTER - VI - HONOURS COURSE

[(4+2) + (4+2) + (4+2) + (4+2)] =24 Credits

OBJECTIVES:

CC13 EVOLUTION OF GEOGRAPHICAL THOUGHT

The philosophy of geography is about the 'Pre-Modern Geography' and the foundations of modern Geography and recent trends (structural, behavioural, humanistic, radical approach). Practical course involves changing perception of maps and mapping voyages.

CC14 DISASTER MANAGEMENT

This portion comprises the concept of hazard and disaster. Hazard mapping and hazard specific study on West Bengal and India. Factors, vulnerability, consequences and management. Practical course involves preparation of a group project on a specific hazard.

DSE RESOURCE GEOGRAPHY/GEOGRAPHY OF INDIA

The Resource Geography consults with the type of various resource and its uses for the development of the nation. Different policy to conserve, utilize and depletion of the resource in respect to the World. Sustainable use of the resources for the future generation of this planet. Geography of India is about the physical as well as cultural features of India, development and distribution.

COURSE OUTCOMES

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This course gives an overview on evolution of geographical thought. Geographical approaches during Pre-modern, Modern & Post-modern phase. Hazard management provides the causes, consequences and management strategies of different hazards. The environmental issues help to learn how to prepare the checklist for EIA and implementation of that and enhance the skill to analyse the pollution data. Geography of India provides the overview about the physical as well as cultural features of India.

CC13 EVOLUTION OF GEOGRAPHICAL THOUGHT

- Perceive the evolution of the philosophy of Geography.
- Appreciate the contribution of the thinkers in Geography.
- Give power point presentations on different schools of geographical thought.
- Discussing the evolution of geographical thought from ancient to modern times.
- Establishing relationship of Geography with other disciplines and man-environment relationships.
- Analyzing modern and contemporary principles of Empiricism, Positivism, Structuralism, Human and Behavioral Approaches in Geography

CC14 DISASTER MANAGEMENT

- Understand the nature of hazards and disasters.
- Assess risk, perception and vulnerability with respect to hazards.
- Prepare hazard zonation maps.
- Assessing the nature, impact and management of major natural and man-made hazards affecting the Indian subcontinent.

DSE RESOURCE GEOGRAPHY/GEOGRAPHY OF INDIA
- Understanding the resource type and its utilization.
- Role of resources to the growth and development of the national economy
- Adopt the knowledge of resource related problems throughout the world
- Learning the pattern of world resource
- Politics of resources and sustainability in resource utilization for the future world
- Mapping and Presentation of the decadal changes of world natural resource
- To know the physiographic division of India
- Understanding the Physical and Cultural aspects of India
- Learning about the people of India & their culture
- Comprehension about the natural resources of India and the emerging crisis
- Highlighting The regional disparity and the burning issues of the country.

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PROGRAMME OUTCOMES

- ❖ PO 01 -Knowledge Explore: To understand the scope and evolution of the diverse discipline of Geography.

- ❖ PO 02 – Application of the Discipline Knowledge: Recognize, synthesize and evaluate diverse sources of knowledge, arguments and approaches pertinent to exploring human-environment problems. Explain societal relevance of geographical knowledge and apply it to real world human- environment issues.

- ❖ PO 03 – Significance of Nature: Appreciate and reflect critically on the importance of holistic and interpretative human- environment perspectives.

- ❖ PO 04 – Caring of the Mother Earth: An understanding and acknowledgment of the threats that endanger the earth's natural systems. This helps in further realization of the significance of anthropogenic causes of many of the disasters and threats that puts life on this planet on the edge.

- ❖ PO 05 – Application of Field Knowledge: Development of knowledge, skills and holistic understanding of the discipline among students. Encouragement of scientific mode of thinking and scientific method of enquiry in students. This goal is achieved through the regular field excursions conducted by the Department to various parts of India extensively and the writing of a report/thesis on it.

- ❖ PO 06 – Disaster Management Skills: Students become equipped with the ability to respond to both natural and man-made disasters and acquire management skills. This is attained through the curriculum by studying and analyzing hazards, disasters, their impact and management.

- ❖ PO 07 – Research Ability: Ability to undertake research in interdisciplinary studies and problems or issues beyond the realm of what strictly comes under the purview of geography. This is possible because of the varied nature of the curriculum that encompasses the study and analyses of concepts of sub-disciplines and allied disciplines of Geology, Seismology, Pedology, Hydrology, Environmental Studies, Disaster Management, Resource Management and Conservation, Regional Planning and Development Studies etc.

- ❖ PO 08 - Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal)

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from different perspectives.

❖ PO 09 - Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

❖ PO 10 - Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

❖ PO 11 - Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

❖ PO 12 - Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

❖ PO 13 - Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

❖ PO 14 - Self-directed and Life-long Learning: Acquire the ability to engage in independent and lifelong learning in the broadest context socio-technological changes.

PROGRAMME SPECIFIC OUTCOMES

❖ PSO 01 - Student will gain the knowledge of physical geography. They will gather knowledge about the fundamental concepts of Geography and will have a general understanding about the geomorphologic and geotectonic process and formation. Imbibing knowledge, skills and holistic understanding of the Earth, atmosphere, oceans and the planet through analysis of landform development; crustal mobility and tectonics, climate change.

❖ PSO 02 – Associating landforms with structure and process; establishing man-environment relationships; and exploring the place and role of Geography vis-a-sis other social and earth sciences. Students can easily correlate the knowledge of physical geography with the human geography. They will analyze the problems of physical as well as cultural environments of both rural and urban areas. Moreover, they will try to find out the possible measures to solve those problems

❖ PSO 03 – Understanding the functioning of global economies, geopolitics, global geostrategic

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views and functioning of political systems

❖ **PSO 04** – Developing a sustainable approach towards the ecosystem and the biosphere with a view to conserve natural systems and maintain ecological balance.

❖ **PSO 05** –The physical environment, human societies and local and/or global economic systems are integrated to the principles of sustainable development

❖ **PSO 06** – Inculcating a tolerant mindset and attitude towards the vast socio-cultural diversity of India by studying and discussing contemporary concepts of social and cultural geography. Explaining and analyzing the regional diversity of India through interpretation of natural and planning regions.

❖ **PSO 07** – Analyzing the differential patterns of the human habitation of the Earth, through studies of human settlements and population dynamics. Understanding and accounting for regional disparities, poverty, unemployment and the impacts of globalization

❖ **PSO 08** – Understanding the history of the subject; over viewing ancient and contemporary geographical thought and its relationship with modern concepts of empiricism, positivism, radicalism, behavioralism, idealism etc.

❖ **PSO 09** – Sensitization and awareness about the hazards and disasters to which the subcontinent is vulnerable; and their management.

❖ **PSO 10** – As a student of the Course they will enrich their observation power through field

   experience and in future this will be helpful for identifying the socio- environmental problems of their community.

❖ **PSO 11** – Training in practical techniques of mapping, cartography, software, interpretation of maps, photographs and images etc; so as to understand the spatial variation of phenomena on the Earth's surface. They will learn how to prepare map based on GIS by using the modern geographical map making techniques.

❖ **PSO 12** – The students will be enlightened with global tectonic mechanism, earth surface features, geology, concept and measuring of distance.

❖ **PSO 13** – The students will have an idea about the evolution of human society and culture,

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settlements, spatial & temporal distribution of population. How to prepare & interpret the geological & weather map & will also help to learn the use of surveying instruments

❖ **PSO 14** – The students will be enlightened with the interrelationship between different elements of weather, atmospheric disturbances, climate change phenomenon. It will also help to know about surface & groundwater hydrology, oceanic features, coastal morphodynamics, coastal hazards & management and also the use of statistical techniques to measure different parameters.

❖ **PSO 15** – The students will have an idea about sectors of economy, the significance of location in economic benefits, GDP, objectives & significance of regional planning, Physical & Chemical properties of soil, problems of soil erosion, detailed discussion on Biosphere and sustainable approach to the environment.

Name of the Course/Programme: B.A./B.Sc. Geography General

Sem 1:
Course Type: CC 1 Th+Pr. Credit: 4+2

COURSE OUTCOME

Course Name: Physical Geography

- o Basic understanding of Earth's structure, composition and dynamic changes

- o Formation of relief: types and their origin

- o Evolution of Earth's topography and ordering of landforms as well as landscape through different geomorphic agents

- o Analysis of Hydrological scenarios of the Earth and its impact on environment

- o Identification of distribution and physico-chemical characteristics of Ocean water in different climatic regions with an approach of sustainable utilization

- o Acquire applied knowledge on different forms of rocks and minerals with overall cartographic and qualitative interpretation of topographical map base landscape analysis

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Sem 2:
Course Type: CC 2 Th+Pr. Credit: 4+2

COURSE OUTCOME

Course Name: Environmental Geography

- o Understanding of global climatological patterns and interrelationships of different components considering different latitudinal locational uniqueness

- o Proper knowledge development on Contemporary issues like Climate change, greenhouse effects and issues of environmental pollution

- o Identification of soil profiles and their characteristics different parts of the world with overall interpretation of regional air-water-soil combination as well as management

- o Basic understanding of global as well as regional ecosystem and biodiversity with their impact on human habitations and adjoining territories

- o Ability to record different environmental parameters including Biodiversity Register from localities and mapping of sub continental weather phenomenon

Sem 3:
Course Type: CC 3 Th + Pr. Credit: 4+2+2

COURSE OUTCOME

Course Name: Human Geography

- o Trace the rise, classification, growth and locational analysis of different economic components in both regional and global level

- o Understanding the development of Human society and the different issues of social organizations, their evaluation, dynamic changes and challenges through time

- o Recognize the settlement patterns and structural changes with geographical compulsions.

- o Analyze cultural understanding and regional distinctiveness from global

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understanding to local aspirational issues

- Cartographic interpretation of Indian state wise or National level production and performance data with specific attention to topographical map analysis related with development clusters.

SEC: Coastal Management Th Credit: 2

- Evaluation of Coastal geomorphology with special reference to forms and changing patterns due to anthropogenic activities

- Analysis of environmental impact of Coastal hazards both short and long term under the shadow of commercial interests and socio-economic compulsions

- Analysis of Coastal Management in global and sub continental cases with special mention to India 's experiences and possibilities with changing environmental awareness.

Sem 4:
Course Type: CC 4 Th +Pr. Credit: 4+2+2

COURSE OUTCOME

Course Name: Cartography

- Understanding of different forms, classification and utilization of scales and map projections

- Acquiring knowledge about different techniques, instruments and their effective utilization on ground at the time of Surveying and Leveling.

- Identification and reading of Remote Sensing Data base map as well as interpretation of Satellite imageries with basic understanding.

- Construction of different components of measurements and indicators associated with maps and ground level locational interpretation

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SEC: Rural Development Th Credit: 2

- o Understanding of the basic knowledge of rural development and needful accessibility for regional balance

- o Trace the changing dynamics of rural development models and ethical as well as economic benefits, challenges on Indian soil

- o Understanding rural governance systems in India and its attributes since independence.

Sem 5
Course Type: DSE -1 Th + P Credit: 4+2+2

COURSE OUTCOME

Course Name: Regional Development

- o Understanding on basic concept of region and regionalization

- o Analysis of strategies and development programs for the regional growth and development in India

- o Understanding issues and challenges related with regional disparities and development challenges since independence

- o Applications of regional development analysis and statistical interpretation of measurements of inequality and growth patterns.

Course Name: Geography of Tourism

- o Trace the scope, nature and changing patterns of tourism in India

- o Analysis of impact of tourism with special mention to social, cultural, economic, religious and political uniqueness in diversity of India

- o Explanation of promotional patterns of contemporary tourism and technology base tourism planning in globalized world with special mention to India

- o Cartographic interpretation of tourist flow and destination choices with special emphasis on Environmental impact analysis of tourism.

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Course Name -SEC: Forest and Wildlife Management Th Credit: 2

- o Historical understanding of forest and wildlife management in India, socio-economic background of changing laws and prohibition

- o Understanding of different aspects of deforestation and poaching in forests: causes and consequences

o Trace the role of human activities in forest and wildlife management in India withspecial mention to environmental movements of native villagers particularly women.

Sem 6:
Course Type: DSE -2 Th+Pr. Credit: 4+2+2

COURSE OUTCOME

Course Name: Agricultural Geography

- o Trace the agricultural system and locational analysis with special mention to factors affecting development and dispersal of agriculture

- o Details understanding of regionalization of agricultural growth under expert's observations and changing perspectives from global to regional scale

- o New challenges of agriculture in India with special reference to impact on Socio-economic backwardness in globalized era.

- o Cartographic measurements of agricultural growth and different forms of mapping for crop patterns and its changing nature

Course Name: Population Geography

- o Special understanding of global population dynamics with special reference to demographic components and changing patterns of distribution

- o Trace the different aspects of Migration and population policies of different experiences with special reference to India since its colonial period.

- o Analysis of different Contemporary issues of population with special mention to health hazards.

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- o Cartographic and statistical interpretation of population data particularly related with socio-economic development.

Course Name: SEC -4 Sustainable Development Th Credit: 2

- o Understanding the concept and historical perspective of Sustainable development in contemporary world.
- o Trace the challenges of Sustainability and effective analytical studies particularly on environment and poverty

- o Global environmental issues related with sustainable development and understanding of co-existence

- o Knowledge development on the issues of global goals for sustainable development

Program Outcomes

- o Geography is not only a dynamic subject but also it is mother subject considering all the concerned of human surroundings. The understanding of the scope and content of Geography is very important students with diverse backgrounds.

- o As geography is expressing different aspects of human-environment relationships, mutual human coordination and conflicts within society and regional distinctiveness students' acknowledgment of this program is not only essential for academic benefits but also for social responsibilities.

- o The present age is known as Anthropocene. Youth must learn challenges, opportunities, threats and distinctiveness of the present system of planet earth and human civilization acquiring knowledge from different sections of present program.

- o Development is a key issue for holistic plan of sustainability and progression. Students' involvement with this program is a learning experience for better understanding of development purposes, requirements and management in and around our environment.

- o Our general students are very much oriented with multidisciplinary studies and issue base understanding of the problems of both nature and human beings. Geography gives the insight of such kind of introspection and interrelationships. There are several components in our Geography general curriculum which is closely associated with other disciplines and sub-disciplines. Environmental studies, Human Geography, Regional Development, Forest and Wildlife Management, Coastal

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Management, Tourism development all these are very not only applied knowledge but also contribute in future research orientation as well as public services.

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Course and Programme & Outcomes Of
B.Sc. (HONOURS) FOOD AND NUTRITION (FNTA)
CBCS SYSTEM -2018
UNIVERSITY OF CALCUTTA

RAIDIGHI COLLEGE
 COURSE TITLE: B.Sc. (Honours) in Food and Nutrition.

