

ST. XAVIER'S COLLEGE (AUTONOMOUS), KOLKATA

# PROGRAMME OUTCOME, COURSE OUTCOME, PROGRAMME SPECIFIC OUTCOME

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# BIOTECHNOLOGY

## COURSE OBJECTIVES BIOTECHNOLOGY

### CORE PAPERS

#### **MBTCR1011T (Biochemistry & Metabolism)**

1. Students are introduced to the biological macromolecules – protein, lipids, carbohydrates and nucleic acids - the key players in a living system.
2. Focus is on structure-function relationship of the bio-molecules.
3. Lessons on bioenergetics will lead to the realisation that biological systems indeed abide by the physico-chemical laws.
4. Students are introduced to enzymes, the wonder molecules, and the magnificent roles they play in the isothermal and isobaric biological systems.
5. Students are provided with an overview of carbohydrate and lipid metabolism.
6. The complex regulation of metabolic processes is elucidated by in-depth carbohydrate metabolism.

#### **MBTCR1022T & MBTCR1022P (Cell Biology)**

The course aims to

1. impart a comprehensive overview of the basic principles of cell biology.
2. provide information about the chemistry and structure of the cell membrane.
3. provide information about the assembly and dynamics of the cytoskeleton.
4. provide an overview of cell-cell communication.
5. to introduce students to basic biochemical techniques used for study of biomolecules.
6. to familiarize students with techniques and equipment used in the studies of cells and tissues.

#### **MBTCR2032T & MBTCR2032P (Mammalian Physiology)**

The course aims to

1. impart a comprehensive overview of the principles and basic concepts of mammalian physiology, especially human physiology.
2. provide an advanced understanding of skeleton-muscle physiology and digestive system functioning.
3. give an overview of renal physiology and electrolyte homeostasis and endocrine function.
4. provide a comprehensive idea about circulatory and respiratory biology and functioning of the heart.
5. provide a comprehensive idea about nervous coordination, nerve impulses and the central and peripheral nervous systems.
6. familiarize students with laboratory techniques and equipment used in the acquisition of physiological data.

#### **MBTCR2042T & MBTCR2042P (Plant Physiology)**

1. Students will be introduced to plant physiology and biochemistry.

2. This will give students an understanding of the essential physiological processes in plants.
3. They will get a glimpse of the signalling pathways involved in these physiological processes.
4. They will understand the concepts and theories of plant anatomy.
5. In the practical module students will be familiarized with laboratory techniques and equipments used for study of plant physiology and biochemistry.
6. In the practical module students will be made familiar with laboratory techniques and equipments used for study of plant anatomical experiments.

### **MBTCR3052T & MBTCR3052P (Genetics)**

The course aims to

1. impart a comprehensive understanding of the principles of genetics and the modes of inheritance including allelic and non-allelic interactions.
2. provide an overview of the basic structure and function of chromosomes.
3. provide a comprehensive idea about genetic linkage, crossing over and chromosome mapping
5. introduce students to DNA damage and mutation.
6. thereafter introduce students to various DNA damage repair pathways and their detailed mechanisms.
6. enable students use their knowledge of genetics to analyze pedigrees and predict genotypes and phenotypes.

### **MBTCR3062T & MBTCR3062P (General Microbiology)**

1. In this paper, students will be introduced to microbes that form many of the basic models for research in Biotechnology, Molecular Biology and Medicine.
2. Light will be thrown on the fundamental concepts in Microbiology and Microbial Taxonomy.
3. The cultivation and nutritional requirements of microbes, their growth and reproductive strategies including sporulation, how to control microbial growth, and the importance of water and food as their natural niches and vehicles of disease transmission will be explained to the students.
4. Students will also be given a brief introduction to Virology here. Uniqueness of viruses with respect to their obligate parasitism, structural & genomic organisation, replication cycle and classification will be explained.
5. This Virology module will serve as a prelude to the Recombinant DNA Technology module (in Sem V) that includes viral vectors.
6. In the practical module, students will be introduced to methods for staining microorganisms, for cultivation of microorganisms and isolation of bacteria from natural sources.

### **MBTCR3072T & MBTCR3072P (Chemistry 1)**

The course aims to

1. introduce students to basic chemistry.
2. introduce students to the application of basic chemistry to the biological system.
3. enable students understand stereochemistry and its applications.
4. provide knowledge about acid, base and buffer and their applications.

5. enable students to understand chemical bonding and its application.
6. enable students to qualitatively analyse solid organic compounds in the practical module.