COURSE DESCRIPTION: B.Sc. in Food &Nutrition is a 3years undergraduate course comprising of 6 semestersoffering multidisciplinary subject including various aspects of food, health and nutrition such as basic food science, human physiology, human nutrition in different phases of life, community health and nutrition, knowledge about food commodities, therapeutic diet, nutritional biochemistry, food chemistry, community nutrition, public health, food preservation, food microbiology, food service management, sports nutrition, geriatric nutrition, nutrition and health education, Mushroom culture, diet counselling and patient care, bakery science, food safety and quality control, functional foods and nutraceuticals, food fermentation and food packaging- both theory and practical.

Job prospects of this course include the opportunity to work as dietitians in hospitals, nutritionists in clinics or gyms/ health clubs and as food scientists, food technologists, quality control managers, food production managers, community health workers, health and nutrition instructors in NGOsare some of the options. Avenues for higher education remain open as they can doa Master's in food and nutrition or any other allied subjects and later do research work. Teaching options can also be availed after completion of this course.

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SEME STER	COURSE CODE	NAME OF THE PAPER	COURSE OUTCOME
I	FNTA-CC-1 (Th & P)	BASIC FOOD SCIENCE-I	The **theory** portion of this paper gives in-depth information to a student about food, its function in the human body, classification, compositionand different nutrients like carbohydrates, proteins and fats, their role in human health, digestion, absorption and metabolism, food sources, recommended dietary allowances, effects of deficiencies and excess on human health. (**4 credits**) The **practical** partincludes the identification of carbohydrates, proteins, and glycerol. (**2 credits**)
	FNTA-CC-2 (Th & P)	HUMAN PHYSIOLOGY-I	The **theory** portion of this paper gives an idea about the unit of life and includes different vital systems like circulatory, cardiovascular, digestive, respiratory, and musculoskeletal -their structures, composition, functions and regulation. (4 credits) The **practical** includes the determination of pulse rate, blood pressure, bleeding time, clotting time, and haemoglobin level using different methods. (2 credits)
II	FNTA-CC-3 (Th & P)	BASIC FOOD SCIENCE-II	This paper teaches about dietary fibres, minerals, and vitamins- classification, sources, composition, properties, physiological roles, bio-availability, requirements, deficiency and excess along with the chapter on water. (4 credits) The practical of this paper includes the determination of ash, moisture, calcium, iron and vitamin C content in foods. (2 credits)
	FNTA-CC-4 (Th & P)	HUMAN PHYSIOLOGY-II	This paper includes topics like the excretory system, reproductive system, nervous system and endocrine system- their structure, functions, regulation of vital bodily mechanisms and other concepts required to understand human anatomy. (4 credits)

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| III | FNTA-CC-5 (Th & P) | HUMAN NUTRITION-I | The practical of this paper teaches histological slide identifications of various parts of the human body, blood film staining and identification of different types of blood cells, qualitative determination of glucose acetone in urine and Harvard step test to check cardiovascular function status. (2 credits)

The theory paper teaches about concepts, definitions, the scope of nutrition, recommended dietary allowances for different age groups of people, adult consumption unit (A.C.U.), ideas about energy, its units, basal metabolic rate, thermic effect of food, growth and development from infancy to adulthood, the importance of nutrition through these stages of life and prevention of growth faltering through growth monitoring and promotion, utility of growth charts and standards in infant -child care. (4 credits)

The practical portion teaches different processes of cooking like pressure cooking, microwaving, steaming, grilling, and deep fat frying. It also imparts the general concepts of weights and measurements to the students. Eye estimation of raw and cooked food items is taught to develop a general idea of food. This practical includes planning and preparation of meals from different food groups, and supplementary meals for different age groups special focus on low-cost meal preparations for malnourished children and at-risk groups. (2 credits) |
| | FNTA-CC-6 (Th & P) | COMMUNITY NUTRITION | This core paper is all about community nutrition and health. It includes nutritional assessment methods like A-B-C-D which stands for anthropometry, biochemical methods, clinical findings and diet survey. Role of National and international agencies, and regional organisations in combating malnutrition in the community. Food security and nutritional intervention programmes to uplift community health. (4 credits)

The practical includes field study where the |

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			anthropometric measurements of infants -length, weight, circumference of head, chest and mid-upper arm as well as adults are done. The comparison of data with standards helps in interpretations to judge the nutritional status of the infants. Plotting of growth charts, and clinical assessments to identify nutritional deficiencies like vitamin A deficiency, anaemia, rickets etc. is also done along with 24-hour diet recall for estimation of food intakes. (2 credits)
	FNTA-CC-7 (Th & P)	**FOOD COMMODITIES**	This paper gives in-depth knowledge about cereals, millets, pulses, milk and its products, eggs, meat, fish poultry, vegetables and fruits, sugar, fats and oils, raising and leavening agents-uses in cookery and bakery, food adjuncts, convenience foods, salt and beverages- their composition, structure, classification, selection, storage, spoilage, nutritional aspects. (4 credits)

The practical is all about the detection of adulterants in commonly consumed food items for example- starch, sucrose, formalin, boric acid and urea in milk. It also includes the detection of urea in puffed rice, vanaspati in ghee/ butter, and khesari flour in besan. (2 credits) |
| | **FNTA-SEC-A-2 (Theory)** | **FOOD SERVICE MANAGEMENT** | This skill enhancement course (SEC) teaches about the organization of food service management- characteristics and functions. It also includes institutional service units, menu planning, kitchen handling, sanitation and hygiene, personnel management and many other aspects related to food service. (2 credits)

Includes no practical. |
| **IV** | **FNTA-CC-8 (Th & P)** | **HUMAN NUTRITION-II** | |

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	FNTA-CC-9 (Th & P)	**DIET THERAPY-I**	This paper teaches the student about the importance of nutrition during pregnancy, lactation, infancy, toddlers, preschool children, school-going children, and adolescence. Management of preterm and low-birth babies is also taught along with many other important sub-topics related to each stage of life. (4 credits)
			The practical teaches planning and preparation of adequate meals for different age groups with special reference to different physiological conditions: infants, pre-schoolers, school-going children, adolescents, adults, pregnancy, lactation and old age. (2 credits)
			This core paper is taught to give basic concepts of diet therapy to the students. Assessment of a patient's need and thus the team approach required to help him/her to recover faster from the disease condition. Routine hospital diets are taught like liquid, semi-solid, parenteral, and enteral feedings. Many disease conditions, their aetiology, symptoms and dietary management are taught through this core paper. It includes febrile conditions, diseases of the stomach-gastritis, peptic ulcer, intestinal diseases like inflammatory bowel disease, ulcerative colitis, constipation etc. Anaemia and diseases of the liver are also covered in this paper. (4 credits)
			The practical of this paper is very interesting as it teaches the students how food through proper planning and preparation can heal a patient alongside his medication. This paper includes planning and preparation of- normal, fluid, and semi-solid diets along with peptic ulcer, viral hepatitis and anaemia management diets. (2 credits)
	FNTA-CC-10 (Th & P)	**NUTRITIONAL BIOCHEMISTRY -I**	
			This paper introduces the student to the scope and

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V	**FNTA-SEC-B-1**	**NUTRITION AND HEALTH EDUCATION**	inter-relationship between biochemistry and other biological sciences. It deals with enzymes, their classification, their role in the human body, metabolism of carbohydrates, various pathways, lipids-its oxidation, biosynthesis, and clinical significance. (4 credits) The practical paper includes a quantitative estimation of sugars- glucose, lactose, and starch along with the estimation of acid value, iodine value, saponification value of fats, and estimation of blood glucose and serum cholesterol. (2 credits) This paper deals with the concept, objectives, and importance of nutrition and health education in uplifting community health as well as individual health. It teaches the principles of effective communication process, steps included in planning health & nutrition education, various methods of teaching and techniques of evaluation to assess the effectiveness or outcome of such education programs.
	FNTA-CC-11 (Th & P)	**DIET THERAPY-II**	This paper teaches energy modifications and nutritional care for weight management, diet in diabetes mellitus, hypertension, cardiovascular diseases, renal diseases and nephrolithiasis- their symptoms, aetiology, dietary management and ways to prevent them through lifestyle modifications. (4 credits) The practical includes planning and preparation of diets for the following diseases - obesity, underweight, Diabetes mellitus, hypertension, atherosclerosis, acute & chronic glomerulonephritis. (2 credits)
	FNTA-CC-12 (Th & P)	**NUTRITIONAL BIOCHEMISTRY**	

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		-II	This paper introduces the molecular aspect of transport, passive and facilitated diffusion, active transport, knowledge of biosynthesis of proteins, amino-acid metabolism, urea cycle, chemistry and biochemical role of vitamins and minerals in humans. (4 credits)
	FNTA-DSE-A-1	PUBLIC HEALTH	The practical is all about qualitative analysis of amino acids, and proteins, estimation of serum protein, serum creatinine, serum urea, iron, phosphorous and calcium. (2 credits)
			This paperteaches about community health, its dimensions, the concept of epidemiology, communicable disease and infective disease -their control, prevention, public health & hazards due to contaminated foods. It also includes the importance of immunization, community health care, water &wastemanagement, and air pollution. (4 credits)
			The **practical** of this paper includes the preparation of 3 audio-visual aids like charts, posters, and models related to public health and nutrition education to spread awareness and disease prevention. Formulation and preparation of low-cost and medium-cost supplementary recipes as well as field visits to health centres, ICDS centres, MCH centres, NGOs etc. (2 credits)
	FNTA-DSE-B1	FOOD SAFETY AND QUALITY CONTROL	This portion deals with the study and maintenance of good quality and standards related to food, different types of food hazards, their management, hygiene and sanitation, food safety management tools, and food laws and standards. (4 credits)
			The practical consists of the preparation of projects on different topics related to food safety and quality control anddemonstration/ presentation. (2 credits)
			This part helps to understand the concept of microbiology and the use of the microscope in identifying the microbes in foods,cultivation of

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| VI | FNTA-CC-13 (Th & P) | FOOD MICROBIOLOGY | microorganisms, nutritional requirements of microorganisms, types of media used, methods of isolation of primary sources ofmicroorganisms in foods,physical and chemical methods used in the destruction ofmicroorganisms in foods: (Sterilisation & Disinfection) and fundamentals of control of microorganisms in foods: Extrinsic and intrinsicparameters affecting the growth and survival of microbes, use of high and low temperatures, dehydration, freezing, freeze-drying, irradiation and preservatives in food preservation and also Food Spoilage: Contamination and microorganisms in the spoilage of different kinds of foods and food commodities. (4 credits)

The practical paper consists of an introduction to microbiology: Use of equipment -compound microscope, autoclave, incubator, Inoculation chamber, Microscopic identification of microorganisms (prepared slides): Bacterial, fungal strains, Preparation of liquid and solid media for culture ofmicroorganisms and Staining Techniques to study of Morphology of bacterial cells: Simple staining with methylene blue, methyl violet, carbolfuschin, etc. Differential stainingwith Gram stain technique and Microbiological techniques: Pure culture technique-Spread plate, Pour plate and Streak plate. (2 credits) |
|---|---|---|---|
| | FNTA-CC-14 | FOOD | The theory paper teaches the student about food preservation- objectives, principles, and methods. It also teaches about preserved products commonly consumed in daily diet like jam, jelly, pickles, squash etc- the composition, manufacture, selection, cost, storage, uses and nutritional aspects. The paper includes information on food standards like- ISI, Agmark, FPO etc. (4 credits) |

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	(Th & P)	**PRESERVATION**	The practical teaches students about different methods of food preservation like drying, freezing, frying, canning, bottling etc. It also includes aseptic handling of food commodities, and preparation of pickles, sauce, jelly, puree, squash etc. (2 credits)
	FNTA-DSE-A-4	**GERIATRIC NUTRITION**	This section helps in understanding the process of ageing, senescence, ageing-related health problems, nutritional status assessment and changes in nutrition.This paper gives an insight into gerontology, geriatrics, geriatric nutrition and physiological and biochemical changes during old age, nutritional requirements and general dietary guidelines for the elderly and major nutritional and health problems during old age. In **practice,**students will learn to prepare dishessuitable for elderly people like a semisolid and easily digestiblebalanced diet and there is also a visit to an old age home.
	FNTA-DSE-B-3	**FOOD FERMENTATION**	This paper teaches about food fermentation,microorganisms used for, types of culture,study of fermenter, production of baker's yeast, production and nutritional significance of fermented milk products, cereal products, vinegar, andfermented soya products and their nutritional significance and impact on health. In **practice,**studentslearn hygienic handling of equipment and utensils during food fermentation process,preparation of fermented milk products,fermented vegetable pickles and preparation of different food items from fermented products.

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PROGRAM OUTCOMES (POs)

PO 1- **Development of intra-disciplinary knowledge &skills** – Studying a wide range of subjects like Dietetics, Community Nutrition, Family Meal Management, Quantity Food Production and service, Food Safety and Quality Control, Therapeutic nutrition, and Geriatric Nutrition –both theory and practical, helps students developin-depth knowledge and requisite skills whichopens avenues for various job prospects.

PO 2 – Scientific and Critical Thinking – With the gain of scientific knowledge, and hands-on skills through practical and demonstration these students develop critical thinking.

PO 3- Health management and community upliftment- The course teaches the student the importance of healthy eating and its impact on the mind body and soul.It helps them to work on their health as well as uplift their family and community health through the dissemination of information gathered in this course.

PO 4- Entrepreneurship skills- The course allows establishing an enterprise of their own in the health & food sectors thus becoming self-reliant.

PO 5- Problem analysis-Students developthe ability to analysesociety-related/ applied research problems, and design and execute experiments to find relevant solutions within the limited resources.

PO 6- Advanced Usage of Technology course also allows applying advanced instrumentation tools, and online resources with an understanding of the troubleshooting and limitations.

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PO 7- Ethics-Commitment towards professional ethics and responsibilities as a social endeavour to bring harmony with nature.

PO 8- Lifelong learning- Scientific skills for industrial applications and entrepreneurship.

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of B. Sc., Food and Nutrition program, the Graduate will be able to:

PSO 1- Sustainable approach, sensitivity towards community people's health.

PSO 2- Understanding the role and importance of dieticians and nutritionists in nutrition and health education of community people.

PSO 3- Development of an understanding of physiological mechanisms of the human body and pathophysiological processes of diseases and their management through diet.

PSO 4- to enter the teaching profession at school/ college/ university level after higher studies in related field.

PSO 5- Development of an understanding of food laws, national healthcare delivery system, national and international agencies in the management of diseases and address the problem of malnutrition in communities and family level.

PSO 6- Developing diet planning skills for healthy and diseased individuals in society for better health management and prevention of diseases.

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PSO 7- Generation of awareness regarding hazards of poor hygiene, sanitation and its management.

PSO 8- Apply the principles of food science to produce commercial products for the benefit ofsociety honing the entrepreneurial skills ofstudents imbibing sustainable living concept.

PSO 9- Inculcating an entrepreneur mindset to be able to have one's own established business in future with proper training and usage of technology/effective communication.

PSO 10- Developing a clear understanding of the human anatomy, various organ system, their functioning.

PSO-11- Information on food spoilage, safety and laws is vital for healthy living.

PSO 12- Developing research skills in the nutrition field through project formulation.