### **MBTCR4081T (Molecular Biology)**

1. Students will be introduced to the major biological processes – replication, transcription and translation, in prokaryotic and eukaryotic systems.
2. Students will also be made familiar with DNA damage and repair mechanisms.
3. The course aims to impart knowledge about the mechanisms and regulation of prokaryotic transcription.
4. The course aims to impart knowledge about the mechanisms and regulation of eukaryotic transcription.
5. The course aims to impart knowledge about the mechanisms and regulation of prokaryotic and eukaryotic translation.
6. Students would be made familiar with DNA structure and replication.

### **MBTCR4092T & MBTCR4092P (Immunology)**

1. Through this paper the students will be introduced to the very complex but intriguing vertebrate immune system.
2. They will realise the significance of innate immunity and how it contributes to the activation of the adaptive branch.
3. The enormous diversity in recognition of foreign antigens resulting from the very unique ‘gene segment rearrangement’ phenomenon will be dealt with at molecular level.
4. The different immuno-techniques of wide-spread applications in different branches of biological research will be explained to the students.
5. The students will realise the details of intricate cell-cell, as well as intracellular signalling in the context of the immune system.
6. In the practical module, students would learn about immunological techniques like Western blot, ELISA and immunofluorescence.

### **MBTCR4102T & MBTCR4102P (Chemistry 2)**

The course aims to

1. enable students understand the principles and applications of thermodynamics.
2. provide further information about Chemical Bonding (which was started in Sem III).
3. enable students understand bonding features in organic molecules and its application.
4. introduce students to elementary quantum mechanics
5. introduce students to chemical kinetics.
6. perform qualitative inorganic analysis of mixtures in the practical module.

### **MBTCR5112T & MBTCR5112P (Bioprocess Technology)**

The course aims to

1. acquaint the students with an overall idea of the techniques and methodologies that industries employ for the large-scale fermentative production of beneficial products, using microbes.
2. provide students with information about bioreactors and the usage of microbes in industry.
3. outline the basic principles of water treatment.

4. introduce the principles of fermentation and techniques for microbial production of enzymes, proteins etc.
5. provide the students the hands-on essence of a bioprocess technique by means of a visit to any industrial plant.
6. provide students with hands-on-experience of relevant techniques e.g. isolation of industrially important microorganism and microbial analysis of drinking water supplies relevant in bioprocess technology in the practical module.

#### **MBTCR5122T & MBTCR5122P (Recombinant DNA Technology)**

1. Students will be introduced to the basics and applications of recombinant DNA technology.
2. They will learn various aspects about generating clones and gene expression using modern and relevant techniques.
3. Students will be provided with an overview of the application of molecular tools and Polymerase chain reaction (PCR).
4. Students will be provided with further knowledge about viral vectors (in continuation of the knowledge imparted in General Microbiology Module (Semester III).
5. In practical module the students will be given hands on training of some of the techniques discussed in theory classes.
6. The module seeks to make students well versed with the technological aspects of the knowledge about recombinant DNA technology.

#### **MBTCR6132T & MBTCR6132P (Bio Analytical Tools)**

The course aims to

1. provide an overview of various technical methods and bio-analytical tools which have useful applications in biotechnology.
2. introduce students to microscopy, centrifugation and cell fractionation techniques.
3. introduce students to electrophoresis and its applications.
4. enable students understand the principles of chromatography.
5. introduce students to the principles of spectroscopy.
6. provide students with a hands-on-experience of several bio-analytical techniques in the practical module.

#### **MBTCR6141T (Genomics & Proteomics)**

The course aims to

1. impart theoretical knowledge and information about computational tools of genomics.
2. impart theoretical knowledge and provide information about computational tools of proteomics.
3. introduce students to structural and functional genomics and DNA sequencing methods.
4. introduce students to proteomics and techniques for analysis of proteomes.
5. to provide knowledge about computational tools for high throughput handling of gene and protein sequences
6. provide students with information about web based servers and softwares for genome analysis by means of projects/ tutorials.

## **DISCIPLINE SPECIFIC ELECTIVES (DSE)**

### **MBTDS5012T & MBTDS5012P (Bioinformatics and Structural Enzymology)**

1. Students will be introduced to the principles of Bioinformatics.
2. Students will be provided with an essence of the different tools and aspects of Bioinformatics.
3. Students will learn about structure-function relationship in functioning of enzymes, enzyme regulation and enzyme immobilization technique for commercial application of enzymes.
4. An overview of protein information sources, protein tertiary structure prediction, biological databases, searching of databases and information retrieval would be provided.
5. Students would be introduced to data generating techniques and bioinformatics problems.
6. Students would be familiarized with techniques in bioinformatics by means of project/ computer based practicals.

### **MBTDS5022T & MBTDS5022P (Chemistry 3 & Enzyme Kinetics)**

1. Students will be introduced to fundamentals of organic reaction mechanisms.
2. Students will study the application of various kinds of reaction mechanisms to biotechnological and biological systems.
3. An overview of bioinorganic chemistry and its application to biological systems will be provided.
4. Students will learn about kinetic characterization of enzymes and enzyme inhibitors.
5. An overview of multi-substrate systems and multi-enzyme complexes will be provided.
6. In the practical module students will study various aspects of enzyme kinetics and enzyme action.