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Ref. No   *Date:*

Honours Cours

সেমিস্টার – ১

CC-i: বাংলা সাহিত্যের ইতিহাস (১৮০০ খ্রিস্টাব্দ পর্যন্ত)

অবজেকটিভ : বাংলা ভাষা ও সাহিত্যের উদ্ভবের সময়কাল থেকে ১৮০০ খ্রিস্টাব্দ পর্যন্ত বাংলা সাহিত্যের বিভিন্ন ধারার সঙ্গে পরিচিতি ঘটানো এই পাঠের উদ্দেশ্য।

আউটকাম : এখানে মূলত, শিক্ষার্থীরা সাহিত্যের যুগবিভাগ থেকে শুরু করে চর্যাপদ, শ্রীকৃষ্ণকীর্তন, অনুবাদ সাহিত্য, চরিত সাহিত্য, মঙ্গলকাব্য ও পদাবলী সাহিত্য সম্পর্কে সম্যক ধারনা থাকা একান্ত প্রয়োজন। সেই লক্ষ্যপূরণে এই কোর্সের অবতারণা।

CC0ii : বর্ণনামূলক ভাষাবিজ্ঞান ও বাংলা ভাষা

অবজেকটিভ : সাহিত্যের সাম্মানিক পর্যায়ের ছাত্র-ছাত্রী হিসেবে বাংলা ভাষাতত্ত্ব ও শব্দতত্ত্ব সম্পর্কে ধারণা থাকা একান্ত প্রয়োজন। সেই লক্ষ্যপূরণে এই কোর্সের অবরারণা।

আউটকাম : এই কোর্সটি পাঠ করলে শিক্ষার্থীর মধ্যে ধ্বনি, বর্ণ, অক্ষর, বচন, লিঙ্গ, পুরুষ, সমাস, কারক, প্রত্যয়, শব্দ বিবর্তন, শব্দার্থ পরিবর্তনের জ্ঞান অর্জিত হবে।

AECC (সর্বসাধারণের জন্যে)

অবজেকটিভ : সাহিত্য ও সমাজের সঙ্গে শিক্ষার্থীর পরিচয় করে দেওয়া।

আউটকাম : এর ফলে শিক্ষার্থীর সাহিত্য পাঠের মধ্য দিয়ে সমাজ সচেতনতা বৃদ্ধি করা যাবে।

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সেমিস্টার – ২

CC-iii: বাংলা সাহিত্যের ইতিহাস (উনিশ শতক)

অবজেকটিভ :   ঔপনিবেশিক আধুনিকতা সংস্পর্শে এসে আমাদের চিন্তা-চেতনা, জীবনমান ও সাহিত্যে যে আধুনিকতার সঞ্চার ঘটেছিল তাঁর সঙ্গে শিক্ষার্থীর পরিচিতি ঘটানোই এই কোর্সের উদ্দেশ্য।

আউটকাম :   উনিশ শতকের বাংলা কাব্য-কবিতা, নাটক-প্রহসন, কথসাহিত্য, গদ্য-প্রবন্ধ এমনকি সাময়িক পত্রেরও জ্ঞানার্জন করবে শিক্ষার্থীরা।

CC-iv: বাংলা সাহিত্যের প্রবেশক পাঠ

অবজেকটিভ :   বাংলা ভাষা ও সাহিত্যের ইতিহাস সম্পর্কে প্রাথমিক জ্ঞানার্জনের পর এখানে শিক্ষার্থিরা রসাস্বদনের সুযোগ পাবে। সাহিত্যের পাঠকে যতটা সম্ভব আনন্দদায়ক করে তোলাই এক্ষেত্রে লক্ষ্য।

আউটকাম :   এখানে প্রাচীন যুগের পদ (কবিতা) থেকে শুরু করে একেবারে সাম্প্রতিক সময়ের কবিতা, উপন্যাস, ছোটগল্প, নাটক ও প্রবন্ধের জ্ঞান পাবে শিক্ষার্থীরা।

সেমিস্টার – ৩

CC-v: বাংলা সাহিত্যের ইতিহাস (বিশ শতক)

অবজেকটিভ :   বিশ শতকের বাংলা সাহিত্যের গতি প্রকৃতি এবং স্বরূপ সম্পর্কে ধারণা তৈরি করা এই কোর্সের মূল লক্ষ্য।

আউটকাম :   বিশ শতকের বাংলা কাব্য, নাটক, কথসাহিত্য, গদ্য-প্রবন্ধ ও সাময়িক পত্র সম্পর্কে জ্ঞান অর্জন করবে শিক্ষার্থীরা।

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Ref. No   Date:

CC-vi: ঐতিহাসিক ভাষাবিজ্ঞান

অবজেকটিভ :   প্রাচীন ভারতীয় আর্যভাষা থেকে আধুনিক ভারতীয় আর্যভাষা হিসেবে বাংলা ভাষার উদ্ভব ও বিকাশের প্রতিটি পর্যায়ের সাহিত্যিক নিদর্শনের সহায়তা সেই সেই পর্যের ভাবগত বৈশিষ্ট্য সম্পর্কে শিক্ষার্থীদের ধারণা দেওয়া।

আউটকাম :   এখানে শিক্ষার্থীরা 'প্রাচীন বাংলা ভাষা', 'অন্ত-মধ্য' ও 'আধুনিক বাংলা' ভাষার ভাষাতাত্ত্বিক লক্ষণ জেনে যাবে।

CC-vii: কথাসাহিত্য

অবজেকটিভ :   আধুনিক সময়ের জটিলতা, ব্যক্তি ও সমষ্টির দ্বন্দ্ব, বাঙালির পারিবারিক জীবনে নারীর অবস্থান, পরিবেশ সম্পর্কিত ধারণা তৈরি করাই এই কোর্সের উদ্দেশ্য।

আউটকাম :   এখানে মূলত রবীন্দ্রনাথ, শরৎচন্দ্র, মানিক, মহাশ্বেতা দেবীর উপন্যাস ও জগদীশ গুপ্ত, সুচিত্রা ভট্টাচার্য প্রমুখের ছোটগল্প সম্পর্কে অবহিত হবে শিক্ষার্থীরা।

SEC-১,২,৩,৪ : মুদ্রণ ও প্রকাশন, ব্যবহারিক বাংলা, গবেষণা পদ্ধতি

অবজেকটিভ :   এখানে মূলত, শিক্ষার্থীরা মুদ্রণ ও প্রকাশন, আবৃত্তি, সিনেমা-সিরিয়াল, গবেষণার রীতি ও নির্মাণ পদ্ধতির সম্যক জ্ঞান অর্জন করবে।

আউটকাম :   এই কোর্স পড়ে শিক্ষার্থীরা অনেকে পেশা হিসেবে সাংবাদিকতা, আবৃত্তিকার, অভিনেতা ও প্রকাশনার জগতে প্রবেশ করতে পারবে।

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সেমিস্টার – ৪

CC-viii: প্রাগাধুনিক বাংলা সাহিত্য

অবজেকটিভ : প্রাগাধুনিক সাহিত্যের এই কোর্সটির মাধ্যমে শিক্ষার্থীরা সাহিত্যের রসাস্বাদনের পাশাপাশি যাতে বাঙালির সমাজ ও ধর্ম-সংস্কৃতি গতিরেখাটিকেও অনুধাবন করতে পারে, সেদিকে লক্ষ্য রাখা হয়েছে।

আউটকাম : এক্ষেত্রে বৈষ্ণব পদাবলী ও শাক্ত পদাবলীর নানান পদ সম্পর্কে ছাত্র-ছাত্রীরা ওয়াকিবহাল হবে। একই সঙ্গে চণ্ডীমঙ্গল কাব্যেরও ধারণা পাবে।

CC-ix: ছন্দ-অলঙ্কার ও কাব্যতত্ত্ব

অবজেকটিভ : সাহিত্যের শিক্ষার্থীদের ছন্দ, অলঙ্কার ও কাব্যতত্ত্ব বিষয়ে তত্ত্বজ্ঞান থাকা বাঞ্ছনীয়। এই কোর্স কাব্য-কবিতা পাঠকে গভীরতর উপলব্ধিতে সাহায্য করবে।

আউটকাম : বাংলা ছন্দের ধারা অলংকার সম্পর্কে সামগ্রিক জ্ঞান অর্জন করবে। একই সাথে যে কোনো কবিতার রস উপলব্ধি করতে পারবে।

CC-x: প্রবন্ধ ও বিবিধ রচনা

অবজেকটিভ : সমাজ, রাষ্ট্র, শিক্ষা, বিজ্ঞান, ধর্ম, দর্শন-নানা বিষয়ে বাঙালি চিন্তাকগন প্রবন্ধের মাধ্যমে তাঁদের ভাবনাকে ব্যক্ত করেছেন। এই কোর্সের মাধ্যমে সেই বিচিত্র সম্পর্কে ধারনা দেওয়া হবে।

আউটকাম : উনিশ শতক থেকে সাম্প্রতিক কালের প্রাবন্ধিকদের বৈচিত্র্যময় প্রবন্ধের সঙ্গে পরিচিতি ঘটবে শিক্ষার্থীর।

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সেমিস্টার – ৫

CC-xi: সাহিত্যের রূপ ও রীতি

অবজেকটিভ :   সাহিত্যের রূপবৈচিত্র্য ও গঠনরীতি সম্পর্কে ধারণা দেওয়া হবে এই কোর্সে।

আউটকাম :   সাহিত্যের বিভিন্ন সংরূপের রূপ ও আঙ্গিক সম্পর্কে জ্ঞানার্জনের ফলে শিক্ষার্থীরা যে কোনো সাহিত্য পড়ে তার শ্রেণী নির্ণয় করতে পারবে।

CC-xii: নাটক ও নাট্যমঞ্চ

অবজেকটিভ :   সামাজিক বাস্তবতার দর্পণ হিসাবে নাট্যসাহিত্যের পাশাপাশি পড়ুয়ারা নাট্যমঞ্চ সম্পর্কেও যাতে জ্ঞানার্জন করতে পারে, সেই উদ্দেশ্যে এই কোর্সটি তৈরি।

আউটকাম :   এখানে শিক্ষার্থীরা একাধিক নাট্যকারের নাটক সম্পর্কে অবহিত হওয়ার পাশাপাশি 'রঙ্গমঞ্চের ইতিহাস' সম্পর্কেও জ্ঞানার্জন করবে।

DSE – ১-৮ :

অবজেকটিভ :   বাংলার সমাজ ও সংস্কৃতির ইতিহাস, বাংলাদেশের সাহিত্য, শিশু-কিশোর সাহিত্য, গোয়েন্দা সাহিত্য, অলৌকিক কাহিনী, লোকসংস্কৃতি ও লোকসাহিত্য, দেশভাগ ও বাংলা সাহিত্য সম্পর্কে সামগ্রিক জ্ঞানদানের জন্য এই কোর্সটি তৈরি।

আউটকাম :   এতদিন এপার বাংলার পড়ুয়াদের মধ্যে 'বাংলাদেশের সাহিত্য' সম্পর্কে তেমন ধারণা ছিল না। কিন্তু এবার এই কোর্সের মাধ্যমে তারা সেই জ্ঞান অর্জন করবে। সেই সঙ্গে, তুলনায় কম চর্চিত-শিশু-কিশোর সাহিত্য, গোয়েন্দা সাহিত্য ও অলৌকিক কাহিনির সঙ্গেও পরিচিত ঘটবে।

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সেমিস্টার – ৬

CC-xiii: আধুনিক বাংলা কাব্য-কবিতা

অবজেকটিভ :   ঔপনিবেশিক আধুনিকতার সংস্পর্শে এসে আমাদের কব্যে যে নবযুগের সঞ্চার হয়েছিল, তার বিভিন্ন পর্ব যাতে পড়ুয়ারা অনুধাবন করতে পারে, তার জন্য এই কোর্স।

আউটকাম :   এক্ষেত্রে মধুসূদন থেকে শুরু করে রবীন্দ্রনাথ, নজরুল, জীবনান্দ হয়ে সুভাষ মুখোপাধ্যায় এবং একেবারে সাম্প্রতিক উত্তর-আধুনিক কবি অমিতাভ দাশগুপ্তের কবিতা সম্পর্কে জ্ঞান লাভ করবে শিক্ষার্থীরা।

CC-xiv: সংস্কৃত, ইংরেজি ও প্রতিবেশী (হিন্দি) সাহিত্যের ইতিহাস

অবজেকটিভ :   বাংলা সাহিত্যের সঙ্গে সংস্কৃত, ইংরেজি ও হিন্দি সাহিত্যেরও সম্পর্ক রয়েছে। ফলে একজন বাংলা সাহিত্যের শিক্ষার্থী হিসেবে উক্ত সাহিত্যের ইতিহাস সম্পর্কে জ্ঞান রাখা প্রয়োজন।

আউটকাম :   বাংলা সাহিত্যের সামগ্রিক পরিচয় পাওয়ার পর শিক্ষার্থী সংস্কৃত, ইংরেজি ও হিন্দি সাহিত্যের ইতিহাস সম্পর্কে প্রাথমিক পরিচয় লাভ করবে এবং সেই আলোকে বাংলা সাহিত্য সম্পর্কেও তার মূল্যায়ন আরও স্বচ্ছ হয়ে উঠবে।

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General Course

বাংলা সাধারণ সিলেবাসেও ছ'টি সেমিস্টার। যেখনে ....