### **MBTDS6031T (Plant and Animal Diversity)**

The course aims to

1. introduce students to plant groups and their overall morphological and anatomical structures.
2. provide knowledge about complexity of plant groups and their evolutionary relationship.
3. provide an overview of angiosperm morphology and embryology in plants.
4. provide an overview of animal diversity and comparative anatomy of vertebrate phyla.
5. compare and contrast the life processes in different animal phyla and learn how the different systems evolved in their complexity
6. familiarize the students with diverse aspects of animal biology and enable them to develop an understanding of the animal kingdom.

### **MBTDS6041T (Microbial Physiology)**

1. This paper aims at introducing the students to the basic regulatory mechanisms underlying chief physiological processes in microbes.
2. Through this paper, students will be explained about the details of bacterial stress response.
3. The membrane transport processes will be elaborated in this paper.
4. Through this paper, students will be explained the details of growth physiology and nutritional diversity of microbes.
5. Phototrophic metabolism of microbes will also be elaborated in this paper.
6. The effect of the environment on microbial growth will be elaborated in this paper.

## **SKILL ENHANCEMENT COURSE (SEC)**

### **MBTSE3011T (Biotechnology in Health and Agriculture)**

The course aims to

1. make students familiar with different plant improvement techniques, enhancing their knowledge to execute such techniques in real world.
2. impart a fundamental understanding of histology and histochemistry and an overview of clinical and nutritional biochemistry.
3. provide students with an integrated knowledge and understanding of biochemical toxicology.
4. expose students to the basic concepts of nanoscience and nanotechnology.

### **MBTSE4011T (Techniques in Molecular and Cell Biology)**

The course aims to

1. give the students an essence of molecular tools and techniques.
2. expose students to cell biological tools and techniques.
3. provide an overview of protein purification, DNA and RNA related methods used in molecular biology and gene transfer in bacteria.
4. provide an overview of histochemical assays, immunotechniques, electrophysiological, biophysical and radioactive methods.

## **GENERIC ELECTIVES (GE)**

### **HBTGE1012T & HBTGE1012P (Cellular Biochemistry)**

The course aims to

1. impart a basic understanding of biomolecules, cell biology and genetics with special emphasis on biological organisms.
2. to impart a fundamental understanding of metabolism and various macromolecular components of cells and their functions.
3. give an overview of various perspectives of cell biology.
4. emphasize on the basic principles of genetics and DNA replication.
5. provide students with an integrated knowledge and understanding of dynamics of cell, including the dynamics of membrane-bound organelles in eukaryotic cells.
6. provide a basic understanding of microscopy, micrometry, cytology and biochemistry experiments in the practical module.

### **HBTGE2022T & HBTGE2022P (Biotechnology and Human Welfare)**

The course aims to

1. impart a comprehensive understanding of the basic techniques as applied to biological systems and living organisms to produce or modify products or processes for human welfare.
2. enable students understand the basic biology of plants and their utilization in biotechnological improvement through tissue culture and genetic engineering.



3. familiarize students with basic techniques applied for improving plant variety, creating transgenic organisms and in animal husbandry.
4. provide an overview of techniques used for genome analysis.
5. provide an overview of medical diagnostics and disease biology.
6. familiarize students with laboratory techniques and equipment used in biotechnology laboratories and for acquisition of physiological and environmental data.

# HISTORY

## Course Outcome (History,CBCS)

### Discipline Specific Core Papers

#### 1. **History of India I**

- A Broader understanding of the concepts/subject
- To distinguish periodization in history
- An understanding of socio-cultural, politico-economic aspects
- Knowing the historians who wrote on early Indian history

#### 2. **Social Formations and Cultural Patterns of Ancient Greece**

- A deep understanding of the concepts/subject
- To get an exposure to the history of classical age in Europe
- Knowing the writings of the famous historians like JB Bury
- An understanding of socio-cultural, politico-economic aspects

#### 3. **History of India II**

- To apprehend the continuity
- To get a more concrete idea about the events of the ancient Indian history
- Getting an exposure to discourses/theories/debates
- Knowing the socio-cultural history

#### 4. **Social Formations and Cultural Patterns of the Medieval World**

- To apprehend the continuity
- Getting an exposure to discourses/theories/debates
- Knowing the writings of the famous historians

#### 5. **History of India III (750 - 1206)**

- An idea about the early medieval Indian history from the politico-economic perspectives
- To understand the transition which took place during the period
- To get a revelation about the socio-cultural synthesis as the result of the advent of Islam
- Knowing the writings of the famous historians