ক) সাহিত্যের ইতিহাস

খ) গল্প

গ) উপন্যাস

ঘ) নাটক এবং

ঙ) নানা স্বাদের প্রবন্ধ পাথ্য রয়েছে।

অবজেকটিভ : সাহিত্যের এই সব রূপভেদ গুলি পাঠদানের দ্বারা ছাত্র ছত্রীদের নানামাত্রিক চিন্তা চেতনার বিকাশ সাধনের চেষ্টা

আউটকাম : এর দ্বারা ছাত্রছাত্রীদের সমাজ বাস্তবতা সম্পর্কে একটা বাস্তবতার বোধ তৈরি হবে। এরা জেনে নিতে পারবে গল্প উপন্যাসের সূত্রে মানবিক নানা জ্যামিতিগুলিকে। যা ছাত্র ছাত্রীদের জীবনে অগ্রগতির পথে একটা নতুন গতি যোগাবে সন্দেহ নেই। তাছাড়া সাহিত্য পাঠের দ্বারা গঠিত হয় এমন একটা মনন, যা সুস্থ মন ও সমাজ গড়ে তোলবার ক্ষেত্রে সবচেয়ে শক্তিশালী একটা অনুপ্রেরণা হয়ে উঠতে পারে।

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BANG/BNGG DSE-A-S-1 বাংলার সমাজ ও সংস্কৃতির ইতিহাস

অবজেকটিভ   বাংলা ভাষার উদ্ভবের সময়কাল থেকে আধুনিককাল পর্যন্ত বাঙালি জাতির সাংস্কৃতিক বিকাশের গতিরেখার সঙ্গে শিক্ষার্থীদের পরিচয় ঘটানোই এই কোর্সের উদ্দেশ্য।

আউটকাম   শিক্ষার্থীরা এই পত্রে তৎকালীন ইতিহাসের আর্থ-সামাজিক রাজনৈতিক অবস্থান সম্পর্কে সচেতন হয়ে ওঠে, দেভাগের মূলে যে আন্দোলন ও তার প্রতিফলন সম্পর্কে অবগত হয়।

BANG-A- DSE-A-S-1 বাংলাদেশের সাহিত্য

অবজেকটিভ   দেশভাগের পর পূর্ববঙ্গ তথা বাংলা দেশে বাংলা সাহিত্যের এক সমৃদ্ধ ধারা গড়ে উঠেছে। বাংলা সাহিত্যের পাঠ বাংলাদেশের সাহিত্য ব্যাতিরেকে সম্পূর্ণতা লাভ করতে পারে না এই বিবেচনাতেই কোর্সটির পরিকল্পনা করা হয়েছে।

আউটকাম   শিক্ষার্থীরা বাংলার সামাজিক রাজনৈতিক পরিস্থিতিতে দেশভাগের পটভূমি এবং তার ফলাফল হিসেবে দৈনন্দিন মানুষের জীবন কিভাবে পর্যালোচিত হয়। তার বিবরণ পাওয়া যায় এই পত্রে।

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Ref. No   *Date:*

BANG-A- DSE-B-S-1 বাংলা শিশু কিশোর সাহিত্য

অবজেকটিভ	বাংলা শিশু কিশোর সাহিত্যের সুগভীর ঐতিহ্য রয়েছে। সেখান থেকে নির্বাচিত পাঠককে এখানে পড়ুয়ারা বিদ্যায়তনিক পাঠ শৃঙ্খলাই অধ্যয়ন করতে শিখবে।
আউটকাম	শিক্ষার্থীরা বাংলার সামাজিক রাজনৈতিক পরিস্থিতিতে দেশভাগের পটভূমি এবং তার ফলাফল হিসেবে দৈনন্দিন মানুষের জীবন কিভাবে পর্যালোচিত হয়। তার বিবরণ পাওয়া যায় এই পত্রে।শিশু কিশোর মনে কল্পনা জ্ঞাতের বাইরে রহস্যময় চিন্তা চেতনা তাদের জিজ্ঞাসু মনে উত্তর জানাতে সাহায্য করবে।

BANG-A- DSE-B-S-2 দেশভাগ ও বাংলা সাহিত্য

অবজেকটিভ	বাঙালি জাতির ইতিহাসে দেশভাগের একটি গভীরমূল এবং সুদুরপ্রসারী অভিঘাত রয়েছে। দেশভাগকে ঘিরে বাঙালির সাম্যক এবং ব্যক্তিক বিপন্নতা, বিপর্যয় এবং অসহায়ত্বের সাক্ষ্যবাহী নির্বাচিত কিছু সাহিত্যকে এখানে পাঠ্য করা হয়েছে।
আউটকাম	দেশভাগের প্রেক্ষাপটে কিশোর মনের দেশভাগের যে চিত্র অস্পষ্ট ছিল, তা ক্রমশ বাইরের দ্বার খুলে স্পষ্ট হয়ে উঠবে।

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BANG-A-BNGG- DSE-A-6-3 – বাংলা গোয়েন্দা সাহিত্য, কল্পবিজ্ঞান আশ্রয়ী রচনা এবং অলৌকিক কাহিনি।

অবজেকটিভ	সাহিত্যের পাঠ এবং আস্বাদনে কিশোরদের অভ্যাস তৈরি হয়ে ওঠে গোয়েন্দা গল্পের মধ্য দিয়ে। তাদের চেনা ক্ষেত্রকে পড়ুয়ারা এখানে বিদ্যায়তনিক পাঠ শৃঙ্খলায় অধ্যয়ন করতে শিখবে।
আউটকাম	গোয়েন্দা সাহিত্য-এর মধ্য দিয়ে শিক্ষার্থীরা অপরাধ বিজ্ঞানের ধারা-র চিন্তায় নিজেকে জগতের বাইরে রহস্যময় চেতনা তাদের অন্তর্মাপকে জাগিয়ে তোলে।

BANG-A- DSE-A-6-4 তুলনামূলক সাহিত্য

অবজেকটিভ	এই কোর্সে ধ্রুপদি সাহিত্যের সঙ্গে আধুনিক সাহিত্যের অথবা এই পর্যায়ের বিভিন্ন ভাষায় লেখা সাহিত্যের তুলনামূলক পাঠ করে হবে। এর মধ্য দিয়ে পড়ুয়াদের সাহিত্য সংক্রান্ত চেতনার প্রসার ঘটানোই উদ্দেশ্য।
আউটকাম	এই সাহিত্য প্রাচ্য সাহিত্য যথা সংস্কৃত সাহিত্যের সাথে বাংলা সাহিত্য, ইংরেজি সাহিত্যের সাথে বাংলা কবিতা এবং

BANG-A- DSE-B-6-3 চরিত সাহিত্য, আত্মচরিত ও ভ্রমণ সাহিত্য

অবজেকটিভ	চরিত সাহিত্য ও আত্মচরিত পাঠের মধ্য দিয়ে পড়ুয়ারা ব্যক্তি চৈতন্যদেব কিংবা ব্যক্তি রবীন্দ্রনাথকে যেমন চিনবে তেমনি তাদের সময়কালের ধারণাটিকেও আয়ত্ত করতে পারবে।

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আউটকাম	জীবন মনীষী রূপে যাদের আদর্শ গ্রহনীয়, তাদের জীবনী সম্পর্কে সচেতন হয়ে ওঠা। দেশ- বিদেশের ভ্রমণ সম্পর্কে অবগত হয়ে ওঠা।

BANG-A-BNGG-DSE-A-6-4 – লোকসংস্কৃতি ও লোকসাহিত্য

অবজেকটিভ	বাঙালি এবং তার সংস্কৃতিকে জানতে গেলে আমাদের লোকসংস্কৃতির ও লোকসাহিত্যের পাঠ নেওয়া খুবই জরুরি বাংলার সমৃদ্ধ লোক-ঐতিহ্যের থেকে নির্বাচিত কয়েকটি প্রসঙ্গই এখানে পড়ুয়াদের চর্চার জন্য রাখা হচ্ছে।
আউটকাম	প্রাচীনকাল থেকে মানুষের প্রস্তুত করা রীতি-নীতি, নিয়ম-কানুন বাস্তব জীবনকে কিভাবে প্রভাবিত করেছে তার জীবন দর্শন।

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Department of English

The Department of **English** runs Undergraduate Honours and General Courses under the Choice-Based Credit System (CBCS) introduced in 2018-19 session. As per the Syllabi of the courses, approved by the University of Calcutta, the dept. offers both Core Courses and General Elective Courses, and also offers Ability Enhancement Compulsory Courses (AECC) in English language to all undergraduate students of the college.

At Raidighi College, the undergraduate course of study in English literature intends to offer the students a fair idea about the trends in British Literature, primarily. With students coming mostly as first generation learners and from rural interiors, it seems challenging at first to inculcate within them the unmistakeable sense of urbanity that comes with the linguistic paradigm of British Literature. However, beyond that, throughout the three years, the department tries to do justice to the broader name it comes under --- 'humanities'. More than practical utility, a course on literature comes with a promise to provide an insight into the finer humanitarian values of the world, and nourish the scope ofcreative faculty and imagination in the young minds. In time, if a student is able to get into this scheme of things, the course transcends beyond literary boundaries and plays its part in making the students better, compassionate citizens.

Besides, on practical grounds, English, being a language of official purpose, prepares the students for various scopes of employment through competitive examinations, keeping them at par with the

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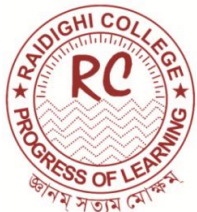Ref. No   Date:

formal trends and practices of the world. A thorough reading of English literature in the undergraduate course also opens up scopes for higher studies for the students to pursue, and join the fields of research and teaching.

Subject Outcomes (Nos)	Subject Outcomes (SO)
SO 1	To prepare the students for a successful career in academics in government sector/ private sector.
SO 2	To provide strong foundation in basic English language skills, both reading and writing.
SO 3	To identify and analyse basic human concerns in literary works, and thereby, relate them to the present time.
SO 4	To motivate them for higher education and to take up research.
SO 5	To provide them with scopes and encouragement for careers in disciplines that are not directly under but strongly connected to English language and literature.

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ENGA

SEM	COURSE	SUBJECT OUTCOMES				
		1	2	3	4	5
1	CC 1	X	X	X		
1	CC 2	X	X	X		
2	CC 3	X	X	X		
2	CC 4	X	X	X		
3	CC 5	X	X	X		
3	CC 6	X	X	X		
3	CC 7	X	X	X		
3	SEC-A	X	X	X		X
4	CC 8	X	X	X		
4	CC 9	X	X	X		

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4	CC 10	X	X	X		
4	SEC-B	X	X	X	X	X
5	CC 11	X	X	X	X	
5	CC 12	X	X	X	X	
5	DSE-A	X		X	X	X
5	DSE-B	X	X	X	X	
6	CC 13	X	X	X	X	
6	CC 14	X	X	X	X	
6	DSE-A	X	X	X	X	
6	DSE-B	X		X	X	X

ENGG

SEM	Course	1	2	3	4	5
1	CC 1		X	X		
2	CC 2		X	X		X
3	CC 3		X	X		
3	SEC-A		X			X
4	CC 4		X	X		
4	SEC-B		X			X
5	DSE-A		X	X		X
5	SEC-A		X			X
6	DSE-B		X	X		X
6	SEC-B		X			X

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Raidighi College
Department of History

Course Objectives and ProgrammeOutcomes

Overall Outcome of Undergraduate

Programme in History

It may be sorted as follows:

Elementary concept of chronology and historical periods.

Development of historical perspectives.Clear understanding of the basic themes, concepts andscope of history.

Critically recognize various aspects of history such associal, political, economic and cultural histories.

Development of analytical skill in writing and discussion.

Prepare for various competitive examinations as well asfor Master degree program.

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Ref. No   Date:

B.A. (Hons.) Programme

Semester I Objectives and Outcomes

- *History of India (Up to c. 300 BCE)* – To build concept about the social and cultural patternsof the earliest period of human civilization developed in India.

- *Social Formations and Cultural Patterns ofThe Ancient World* – It focuses on building conceptual knowledge about the Socio cultural patterns of the ancient world otherthan India.

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Semester III Objectives and Outcomes

- ***History of India (CE 750-1206)*** – To built up the concept about early medieval period and an overall elementary knowledge about the society, political structure and cultureof this period.

- ***Rise of Modern West I*** – Concept building on the transformation of European world from the feudalstructure to the Pre-capitalism.

- ***History of India (CE 1206-1526)*** – To build concept on the socio-politico-economic and cultural pattern and regional variations of the Sultanate period.

- ***Understanding Heritage*** – Concept making on different facets of heritage, their significance & legal and institutional framework for protection.

Semester IV Objectives and Outcomes

- ***Rise of the Modern West II*** - Concept building on thetransformation of European world from the early commercial capitalism to the Industrial capitalism.

- ***History of India (CE 1526-1605)*** – To build concept on the socio-politico-economic and cultural patternand regional variations of the early Mughal period.

- ***History of India (CE 1605-1750s)*** – To build concept on the socio-politico-economic and cultural patternand regional variations of the Late Mughal period.

- ***Understanding Popular Culture*** – Concept on popular culture, the mediums of their expression andimpact on society .

Semester V Objectives and Outcomes

- ***History of the Modern Europe*** – Concept making onthe political and diplomatic history of the world up to the WWII.

- ***History of India (CE. 1750s-1857)*** – Concept making on the political and socio-cultural-economic history of the early colonial India.

- ***History of Bengal (CE. 1757- 1905)*** - Concept makingon the political and socio-cultural-economic history of the early colonial Bengal.

- ***History of Modern East Asia I*** - Concept making on the political and diplomatic history of modern China.

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Semester VI Objectives and Outcomes

- *History of India (CE. 1857-1964)* - Concept making onthe political and socio-cultural-economic history of the British India.
- *History of the World Politics* - Concept making on the political and diplomatic relations of the post WWworld.
- *History of Bengal (CE. 1905-1947)* - Concept making on the political and socio-cultural-economic history of the colonial Bengal.
- *History of Modern East Asia II* – Build conceptual knowledge on the Socio-politico-economic historyof modern Japan.

B.A. (General) Programme

Objectives and Outcomes

- **Semester I:** *History of India up to 300 CE* – to transmit elementaryconcept about the ancient Indian culture and our heritage.
- **Semester II:** *History of India (CE 300-1206)* - to transmit elementaryconcept about the early medieval Indian history.
- **Semester III:** *History of India (CE 1206-1707)* - to transmitelementary concept about the medieval Indian history.
- **Semester IV:** *History of India (CE 1707-1950)* - to transmit elementary concept about the colonial rule and about thefreedom struggle of India.
- **Semester V:** *Some Aspects of European History* – to build conceptabout the political history of Modern Europe.
- **Semester VI:** *Some Aspects of Society and Economy of ModernEurope* – to build concept about the socio-economic patterns and regional variations of pre capitalist Europe.

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Ref. No   Date:

Skill Enhancement Course
Objectives and Outcomes

- *Historical Tourism* – to build elementary skillof conducting historical place visit, writing place visit report and to transmit basic concept about heritage tourism.

- *Museums and Archives* - to build basic concept about the conservation methods ofour heritage and also to enhance skill on writing Museum survey report.

Department of History Programme Outcomes (PO)

PO1 - Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2 - Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3 - Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4 - Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5 - Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6 - Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7 - Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

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Programme Specific Outcomes (PSO)

PSO1 – Students will be able to demonstrate their knowledge of the chronology, narrative, major events, personalities and turning points of the history of India and the world.

PSO2 – Students will be able to offer multi-causal explanations of major historical developments based on a contextualized analysis of interrelated political, social, economic, cultural and intellectual processes.

PSO3 – Students will be able to extract evidence from primary sources by analyzing and evaluating them in relation to their cultural and historical context and use that evidence to build and support an argument.

PSO4 – Students will be able to evaluate secondary historical sources by analyzing them in relation to the evidence that supports them, their theoretical frameworks, and other secondary historical literature.

PSO5 – The programme will be helpful in developing among the students the ability to distinguish between fact and fiction while understanding that there is no one singular historical truth.

PSO6 – Should be able to construct original historical arguments using a blend of primary andsecondary source materials.

PSO7 – Students will be able to ponder over the facts how women have taken responsibilities in the social, economic and religious functionalities in order to be considered equal as their male counterparts.

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Mapping Programme Outcome (PO) and Course Outcome (CO)

Honours Course

Course Outcome (CO) of	Programme Outcome (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CC1	√		√				
CC2			√		√		√
CC3	√	√		√		√	
CC4	√		√				√
CC5				√			
CC6			√		√		√
CC7	√	√	√				
CC8				√	√	√	
CC9	√	√					
CC10			√				
CC11					√	√	
CC12			√			√	√
CC13			√		√		√
CC14	√					√	
SEC A	√	√					
SEC B			√				
DSE A1					√	√	
DSE A2			√			√	√
DSE B1			√		√		√
DSE B2	√					√	

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Mapping Programme Outcome (PO) and Course Outcome (CO)

General Course

Course Outcome (CO) of	Programme Outcome (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CC1/GE1	√		√				
CC2/GE2			√		√		√
CC3/GE3	√	√		√		√	
CC4/GE4	√		√				√
SEC A2	√	√					
SEC B1			√				
DSE A1					√	√	
DSE B1			√			√	√

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Raidighi College (Affiliated to University of Calcutta) **Dept of Political Science**

Course Objectives and Programme Outcomes [COPO]

B.A. Honours Programme in Political Science
Semester I

Understanding Political Theory Concepts

Objectives:
To inculcate concepts of politics, State; Nation; Sovereignty (evolution); Power and Authority--- types and linkages; and also build concepts of Law.
To understand basic concepts of Liberty, Equality, Rights, Law and Justice.
To develop an idea of empirical Political Theory: System Analysis, Structural Functional Analysis

Outcomes:
- Able to assess and differentiate the theories of State (Origin, Nature, Functions): Contract, Idealist, Liberal and Neo-Liberal Theories.
- Able to explain the Concept of State Sovereignty: Monistic and Pluralistic Theories.
- Able to analyze the changing concept of Sovereignty in the context of Globalisation.
- Able to classify David Held's Democratic Theories.
- Able to understand basic concepts of Liberty, Equality, Rights, Law and Justice. ┹ Able to assess and differentiate empirical Political Theory: System's Analysis,
Structural Functionalism.

Understanding Political Theory: Approaches and Debates
Objectives:
To understand different approaches for understanding political theories, like

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Normative; Legal-Institutional; Empirical-Behavioual---Systems Analysis; Structural Analysis.

To discuss the Marxist Approach to politics. Dialectical Materialism & Historical Materialism etc.

Outcomes:
- Able to analyze what is Politics and explaining the approaches to the Study ofPolitical Science – Normative, Behavioral, Post Behavioral, & Feminist.
- Able to assess empirical Political Theory: System's Analysis, Structural Functional Analysis.
- Able to explain Dialectical Materialism and Historical Materialism with specialreference to relationship between base and superstructure.

- Able to analyze the theory of class and class struggle. Able to describe the Marxist Approach to politics.
- Able to analyze Marx's concept of Freedom and Democracy: Nature, Features &Critique.

- Able to discuss Marx's Theory of State with special reference to Relative Autonomy of the State.
- Able to explain Marxian theory of Revolution.
- Able to evaluate the major debates in Marxism: Lenin- Rosa Luxemburg debateon Political party.

B.A. Honours Programme in Political ScienceSemester II

Constitutional Government in India

Objectives:
To enable the student to understand the importance of constitution
To understand the structure of executive, legislature and judiciary.
To understand philosophy of fundamental rights and duties.
To understand the autonomous nature of constitutional bodies like Supreme Court and high court, controller and Auditor General of India and Election Commission of India.

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Outcomes:

- Able to understand historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration.
- Able to apply the knowledge on directive principle of state policy, the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy. Application
- Able to analyze the History, features of Indian constitution, the role Governor & Chief Minister, role of state election commission, the decentralization of power between central, state and local self-government.
- Able to evaluate Preamble, Fundamental Rights and Duties, Zilla Panchayat, block level organization, various commissions of viz SC/ST/OBC and women.

Politics in India: Structures and Processes

Objectives:

To understand Party system: features and trends – major national political partiesin India: ideologies and programmes. Coalition politics in India: Nature and Trends.

To understand Political parties in West Bengal: Overview, Electoral process: Election Commission: composition, functions, role. Electoral reforms. Role of business groups, working class, peasants in Indian politics, Role of Religion, Language; Caste; Tribe; & Regionalism in Indian politics, New Social Movements since the 1970s: environmental movement's women's movements &human rights movements.

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Outcomes:

- Able to critically evaluate the Indian Party system – its development and lookingat the ideology of dominant national parties.

- Able to evaluate the role of various forces on Indian politics: religion; language;caste; tribe; regionalism; business; working class and peasants.
- Able to evaluate the Electoral Process in India with focus on the ElectionCommission. Composition, Functions and Role.
- Able to analyze regionalism in Indian politics.
- Able to investigate the New Social Movements since the 1970s: environmentalmovements, women's movement and human rights movement.

B.A. Honours Programme in Political ScienceSemester III

Indian Political Thought I

Objectives:

To provide knowledge on Ancient Indian Political ideas: Modern Indian Thought: views of Rammohan Bankim Chandra Chattopadhyay, Vivekananda & Rabindranath Tagore: views on nationalis, M.K. Gandhi: views on State, Swaraj,Satyagraha etc

Outcomes:
- Able to trace the evolution of Indian political thought from ancient India tomodern India.
- Able to analyze the nationalist thought of Raja Rammohun Roy.
- Able to assess the nationalist thought of Bankim, Vivekananda and Tagore.
- Able to assess M.K. Gandhi.

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Comparative Government and Politics

Objectives:

To know the evolution of Comparative Politics.

To understand the major approaches to the study of comparative politics---Institutional approach (dominant schools: Systems approach and Structural Functional approach etc.

To know the classification of political systems. Nature of Liberal and Socialist political systems; distinguishing features--- Conventions, Rule of Law (UK), Separation of powers, checks and balances, Judicial Review (USA), DemocraticCentralism (PRC), Referendum, Initiative (Switzerland).

Outcomes:

- Define and apply key concepts in comparative politics, including but not limitedto nation-states, political regimes, political identity, gender and politics, & political violence.
- Explain and evaluate the importance of specific historical events in the context of the political and economic development of the countries studied.
- Compare and contrast the political systems of the countries explored in the course, paying particular attention to historical, political, economic, geographical, and moral aspects of governance in a variety of countries.
- Use the comparative method to analyze contemporary political issues.
- Demonstrate an ability to communicate in writing your knowledge and beliefs about the institutions and forces shaping the political systems of several countries. Particular emphasis will be placed on how each country resolves the conflicts associated with it.

Perspectives on International Relations

Objectives:

To understand International Relations: outline of its evolution as academicdiscipline.

To know the major theories: (a) Classical Realism and Neo-Realism (b) Dependency (c) World Systems Theory.

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Examining the issues of Underdevelopment, Terrorism, Regionalism and Integration that characterizes the Post Second World War order.
To build concepts of foreign policyand understanding Indian foreign policy: major phases: 1947-1962; 1962-1991; 1991-till date, Sino-Indian relations; Indo-US relations.

Outcomes:

+ To be able for creative thinking about pressing global problems and to equip students with the analytic tools, language expertise, and cross-cultural understanding to guide them in that process. Students will learn how to comprehend, critically analyze, and evaluate trends in international politics.
+ Able to exlplain the approaches and methods to study the discipline through Political Realism, Pluralism and Worlds system's Model.
+ Able to explain the issues of Underdevelopment, Terrorism, Regionalism and Integration that characterizes the Post Second World War order.
+ Able to analyse Studying the role of Diplomacy, Propaganda and Military capabilities in the making of foreign policy.

+ Able to explain Indian Foreign Policy: Basic Principles, Evolution and BilateralRelations.
  + Able to analyse the Foreign Policy of India and China + Able to analyse the Foreign Policy of India and US.

Skill Enhancement Course

(Democratic Awareness through Legal Literacy)
Objectives:

To understand laws relating to Criminal jurisdiction-provisions relating to filingan FIR, arrest, bail, search and seizure and some understanding of the questions of evidence and procedure in the Criminal Procedure.
To know the Offences under IPC, India: Personal Laws, Customary Laws, Laws relating to Dowry, sexual harassment and violence against women.

Outcomes:

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🔸 Able to apply the knowledge in real life relating to Criminal jurisdiction provisions relating to filing an FIR, arrest, bail, search and seizure and some understanding of the questions of evidence and procedure in the Criminal Procedure.

🔸 Able to explain the Offences under IPC, India: Personal laws.

🔸 Able to grow awareness about Customary Laws, Laws relating to Dowry, sexualharassment and violence against women.

B.A. Honours Programme in Political Science
Semester IV

Indian Political Thought II
Objectives:

To know about the ideas and views of eminent Indian political thinkers, like M.N. Roy: Radical Humanism, Narendra Deva, Ram Manohar Lohia, Jayaprakash Narayan: Socialist ideas.

To discuss on Syed Ahmed Khan and Iqbal: views on Colonialism and Nationalism.

To explain Nehru: views on Socialism and Democracy and Subhas Chandra Bose: views on Socialism and Fascism.

To analyze Contested notions of 'nation'- Savarkar, Jinnah.

To develop the knowledge on Jyotiba Phule and Ambedkar on caste systemuntouchability. Pandita Ramabai's views on Social Justice.

Outcomes:

🔸 Able to discuss the views of M. N. Roy, Narendra Deva, Ram Manohar Lohia, Jayaprakash Narayan and Syed Ahmed Khan.

🔸 Able to assess views of Nehru on Socialism and Democracy, Subhas ChandraBose: views on Socialism and Fascism.

🔸 Able to analyze Contested notions of 'nation'--- Savarkar, Jinnah.

🔸 Able to describe the movements against caste and untouchability, Ambedkar's views on Social Justice and the depressed classes JyotibaPhule and Ambedkar on caste system and untouchability. Pandita Ramabai's views on social justice.

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Global Politics since 1945

Objectives

To gain knowledge on Cold War and its evolution: outline. Emergence of ThirdWorld: NAM; Pan Africanism. Post-Cold War world: overview.
To discuss on Globalization: conceptions and perspectives.
To explain Europe in transition: European Union, Brexit (overview), Major institutions of global governance: World Bank, IMF, WTO---overview. Major regional organizations: ASEAN, OPEC, SAFTA, SAARC & BRICS. West Asiaand the Palestine question.

Outcomes:

- Able to analyze the the Cold War phases and understanding the post Cold War era.
- Able to explain the developments in third world countries in Post World War II era like NAM and its' Relevance, Pan Africanism. Post-Cold War world: overview.
- Able to explain certain basic concepts like Globalisation in contemporary Worldorder.
- Able to assess the overview of Major institutions of global governance: World Bank, IMF, WTO.
- Able to explain the major regional organizations ASEAN, OPEC, SAFTA, SAARC & BRICS, West Asia-Palestine issue

Western Political Thought & Theory I

Objectives:

To develop knowledge on Plato: justice, communism – Aristotle: State, Classifications of Constitutions,
To know the Roman political thought: theories of Law and Citizenship – contributions of Roman thought,
To build knowledge of Medieval political thought in Europe: major features, Contribution of Machiavelli. Significance of Renaissance. Political thought of Reformation, Bodin: Idea of Sovereignty, Hobbes: founder of Science of Materialist politics

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Outcomes:

- Able to explain the dominant features of Ancient Western Political Thought: Ancient Greek political thought with focus on Aristotle and Plato; Roman, Political Thought: its contributions with special emphasis on the emergence of Roman law.
- Able to examine the features of Medieval Political Thought.
- Able to evaluate the Renaissance; political thought of Reformation; and Machiavelli.
- Able to Critically examine Bodin's contributions to the theory of Sovereignty; Hobbes as the founder of the science of materialist politics;

Skill Enhancement Course [SEC]

Legislative Practices and Procedures

Objectives:

To gain knowledge of powers and Privileges, Constituency Work of Members ofParliament.

To know the powers and functions, functionaries of rural and urban local self government from Zila Parishad, Municipal Corporation to Panchayat/Ward.

To be in a position to know, How a Bill becomes a Law, role of Standing Committees in reviewing a Bill, legislative consultants, the framing of rules andregulations, Types of committee, Role of committees in reviewing government finances, policy, programmes and legislation. Powers and functions of people's representative at different tiers of governance

Outcomes:

- Able to explain the powers and Privileges, Constituency Work of Members of Parliament.
- Able to analyze the powers and functions, functionaries of rural and urban local self-government from Zila Parishad, municipal Corporation to Panchayat/Ward.
- Able to know how a Bill becomes a law, role of standing committees in reviewinga Bill, legislative consultants, the framing of rules and regulations, Types of committee, Role of committees in reviewing government finances, policy, programmes and legislation. Powers and functions of people's representative at different tiers of governance.

B.A. Honours Programme in Political Science
Semester V

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Western Political Thought & Theory II

Objectives:

To know the views and ideas of the following western political thinkers –
Bentham: Utilitarianism. John Stuart Mill: views on liberty and representative
government, Hegel: Civil Society and State, T. H. Green: Freedom, Obligation.
Examining the varieties of non-Marxist socialism: Fabianism, Syndicalism,Guild Socialism,
& German Revisionism.

Outcomes:

- Able to explain Bentham's Utilitarianism; and John Stuart Mill's views on libertyand representative government.
- Able to took an insight into the following: Hegel's views on Civil Society andState; Utopian and Scientific socialism: basic characteristics.
- Able to examine the varieties of non-Marxist socialism: Fabianism, Syndicalism,Guild Socialism, German Revisionism.

Political Sociology

Objectives:

To gain knowledge of Social bases of politics. Emergence of Political Sociology,
Political culture and Political socialization: nature, types and agencies,
Political participation: concept and types, Political development and social
change, Political Communication: Concept and structures.

Outcomes:

- An ability to comprehend the embeddedness of political and the social in eachother.

- Able to familiars with different theoretical and conceptual issues in Political Sociology and a capacity to use them to grasp political phenomena in a cross-cultural and comparative perspective.
- Able to understand and appreciate the diversity of ways in which politics operates historically and spatially to generate a more expansive notion of the realm of thepolitical.
- Able to understand the relationship between state and society in shaping politicsin India both

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historically and analytically.

Understanding South Asia

Objectives:

To gain specific knowledge of the under mentioned subject areas- South Asia-Understanding South Asia as a Region (a) Historical and Colonial Legacies.
To develop knowledge on Geopolitics of South Asia.
To know the Politics and Governance, Regime types:Democracy, Authoritarianism, & Monarchy.
To know the Emerging constitutional practices: forms of government in India,Nepal, Bhutan, Sri Lanka.

Outcomes:

- Able to gain specific knowledge of the under mentioned subject areas-South Asia- Understanding South Asia as a Region Historical and Colonial Legacies.
- Able to assess the Geopolitics of South Asia.
- Able to explain the Politics and Governance, Regime types: Democracy, Authoritarianism, Monarchy.
- Able to identify the Emerging constitutional practices: forms of government inIndia, Nepal, Bhutan, Sri Lanka.

Indian Foreign Policy in a Globalising World

Objectives:

To know India's Foreign Policy: From a Postcolonial State to an Aspiring Global Power. India's Relations with the USA and USSR/Russia, India's Engagements with China.

Outcomes:

- Able to explain Indian Foreign Policy: Basic Principles, Evolution and BilateralRelations.
- Able to analyse the Foreign Policy of India and China. ⬥ Able to analyse the Foreign Policy of India and US.
- Able to analyze India's Relations with the USSR/Russia.

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B.A. Honours Programme in Political Science
Semester VI

Public Administration-- Concepts and Perspectives

Objectives:
To develop knowledge on nature, Scope and Evolution of Public Administration(Indian context) Principles of Socialist Management.
To know the Challenges to discipline of Public Administration and responses: New Public Administration, Comparative.
To build concepts of administration: (a) Hierarchy (b) Unity of Command (c) Span of Control (d) Authority (e) Centralization, Decentralization and Delegation
(f) Line and Staff.
To explain the views of Marx and Weber.
To know the ecological approach to Public Administration: Riggsian Model
To learn the administrative Processes: (a) Decision making (b) Communicationand Control (c) Leadership (d) Coordination.
To know the term Public Policy: definition, characteristics, models & Policy implementation

Outcomes:
🞮 Able to explain the nature, scope and evolution of Public Administration; andPrivate Administration.

🞮 Public Administration; Principles of Socialist Management. 🞮 Able to analyze the major Concepts in Public Administration.
🞮 Able to explain Discussing the Ecological approach to Pub. Administration.
🞮 Able to analyze the Administrative Processes: decision making; communicationand control; leadership; co-ordination.
🞮 Able to classify and differentiate Weberian and Marxian theories of Bureaucracy. 🞮 Able to explain the ecological approach to Public Administration: Riggsian
Model.
🞮 Able to grow the decision making, communication and Control, leadership andCoordination skills.
🞮 To gain knowledge on the term of Public Policy: definition, characteristics, andmodels.

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Policy implementation.

Administration and Public Policy in India

Objectives:
To know the Continuity and change in Indian administration.

To know the brief historical overview, Civil Service in India (Bureaucracy): recruitment (role of UPSC, SPSC), training.

To teach the Organization of Union Government: Secretariat Administration: PMO, Cabinet Secretariat, Organization of State Government: Chief Secretary –relations between Secretariat and Directorate, District Administration: role of District.

To explain relationship between the Citizen and Administration: Lokpal and Lokayukt.

Outcomes:
- Able to explain the Continuity and change in Indian administration.
- Able to know the brief historical overview, Civil Service in India (Bureaucracy):recruitment (role of UPSC, SPSC), training.
- Able to analyze Organisation of the Union Government and State Government.
- Able to examine the Institutions of Local Self Government in India.
- Able to assess the relationship between the Citizen and Administration: Lokpal and Lokayukt.

Discipline Specific Elective [DSE]

Understanding Global Politics

Objectives
To know 'What Makes the World', What is the Sovereign State System Evolution of the State system.

To develop the concept of Sovereignty, the Global Economy.

To discuss the Bretton Woods Institutions and WTO, Ideological underpinningsTransnational Economic Actors, Identity and Culture.

To know 'What Drives the World Apart' a. Global Inequalities b.Violence Conflict, War and Terrorism.

To know 'Why We Need to Bring the World Together' a. Global Environment b. Global Civil Society.

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Outcomes:

- Able to explain 'What Makes the World', What is the Sovereign State SystemEvolution of the State system.
- Able to analyze the concept of Sovereignty b. The Global Economy.
- Able to explain the Bretton Woods Institutions and WTO, Ideological underpinnings Transnational Economic Actors c. Identity and Culture.
- Able to assess 'What Drives the World Apart' a .Global Inequalities b. Violence:Conflict, War and Terrorism.
- Able to identify 'Why We Need to Bring the World Together' a. Global Environment b. Global Civil Society

Citizenship in a Globalising World

Objectives:

To explore theories of citizenship, the historical development of the concept andits practice of in an increasingly globalizing world.

To know the classical conceptions of citizenship, the Evolution of Citizenshipand the Modern State.

To understand Citizenship and Diversity, Citizenship beyond the Nation-state:Globalization and global justice, the idea of cosmopolitan citizenship.

Outcomes:

- Able to apply key concepts in of citizenship, the historical development of the concept and its practice of in an increasingly globalizing world.
- Able to explain and evaluate the classical conceptions of citizenship, the evolution of Citizenship and the Modern State.
- To be in a position to evaluate Citizenship and Diversity, Citizenship beyond the Nation-state: Globalization and global justice, the idea of cosmopolitan citizenship.

Programme Outcomes (PO)

PO1 - Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2 - Effective Communication: Speak, read, write and listen clearly in

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person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3 -Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4 -Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5 -Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6 -Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7 -Self-directed and Life-long Learning: Acquire the ability to engage in independent and lifelong learning in the broadest context socio-technological changes.

Programme Specific Outcomes (PSO)

PSO1 – Able to assess and differentiate the theories of State (Origin, Nature, Functions): Contract, Idealist, Liberal and Neo-Liberal Theories. Able to explain the

Concept of State Sovereignty: Monistic and Pluralistic Theories. Able to analyze the changing concept of Sovereignty in the context of Globalisation. Able to classify David

Held's Democratic Theories. It's able to understand basic concepts of Liberty, Equality, Rights, Law and Justice. Able to assess and differentiate empirical

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Political Theory: System's Analysis, Structural Functionalism.

PSO2 – Able to analyze what is Politics and explaining the approaches to the Study of Political Science – Normative, Behavioral, Post Behavioral, Feminist. Able to assess empirical Political Theory: System's Analysis, Structural Functionalism. Able to explain Dialectical Materialism and Historical Materialism with special reference to relationship between base and superstructure. Able to analyse the theory of class and class struggle. Able to describe the Marxist Approach to politics. Able to analyze Marx's concept of Freedom and Democracy: Nature, Features and Critique. Able to discuss Marx's Theory of State with special reference to Relative Autonomy of the State. Able to explain Marxian theory of Revolution. Able to evaluate the major debates in Marxism: Lenin- Rosa Luxemburg debate on Political party.

PSO3 – Able to understand historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration. Able to apply the knowledge on Directive Principle of State Policy (DPSP), the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy. Application Able to analyze the History, features of Indian constitution, the role Governor and Chief Minister, role of state election commission, the decentralization of power between central, state and local self-government. Able to evaluate Preamble, Fundamental Rights and Duties, Zilla Panchayat, block level organization, various commissions of viz SC/ST/OBC and women.

PSO4 – Able to critically evaluate the Indian Party system – its development and looking at the ideology of dominant national parties Able to evaluate the role of various forces on Indian politics: religion; language; caste; tribe; regionalism; business; working class and peasants Able to evaluate the Electoral Process in India with focus on the Election Commission: Composition, Functions and Role Able to analyze regionalism in Indian politics. Able to investigate the New Social Movements since the 1970s: environmental movements, women's movement and human rights movement.

PSO5 – Able to trace the evolution of Indian political thought from ancient India to modern India. Able to analyze the nationalist thought of Raja Rammohun Roy. Able to assess the nationalist thought of Bankim, Vivekananda and Tagore. Able to assess M.K.Gandhi political thought.

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PSO6 – Define and apply key concepts in comparative politics, including but not limited to nation-states, political regimes, political identity, gender and politics, and political violence Explain and evaluate the importance of specific historical events in the context of the political and economic development of the countries studied Compare and contrast the political systems of the countries explored in the course, paying particular attention to historical, political, economic, geographical, and moral aspects of governance in a variety of countries. Use the comparative method to analyze contemporary political issues. Demonstrate an ability to communicate in writing your knowledge and beliefs about the institutions and forces shaping the political systems of several countries. Particular emphasis will be placed on how each country resolves the conflicts associated with it.

PSO7 – Able for creative thinking about pressing global problems and to equip students with the analytic tools, language expertise, and cross-cultural understanding to guide
them in that process. Students will learn how to comprehend, critically analyze, and evaluate trends in International Politics. Able to exlplain the approaches and methods to study the discipline through Political realism, Pluralism and Worlds System's Model.

Able to explain the issues of Underdevelopment, Terrorism, Regionalism and Integratiothat characterises the Post Second World War order. Able to analyse the role of Diplomacy, Propaganda and Military capabilities in the making of foreign policy.
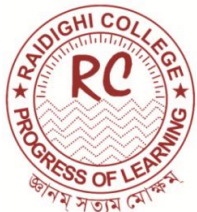Able to explain Indian Foreign Policy: Basic Principles, evolution and Bilateral Relations. Able to analyse the Foreign Policy of India and China Able to analyse the Foreign Policy of India and US.

PSO8 – Able to apply the knowledge in real life relating to Criminal jurisdiction- provisions relating to filing an FIR, arrest, bail, search and seizure and some understanding of the questions of evidence and procedure in the Criminal Procedure Ableto explain the Offences under IPC, India: Personal laws. Able to grow awareness about Customary Laws, Laws relating to Dowry, sexual harassment and violence against women.

PSO9 – Able to discuss the views of M. N. Roy, Narendra Deva, Ram Manohar Lohia, Jayaprakash Narayan and Syed Ahmed Khan. Able to assess views of Nehru on Socialism and Democracy, Subhas Chandra Bose: views on

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Socialism and Fascism. Able to analyse contested notions of 'nation'--- Savarkar, Jinnah, Able to describe the movements against caste and untouchability, Ambedkar's views on Social Justice and the depressed classes Jyotiba Phule and Ambedkar on caste system and untouchability. Pandita Ramabai's views on social justice.

PSO10 – Able to analyze the the Cold War phases and understanding the post Cold War era. Able to explain the developments in third world countries in post world war II era like NAM and its' relevance, Pan Africanism. Post-Cold War world: overview Able to explain certain basic concepts like Globalisation in contemporary world order Able to assess the overview of Major institutions of global governance: World Bank, IMF, and WTO. Able to explain the major regional organisations ASEAN, OPEC, SAFTA, SAARC and BRICS, it also discusses West Asia-Palestine issue.

PSO11 – Able to explain the dominant features of Ancient Western Political Thought: Ancient Greek political thought with focus on Aristotle and Plato; Roman, Political Thought: its contributions with special emphasis on the emergence of Roman law. Able to examine the features of Medieval Political Thought. Able to evaluate the Renaissance; political thought of Reformation; and Machiavelli. Able to critically examine Bodin's contributions to the theory of Sovereignty; Hobbes as the founder of the science of materialist politics.

PSO12 – Able to explain Indian Foreign Policy: Basic Principles, Evolution and Bilateral Relations. Able to analyse the Foreign Policy of India and China Able to analyse the Foreign Policy of India & US. Able to analyse India's Relations with the USSR/Russia.

PSO13 - Able to explain key concept's of citizenship, its historical development and its practice in increasingly globalizing world. Able to explain and evaluate the classical conceptions of citizenship, the evolution of Citizenship and the Modern State to be in a position to evaluate Citizenship and Diversity, Citizenship beyond the Nation-state: Globalization and global justice, the idea of cosmopolitan citizenship.

PSO14 - Able to analyse the concept's of Sovereignty b. The Global Economy Able to explain the Bretton Woods Institutions and WTO, Ideological underpinnings Transnational Economic Actors Identity and Culture Able to assess 'What Drives the World Apart' Global Inequalities, Violence, Conflict,

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War and Terrorism. Able to identify 'Why We Need to Bring the World Together' Global Environment, Global CivilSociety etc.

Mapping Programme Outcome (PO) and Course Outcome (CO) Honours Course

Course Outcome (CO) of	Programme Outcome (PO)						
	PO1 Critical Thinking	PO2 Effective Communication	PO3 Social Interaction	PO4 Effective Citizenship	PO5 Ethics	PO6 Environment & Sustainability	PO7 Self- directed and Life- long Learning
CC1	√		√	√	√		√
CC2	√	√	√	√	√	√	
CC3		√	√	√			√
CC4		√	√	√		√	√
CC5	√		√		√		√
CC6		√	√	√	√		√
CC7	√		√	√	√		√
CC8	√		√	√	√		√
CC9	√		√	√		√	√
CC10	√			√	√		√
CC11	√			√	√		√
CC12	√	√	√	√	√		
CC13		√	√	√	√	√	√
CC14		√	√	√	√	√	√
SEC A1		√	√	√	√	√	√
SEC B1		√	√	√	√	√	√
DSE A1		√	√	√	√	√	√
DSE B1		√	√	√	√	√	√
DSE A2		√	√	√	√	√	√

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COURSE & PROGRAM OUTCOMES

OF

EDUCATION HONOURS (B.A.) UNDER CBCS

Program Outcomes (Education Honours)

PO-1 Social Interaction: To understand the society the students, interact with the members of the society.

PO-2 Thinking Skills: Demonstrate thinking skills by analyzing, synthesizing, evaluating factual and conceptual educational information from multiple sources and verifying the relevance of various topics by applying them.

PO-3 Effective communication: Students demonstrate their communicational skills through paper presentations on subject as well as various interdisciplinary themes. Students engage in research projects to demonstrate effective communication skills.

PO-4 Discovery and Exploration: Explore new ideas and thoughts through the application of theoretical knowledge of Education subject and statistical techniques, pedagogical analysis and various psychological test.

PO-5 Human Values and Ethics: Students will know the human values in education. Applying the knowledge of education in order to inculcate awareness among students concerning racial and gender equity; human rights issues, social justice and other values as enshrined in the Preamble of the Constitution.

PO-6 Social Awareness: The social awareness responsibilities will be developed among the students. Students will aware about their social problems, social difficulties and social factors.

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Program Specific Outcomes (Education Honours)

PSO-1 Students will become a graduate.

PSO-2 Students will develop abilities for further education.

PSO-3 Develop the ability to solve new problems of students.

PSO-4 Students will have the ability to use, analyze and learn communication skills and ICT.

PSO-5 The Learners will learn the basic concept of Teaching, Concept of Learning Design (LD) and Skills of teaching.

Course Outcomes

Paper	Title	Outcome
Semester-I		
CC-1	Introduction to Education	Learners develop a clear idea about the subject Education, like nature, scope and aim of Education, factors, different agencies of education and child centric Education and play-way in education.
CC-2	History of Indian Education	Students will be able to understand about the history of Indian Education system. To be acquainted with the significant points of selected education commissions & national policy of education in independent India

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Semester-II		
CC-3	Psychological Foundation of Education	Students gather knowledge about Educational Psychology, theories of psychology and their role and importance & impact in the field of education and education system.
CC-4	Philosophical Foundation of Education	After the completion of their course,Learners develop knowledge about basic of Indian as well as Western Philosophy. They also develop knowledge about the importance of different schools of philosophy in the field of Education.
Semester-III		
CC-5	Sociological Foundation of Education	To understand the relation between Sociology and Education. nature, and scope of Sociology of education. To explain the concept of Social Groups and Socialization process. To enable the students to understand the concept of social change and social interaction in education.
CC-6	Educational Organization, Management and Planning	The basic knowledge of understanding of the basic concept of ideal organization and all institution.
CC-7	Guidance and Counselling	Students develop the concept of guidance and counselling, various types of Guidance and basic data necessary for Guidance.
SEC	Communication Skill/Skill for Democratic Citizenship	To understand the basic elements of Communication, Listening Skills Speaking Skills and Reading and Writing Skills To enhance their skills about the duties and rights of the citizen and also different Acts like child violence, domestic violence etc.

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Semester-IV		
CC-8	Technology in Education	The basic knowledge of understanding of ICT, learning as well as instructional techniques and different models of teaching.
CC-9	Curriculum Studies	Learners will be able to realize the relation among curriculum, pedagogy and assessment. To develop an understanding about curriculum development and national curriculum frame work, 2005.
CC-10	Inclusive Education	Students understand the meaning of Inclusion and exclusion, types of exclusion and their causes, and how to bring about inclusion in different spheres. Students will be able to set up their minds for building up the inclusive society.
SEC	Teaching Skill / Life Skill Education	To enhance their skill related to basic ideas of teaching. They will be able to frame a design of good teaching learning strategy. To find the ways in which individual's personality can be built through the development of these life skills.
Semester-V		
CC-11	Measurement and Evaluation in Education	Students develop understanding of the concepts of measurement and evaluation in education, process of Evaluation, types of measuring instruments and their uses, concepts of validity and reliability and their importance in

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		educational measurement and principles of test construction.
CC-12	Statistics in Education	After the completion of their course, students will be able to develop the concept of statistics and to develop skills in analyzing descriptive data.
DSE-A	Peace and Value Education/Educational Thought of Great Educators	Students will be able to understand the peace, value and conflict resolution. To understand pedagogical concepts given by Indian and Western educational thinkers.
DSE-B	Teacher Education/Open and Distance Learning	They will learn the concept of teacher education, the historical perspective and development of teacher education in India. To know the concept of open and distance education and understand the relationship among non-formal, correspondence, distance and open education.
Semester-VI		
CC-13	Psychology of Adjustment	Students understand the concept of adjustment, maladjustment and some commonly found problem, multi-axial classification of mental disorders, different coping strategies for stressful situation and administration, scoring and interpretation of the psychological tests.
CC-14	Basic Concept of Educational Research	Students develop a concept of educational research, various steps to be followed for conducting a research and write a research proposal and review research papers.
DSE-A	Gender and Society /Population Education	After completion of this course students will be able to know to understand the concept uses in gender studies, awareness and sensitivity.To understand population growth and its

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		impact on education.
DSE-B	Human Rights /Women Education	Students will be able to understand the role of United Nation and human rights and Enforcement mechanism in India. To know the historical perspective of women education. They will be able to identify the major constraints of women education and women empowerment.

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Raidighi College Department of Philosophy

Course Objectives and Programme Outcomes (B.A. General)

B.A. General

Semester 1

PHI-G-CC-1: Indian Epistemology and Metaphysics

Semester 2

PHIG-CC-2: Western Epistemology and Metaphysics

Semester 3

PHIG-CC-3: Western Logic

Semester 4

PHIG-CC-4: Philosophy of Mind

Discipline Specific Elective

Semester 5

PHIG-DSE-A (any one)

- Ethics: Indian and Western
- Social and Political Philosophy

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Semester 6

PHIG-DSE-B (any one)

- Applied Ethics and Philosophy of Religion
- Contemporary Indian Thought

Skill Enhancement Elective Course

PHIG-SEC-A (any one of the following, either in Semester 3 or Semester 5)

- Logical Reasoning of Application
- Business Ethics

PHIG-SEC-B (any one of the following, either in Semester 4 or Semester 6)

- Man and Environment
- Value Education

Overall Outcome of Undergraduate Programme in Philosophy (B.A. General)

- Familiarize and develop the thought of Indian and Western epistemology and metaphysical thought programmes.
- Understand the basic concepts of logic and relate them with psychological thought. The philosophy of mind helps increase the student's knowledge about the body and brain relationship.
- Familiarize with the basic concepts of ethics in philosophy like virtue ethics, Indian traditional ethical thought, human rights, euthanasia, punishment, equality, and inequality, etc.
- This philosophical course helps students develop the ability to understand classical and contemporary thought of Indian and Western philosophy.

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Programme Specific Outcomes (PSO)

- **PSO 1:** Developing the central idea and thought of the central texts of Indian and Western Philosophical concepts of Indian and Western Metaphysics, Epistemology, Logic, and Ethics.

- **PSO 2:** It helps in psychological development, cognitive development, social, and personal development.

- **PSO 3:** Critically think, read, understand, and interpret philosophical and religious thoughts.

- **PSO 4:** Understand formal logic, which provides symbolic methods for representing and assessing the logical form of arguments.

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RAIDIGHI COLLEGE

Department of Physical Educatio
Programme Specific Outcome (PSO)
Course Outcome (CO)

Programme Specific Outcome (PSO) – An graduate of Physical Educatio of the college should possess the capability to

❖ Develop awareness thinking Own and Other persons for health condition.
❖ Helps students to develop the Skill, Knowledge and competencies to live health and physically active lives at college and for the rest of their life.
❖ Increase the physical competence, health-related fitness, self-responsibility and enjoyment of physical activity for all students so that they can be physically active for a lifetime.
❖ Helping Student socialize with others successfully and provides opportunities to learn positive people skills. Especially during participate in dances, games and sports are an important part of peer culture.
❖ Helps to manage tension, stress, & anxiety. Daily physical education has also been linked with improved emotional stability & greater resilience. quality program helps to develop sportsmanship, increased self-discipline & a healthy respect for others.
❖ Familiarity with major theories, methods, and concepts in the subject
❖ Remain meticulous in thinking systematically about the ethical dimensions of Politics.
❖ Synthesize, analyze, and critically evaluate major arguments in the discipline.
❖ Apply methods appropriate for accumulating and interpreting data applicable to the discipline of Physical Education..
❖ Service to people by opting for civil services.

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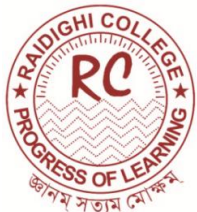*Email –principal.raidighi@gmail.com, raidighicollege95@gmail.com*

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Semester	Core Courses	Content of CU Syllabus	Course Outcome (CO)
		Unit- I: Introduction 1. Meaning and Definition of Physical Education. 2. Aim and Objectives of Physical Education. 3. Misconceptions and Modern Concept of Physical Education. 4. Physical Education in Ancient and Modern Society.	**This Unit introduces the learner to the** **CO 01. Concept of Physical Education** **CO02. Definition ,aim, objectives of Physical Education** **CO 03. Ancient and Modern Society's Physical Activities**
		Unit- II: Foundations of Physical Education 1. Growth and Development: Meaning, Definition, Factors, Principles and Difference. 2. Age Characteristics: Chronological Age, Anatomical Age, Physiological Age and Mental Age. 3. Play, Game and Sports: Meaning, Definition and Characteristics; Play Theories; Play, Games and Sports for Human Development. 4. Society - Meaning and Definition; Social Groups, Sports as a Social Institution, Sports for National and International Harmony	**This Unit introduces the learner to the** **CO 01. Concept of Growth and Development CO 02. Concept of Age Characteristics of Human CO 03. Concept of Play, Game, Sports.** **CO 04. Importance of Play, Game, Sports in Society.**

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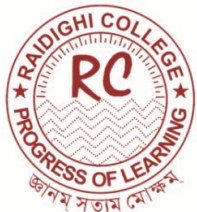*Email –principal.raidighi@gmail.com, raidighicollege95@gmail.com*

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Unit- III: History of Physical Education	This Unit introduces the learner to the
.Unit- III: History of Physical Education 1 History of Physical Education and Sports in India: Pre-Independence and Post-Independence Period. 2 Olympic Movement: Ancient and Modern Olympic Games. 3 Asian Games, Commonwealth Games and SAF Games. 3 National Sports Awards: Arjuna, Dhyanchand, Dronacharya, Rajiv Gandhi Khel Ratna	This Unit introduces the learner to the CO 01. Learn about Physical Education and Sports in Pre-Independence and Post-Independence Period. CO 02. Learn about Olympic Movement. CO 03. Learn about Asian Games, Commonwealth Games and SAF Games CO 04. Learn about National Sports Awards
Unit- IV: Yoga Education 1 .Yoga: Meaning, Definition, Aim, Objectives and Importance of Yoga for Health. 2 History of Yoga: Ancient Period, Vedic Period, Pre-Classical Period, Classical Period, Post-Classical Period, Contemporary Period. 3 .Astanga Yoga: Meaning, Steps, Methods and Objectives. 4 .Yogic Concept of Personality and Diet, Yoga for Health and Wellness	This Unit introduces the learner to the CO 01. Learned about Yoga History. CO 02. Benefit of Yoga in Human Life. CO 03. Technique of Yoga. CO 04. Yoga for Health and Wellness.

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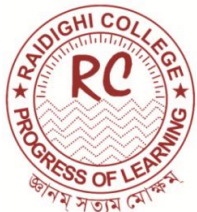*Email –principal.raidighi@gmail.com, raidighicollege95@gmail.com*

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		Unit- I: Introduction 1. Health: Meaning, Definition, Dimensions and Factors. 2. Health Education: Meaning, Definition, Aim, Objectives and Principles. 3. School Health Program: Health Service, Health Instruction, Health Supervision; Personal Hygiene and Health Record; Care of Eyes, Ear, Nose, Skin, Mouth and Teeth. 4. Aim, Objectives and Functions: National Institute of Health & Family Welfare (NIHFW), World Health Organization (WHO), United Nations Educational Scientific & Cultural Organization (UNESCO), United Nations International Children's Emergency Fund (UNICEF).	This Unit introduces the learner to the **CO 01. Concept of Health, Health Education, School Health Program .** **CO 02. Function of WHO, NIHFW, UNESCO and UNICEF for Society.**

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		Unit- II: Health Problems in India - Prevention and Control	This Unit introduces the learner to the
		1. Communicable Disease: Meaning, Definition and Types; Causes, Prevention and Control of Malaria, Dengue, Chicken Pox and Diarrhea. 2. Hypokinetic Disorders: Meaning, Definition and Causes; Management of Obesity, Diabetes, Asthma and Cardiovascular disorders. 3. Nutrition: Nutrients and their Functions and Daily Requirements. Balanced Diet. Balanced Diet principles for Growing ups, Adults, Elderly and Athletes of both Genders and Mothers. Health disorders for deficiency of Protein, Vitamins and Minerals. 4. Posture: Meaning and Definition. Types of Postural Deformities; Causes and Corrective Exercise for Kyphosis, Lordosis, Scoliosis, Bow-Legs, Knock Knees and	**CO 01.** Meaning, Definition and Types Communicable Disease. **CO 02.** Causes, Prevention and Control Communicable Disease. **CO 03.** Meaning, Definition, Causes and Management of Obesity, Diabetes, Asthma and Cardiovascular disorders. **CO 04.** Concept of Nutrition. **CO 05.** Functions and Daily Requirements for Adults, Elderly and Athletes of both Genders and Mothers. **CO 06.** Meaning, Definition, Types of Posture. **CO 07.** Types of Postural Deformities; Causes and Corrective Exercise.
		Unit - III: Physical Fitness and Wellness 1. Physical Fitness: Meaning and Definition, Need and Importance of Physical Fitness. 2. Physical Fitness Components: Meaning, Definition and Usefulness of Health-related and Sports Performance-related	**This Unit introduces the learner to the** **CO 01.** Concept of Physical Fitness. **CO 02.** Meaning, Definition, Components, Need and Importance of Physical Fitness.

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		Unit- IV: Health and First-aid Management	This Unit introduces the learner to the
		1 First-aid: Meaning, Definition, Need and Importance; Golden Rules of First-aid. 2 Sports Injuries: Meaning, Definition and Types; Management of Sprain, Strain, Wound, Facture and Dislocation. 3 Therapeutic Modalities: Therapy - Meaning and Definition; Principles and Sports Injury Management Procedure of Cryo-therapy and Thermo-therapy. 4 Sports Injury Management: Types of Massage. Principles and methods of Sports Injury Management through Exercise and Massage.	**CO 01. Concept of First-aid, Sports Injuries, Therapeutic Modalities and Sports Injury Management** **CO 02. Meaning, Definition, Need and Importance First-aid, Sports Injuries, Therapeutic Modalities and Sports Injury Management**
		Unit-I: Introduction .1. Anatomy, Physiology and Exercise Physiology: Meaning, Definition, Scope and Importance. 2. Cell: Definition, Structure and Function of Human Cell. 3. Tissue: Definition, Types and Functions. 4. System: Definition, Types and Functions in Human Body.	This Unit introduces the learner to the **CO 01. This Unit introduces the learner to the Anatomy, Physiology and Exercise Physiology. CO 02. This Unit introduces the learner to the** **Cell,Tissue And Various System in Humen Body**

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		Unit- II: Musculo-skeletal System 1 Skeletal System: Structure of Skeletal System; Classification of Bones and Joints; Anatomical Differences between Male and Female. 2. Muscular System: Types, Location, Structure and Function of Skeletal Muscle. 3. Muscular Contraction: Meaning, Types, Definition and Characteristics. 4. Effect of Exercise and Training on Muscular System.	**This Unit introduces the learner to the** **CO 01. Skeletal System, Muscular System and Muscular Contraction in Human Body.**
		Unit – III: Circulatory System 1 Blood: Definition, Composition and Functions. 2 Heart: Definition, Structure and Functions. Blood Circulation Mechanism within Heart. 3 Meaning and Definition of Term: Heart Rate, Pulse Rate, Stroke Volume, Cardiac Output Blood Pressure – Systolic and Diastolic, Athletic Heart and Bradycardia. 4 Effect of Exercise and Training on Circulatory System	**This Unit introduces the learner to the** **CO 01. Definition, Composition and Functions of Blood.** **CO 02. Definition, Structure and Functions of Heart.** **CO 03. Effect of Exercise and Training on Circulatory System.**
		Unit -- IV: Respiratory System 1 Structure and Functions of Human Respiratory Organs. 2 Respiration Mechanism. 3 Meaning and Definition of Term: Respiratory Rate, Tidal Volume, Residual Volume, Vital Capacity, O2 Debt and Second Wind. 4 Effect of Exercise and Training on Respiratory System.	**This Unit introduces the learner to the** **CO 01. Definition, Structure and Functions of Respiratory System.** **CO 02. Effect of Exercise and Training on Circulatory System.**

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Ref. No   Date:

		Track Events	This Unit introduces the learner to the
		1. Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. 2. Acceleration with proper running techniques. 3. Finishing Technique: Run Through, Forward Lunging and Shoulder Shrug. 4. Relay Race: Starting, Baton Holding/Carrying, Baton Exchange in between zone, and Finishing.	**CO 01. How the prepared the Track on the Ground.** **CO 02. Various events in track Events.** **CO 03. Starting and Finishing Techniques in Running Event.** **CO 04. Techniques of Relay Race.**
SEC-A **Track and Field**		**Field Events (Any three; Students' choice)** 1. Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing. 2. High jump: Approach Run, Take-off, Bar Clearance/Flight (Straddle Roll) and Landing. 3. Shot put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique). 4. Discus Throw: Holding the Discus, Initial Stance, Primary Swing, Turn, Release and Recovery (Rotation in the circle). 5. Javelin Throw: Grip, Carry, Release and Recovery (3/5 Impulse stride).	**This Unit introduces the learner to the** **CO 01. How the prepared the Long Jump, High jump Pit on the Ground.** **CO 02. How the prepared the Shot put, Discus, Javelin Throw Sector on the Ground.** **CO 03. Techniques of Long Jump, High jump, Shot put Discus Throw and Javelin Throw.**

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Ref. No   Date:

		Unit- I: Introduction 1. Psychology: Meaning, Definition and Scope of Psychology. 2. Nature of Psychology; Branches, Need and Importance of Psychology. 3. Sports Psychology: Meaning, Definition, Scope and Role of Sports Psychology. 4..Need for Psychology in Physical Education and Sports.	**This Unit introduces the learner to the** **CO 01.Meaning, Definition, Scope, Nature and** **Importance of Psychology and Sports Psychology.** **CO 02. Need for Sports Psychology in Physical Education and Sports.**
		Unit- II: Learning 1. Learning: Meaning, Definition and Characteristics. 2. Learning Phenomenon: Basic Theories and Laws of Learning. Learning Phenomena and Physical Education and Sports. 3. Learning Process: Learning Curve - Meaning, Stages and Features; Learning Motor Skills. 4. Transfer of Learning: Meaning, Definition and Types. Factors of Transfer of Learning/Training.	**This Unit introduces the learner to the** **CO 01.Meaning, Definition and Characteristics of Learning.** **CO 02. About Theories and Laws of Learning. CO 03. About Learning Curve and Transfer of Learning.**

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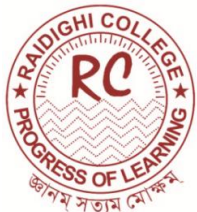*Email –principal.raidighi@gmail.com, raidighicollege95@gmail.com*

		Unit- III: Psychological Factors	This Unit introduces the learner to the
		1 Motivation: Meaning, Definition, Types and Role of Motivation in Life. 2 Instinct and Emotion: Meaning, Definition and Types; Physical Education and Sports for Emotional Development. 3 Stress: Meaning, Definition, Types and Causes; Physical Education and Sports for Students' Stress Relaxation. 4 Personality: Meaning, Definition, Types and Traits; Physical Education and Sports for Personality Development.	**CO 01. Meaning, Definition, Types and Role of Motivation.** **CO 02. Meaning, Definition, Types and Causes of Instinct, Emotion, Stress and Personality.** **CO 03. How to control the Motivation, Emotion, Stress and personality through Sports.**
		Unit- IV: Sociological Aspects	This Unit introduces the learner to the **CO 01. Meaning, Definition, Features,**
		1 Sociology: Meaning and Definition, Society and Social Group – Primary, Secondary and Remote Groups. 2 Culture: Features, Importance, Cultural Values of Games and Sports. 3 Leadership: Meaning, Definition and Types. Leadership and Sports Performance; Leadership and Physical Education and Sports. 4 Sports Related Social Issues: Empowerment, Gender Discrimination, Women and Sport, Socio-economic Status and Sports Participation, Sports in Modern Society.	**Importance of Sociology and Sports Sociology. CO 02. Meaning, Definition and Types Leadership in Sports.** **CO 03.Learn about Sports Related Social Issues.**

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Ref. No   Date:

		GYMNASTICS	
		1.Forward Roll 2.T-Balance 3. Forward Roll with Splitleg 4. Backward Roll 5.Cart-Wheel [Note: Student perform any three of the above skills compulsorily in the same sequence] Optional (any three) 1.Dive and Forward Roll 2.Hand Spring 3.Head Spring 4.Neck Spring 5. Hand Stand and Forward Roll 6. Summersault	**This Unit introduces the learner to the** **CO 01.Technique of Ground Gymnastics.**

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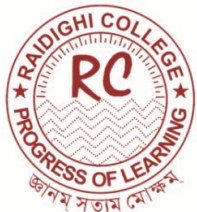*Email –principal.raidighi@gmail.com, raidighicollege95@gmail.com*

Ref. No   Date:

		YOGA	
		*Standing Posture -	
		1. Ardhachandrasana	
		2. Brikshasana	
		1.3. Padahastasana	
		*Sitting Posture	
		1. Ardhakurmasana	
		2. Paschimottanasana	
		3. Gomukhasana	
		* Supine Posture 1. Setubandhasana 2. 2. Halasana 3. 3. Matsyasana * Prone Posture 1 Bhujangasana	This Unit introduces the learner to the **CO 01. Technique of various Asana CO 02. Technique of Suryanamaskara, Kapalbhati and Pranayama**
		2 Salvasana 3 Dhanurasana	
		* Inverted Posture	
		1 Sarbangasana-	
		2 Shirsasana	
		3 Bhagrasana	
		*Note: One Asana from each Posture; Student's Choice+ Suryanamaskara and Pranayama	
		.1. Suryanamaskara	
		2 Kapalbhati	
		3 Pranayama - Bhramari and Anulam Vilom	

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Ref. No   Date:

		Unit- I: Introduction	This Unit introduces the learner to the
		1. Sports Management: Meaning, Definition Nature and Scope. 2. Emergence: History and Importance of Sports Management. 3. Basics: Principles and Practices of Sports Management. 4. Application: Qualities, Duties and Responsibilities of Sports Manager.	**CO 01. Concept of Sports Management** **CO 02. Meaning, Definition Nature , Scope and Importance of Sports Management** **CO 03. Qualities, Duties and Responsibilities of Sports Manager.**
		Unit- II: Tournaments 1. Tournaments: Meaning, Definition and Types; Tournaments - Knock-out, League, Combination, Challenge. Organisation: Fixture Drawing Procedure of Knock-out, League, Combination Tournaments. 3. Annual Program: Athletic Meet and Play Day Organisation and Management. 4. Year-round Programme: Intramural and Extramural Competition Organisation and Management.	This Unit introduces the learner to the **CO 01. Concept of Tournament, Organisation, Annual Program and Year-round Programme.** **CO 02. Fixture Drawing Procedure of various Tournaments.** **CO 03. Learn about Intramural and Extramural Competition Organisation and Management.**

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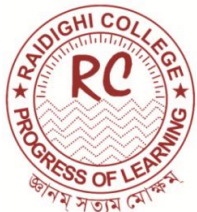*Email –principal.raidighi@gmail.com, raidighicollege95@gmail.com*

Ref. No   Date:

		Unit- III: Facilities and Equipment	This Unit introduces the learner to the
		1 Lay-out: Characteristics, Principles and Lay-out of Standard Athletic Track and Football Field. 2 Care and Maintenance: Meaning, Methods, Need and Importance of Sports Equipment Playground and Gymnasium. 3 Documentation: Meaning, Methods, Need and Importance. 4 Time Table: Meaning, Definition, Importance and Factors.	**CO 01. Lay-out of various Play field.** **CO 02. Care and Maintenance of Sports Equipment Playground and Gymnasium** **CO 03. Meaning, Definition, Importance and Factors of Time Table for Sports.**
	DSE-A **Management in Physical Education and Sports**	**Unit- IV: Financial Management** 1. Financial Management: Meaning, Definition, Need and Importance. 2. Budget: Meaning, Definition, Criteria, Principles; Steps for Preparing a Good Budget. 3. Sponsorship: Meaning, Trends, Process, Aim and Objectives. Sports Promotion: Meaning, Means and Methods; Funding Agencies – Types, Procedure of Communication with the Agencies	**This Unit introduces the learner to the** **CO 01. Learn about Financial Management, Budget of Sports** **CO 02. Meaning, Trends, Process, Aim and Objectives of Sponsorship and Sports Promotion.**

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Ref. No   Date:

		FOOTBALL	This Unit introduces the learner to the **CO 01. Basic Knowledge, Technique , Rules and Regulations of Football Game.**
		1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.	
		2. Trapping: Trapping- the Rolling ball and the Bouncing ball with Sole of the foot, Thigh and Chest Trapping.	
		3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.	
		4. Heading: In standing, running and jumping condition.	
		5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body.	
		7. Tackling: Simple Tackling, Slide Tackling.	
		8. Goal Keeping: Collection of Ball, Ball clearance- kicking, throwing and deflecting. B. Rules and their interpretation and duties of officials.	

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Ref. No   Date:

		VOLLEYBALL 1. Serve: Under hand serve and Side arm serve; Over-head serve, Floating service standing and jumping. 2. Passing: Fore arm passing, Over-head passing. 3. Setting: Front set, Back set and Long set. 4. Spiking: Short ball, Medium ball and High ball (approach, arm and foot movement, and landing). 5. . Blocking: Offensive and Defensive with one or more than one blockers (approach, arm and foot movement, and landing). 6. Service reception and Court coverage. 7. Rotation and front court and back court players. * Rules and their interpretation and duties of officials.	**This Unit introduces the learner to the** **CO 01. Basic Knowledge, Technique, Rules and Regulations of Volleyball Game.**
		Unit- I: Introduction 1. Meaning and Definition Test, Measurement and Evaluation. 2. Criteria of a Good Test. 3. Principles of Evaluation. 4. Importance of Test, Measurement and Evaluation in Physical Education and Sports.	**This Unit introduces the learner to the** **CO 01. Concept of Test, Measurement and Evaluation** **CO 02. Procedure of Test, Measurement and Evaluation in Sports** **CO 03. Importance of Test, Measurement and Evaluation in Physical Education and Sports**

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Unit Content	Course Outcome
Unit – II: Body Composition and Somatotype 1. Body Mass Index (BMI): Concept and Method of Measurement; Significance. 2. Body Fat: Meaning, Types Body Fat Percentage (BF %). 3. Lean Body Mass (LBM), Meaning, Importance and Prediction Process. 4. Somatotype: Meaning, History and Measuring Methods.	**This Unit introduces the learner to the** **CO 01. Concept of Body Mass Index (BMI), Body Fat and Lean Body Mass (LBM)** **CO 02. Concept of Somatotype.**
Unit- III: Fitness Test 1 Kraus-Weber Muscular Strength Test 2 AAHPER Health Related Fitness Test 3 Queens College Step Test 4 J.C.R. Test	**This Unit introduces the learner to the** **CO 01. Concept of Fitness Test** **CO 02. Measurement of Fitness Test** **CO 03. Learn about various Fitness Test. CO 04. Method of Fitness Test.**
Unit- IV: Sports Skill Test 1 Lockhart and McPherson Badminton Skill Test 2 Johnson Basketball Test Battery 3 McDonald Soccer Test .4 Brady Volleyball Test	**This Unit introduces the learner to the** **CO 01. Concept of Sports Skill Test** **CO 02. Measurement of Sports Skill Test CO 03. Learn about various Sports Skill Test CO 04. Method of Sports Skill Test**

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Ref. No   Date:

| | SEC-B

Indian Games (Any One) and Racket Sports (Any One) | **KABADDI**

1. Raiding Skills: Cant, Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow flying kick, roll back; crossing of baulk line; Crossing of Bonus line.
2. Holding skills: Ankle, Knee, Thigh, Wrist, Crocodile and Washer man hold.
3. Formation during holding: Various formations, catching from particular position.
4. Additional Raiding skills: Escaping from various holds, techniques of escaping from chain formation, offense and defence.
5. Game practice with application of Rules and Regulations.
* Rules and their interpretations and duties of the officials. | This Unit introduces the learner to the

CO 01. Basic Knowledge, Technique , Rules and Regulations of Kabaddi Game. |

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		BADMINTON 1. Basic Knowledge: Various parts of the Racket and Grip – hand-shake grip, figure pointing grip. 2. Basic foot work and court coverage. 3. Basic Stance: Defensive, attacking, net stance. 4. Service: Short service, Long service, Long-high service. 5. Shots: fore hand, back hand, clearing, lobbing, over-head shot, defensive clear shot, attacking clear shot, drop shot, net shot, smash. 6. Game practice with application of Rules and Regulations. (Rules and their interpretations and duties of the officials.)	**This Unit introduces the learner to the** **CO 01. Basic Knowledge, Technique, Rules and Regulations of Badminton Game.**

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Ref. No   Date:

Department of Physical Educatio
CO-PO MAPPING
For General students

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CCG - 01			✔		✔	✔		✔	✔	
CCG - 02	✔	✔		✔		✔	✔			✔
CCG - 03				✔			✔		✔	✔
SEC - A		✔		✔	✔		✔			
CCG - 04	✔		✔		✔	✔		✔	✔	✔
SEC - B		✔		✔			✔			✔
DSE - A			✔		✔	✔		✔	✔	
SEC - A	✔		✔	✔		✔	✔		✔	
DSE - B1		✔			✔			✔		✔
SEC - B2		✔		✔					✔	✔

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RAIDIGHI COLLEGE-DEPARTMENT OF SANSKRIT

Sanskrit (General) -COURSE OUTCOME (CO)

Course Outcome (CO): Semester-1

1. Sanskrit Poetry- To learn about classical Sanskrit poetry and classical Sanskrit language as well as the history of Sanskrit poetry.

Course Outcome: Semester-2

1. Sanskrit Prose- To provide knowledge about the social and political thoughts depicted in Sukanasapadesa and the general introduction of Sivarajavijayam and both the text along the survey of Sanskrit literature.

Course Outcome: Semester-3

1. Sanskrit Drama- To provide a holistic study of the famous Sanskrit Drama Abhijnanasakuntalam with all its social, political, literary and lingual aspects and to know about the technical terms from Sanskrit Dramaturgy.

2. Basic Sanskrit- To develop the knowledge about the writing skills in Sanskrit.

Course Outcome: Semester-4

1. Sanskrit Grammar- To know about the Samjnaprakarana, Sandhiprakarana and Vibhaktyarthaprakarana by following Laghusiddhantakaumudi.

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2. Spoken Sanskrit and Computer Awareness for Sanskrit- To develop speaking skills in Sanskrit and typing in Unicode for preservation and digitalization of Sanskrit text web publishing.

Course Outcome: Semester-5

1. Philosophy, Religion and Culture in Sanskrit tradition- To provide knowledge about the form of God, and mode of worship by following Shrimadbhagavadgita.

Course Outcome: Semester-6

1. Literary Criticism- To provide knowledge about Kavyaprakasa with all the poetic aspects.
2. Nationalism in Sanskrit Literature- To develop the concepts of Indian Nationalism and to know its basic features, meaning, national symbols, and freedom struggle movements.
3. Yogasutra of Patanjali- To provide knowledge about Yogasutras.

Programme Outcomes (PO)- Department of Sanskrit, Raidighi College

1. Gaining knowledge of Ancient texts.
2. Knowing about the Indian culture and its heritage.
3. Understanding the value of life and learning self-management, learning to control the mind and the power of mind.
4. Knowing about the various aspects of Indian philosophy, Indian polity, Nationalism, and social life.
5. Knowing about the Modern Sanskrit language.
6. Learning Sanskrit which is the Mother language of all the Indian languages.

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