#### 6. **Rise of the Modern West I**

- To apprehend the continuity
- To identify the transition from feudalism to capitalism in European history
- Deeper understanding of historiography with special emphasis on the Marxist historiography

#### 7. **History of India IV (1206-1550)**

- An idea about the medieval Indian political history
- Knowing the writings of the famous historians
- An understanding of the history of art, architecture and literature with special emphasis on the Delhi Sultanate

#### 8. **Rise of the Modern West II**

- To apprehend the continuity
- Knowing the writings of the famous historians
- An understanding of socio-cultural, politico-economic aspects

**9. History of India V (1550 -1605)**

- An idea about the medieval Indian political history
- Knowing the writings of the famous historians
- An understanding of the history of art, architecture and literature with special emphasis on the Mughal India

**10. History of India VII (1605 – 1750)**

- To apprehend the continuity
- Knowing the writings of the famous historians
- An understanding of socio-cultural, politico-economic aspects
- Having an idea about the advent of the modern period in Indian history with the coming of the Europeans

**11. History of India-VI (c. 1750-1857) with emphasis on Bengal**

- To apprehend the continuity
- Knowing the writings of the famous historians
- An understanding of socio-cultural, politico-economic aspects of the history of India
- The importance of the Great Revolt of 1857 and the end of the rule of East India Company, the beginning of the monarchical British rule in India
- Getting expose to the regional history of Bengal

**12. History of Modern Europe (1780 – 1939)**

- An understanding of the modern European history
- An understanding of socio-cultural, politico-economic aspects of the history of Europe
- Knowing the writings of the famous historians

**13. History of India VIII (1857 - 1950) with emphasis on Bengal**

- To apprehend the continuity
- Knowing the writings of the famous historians
- An understanding of socio-cultural, politico-economic aspects of the history of India as well as of Bengal
- Having a broader understanding of the history of post-independent India

**14. History of Women in Modern India with special emphasis on Women's Movements (Dissertation Paper)**

- To understand the concepts/theories/discourses on gender
- Knowing the Indian perspective
- Getting an exposure to the course of Women's Studies

**Discipline Specific Electives**

**1. History of the United States of America I**

- An introduction to the history of America
- Knowing the writings of the famous historians/historiography
- An understanding of socio-cultural, politico-economic aspects of the American history

**2. History of East Asia I**

- An introduction to the history of East Asia with emphasis on China and Japan
- Knowing the writings of the famous historians/historiography

- An understanding of socio-cultural, politico-economic aspects of the history of China and Japan
3. **History of the United States of America II**
    - To understand the continuity
    - Knowing the writings of the famous historians/historiography
    - An understanding of socio-cultural, politico-economic aspects of the American history
  4. **History of Modern East Asia II**
    - To understand the continuity
    - Knowing the writings of the famous historians/historiography
    - An understanding of socio-cultural, politico-economic aspects of the history of China and Japan

### **Skill Based Electives**

#### **1. Research Methodology in History**

- To have a broader understanding of the subject
- Knowing the theories/concepts/methods
- Getting an exposure to the practical utilization of RM, for example, writing research papers/reports etc.

#### **2. Western Political Thought**

- To understand the theories/concepts
- Knowing the writings of the famous political thinkers
- Relevance of the study

### **General Electives**

#### **1. Making of Contemporary India**

- Understanding the intricacies of the history of post-independent India
- Knowing the historiography
- Relevance of the study

#### **2. Socio-cultural and political developments in 19th and 20th century Bengal**

- Understanding the subject
- Knowing the historiography
- Relevance of the study

### **Courses for BA General, any two (Semester 5 and 6)**

1. History of Indian Journalism
2. Women's Studies in India
3. Political and Cultural Development in Ancient and Medieval India
4. Cultures in the Indian Subcontinent
5. Gender and Education in India
6. Modern Europe (1789-1890)

### **Course Outcome for BA General**

- Understanding the subject
- Knowing the historiography
- Relevance of the study

### **Program Specific Outcome in general**

- Imparting Knowledge
- Getting an exposure to the theories/discourses/debates of social science
- Knowing historiography
- Scope for inter-disciplinary research
- An idea about the recent trends in history

# MASS COMMUNICATION & VIDEOGRAPHY

## Mass Communication and Videography

### Program Objectives of the course

#### **Core Papers**

##### **Semester 1**

##### **HMVCR1011T**

Introduction to Visual Culture and Still Photography

- The the course aims to initiate students with the theoretical concept of visual culture.
- To make the students aware of the popular national and sacred iconographies of India, critical examination of such iconographies are discussed in class.
- By the end of the course students should be able to understand concepts like sign, image, representation etc.
- Help students understand the basics of still photography – covering areas such as DSLR workflow, controlling exposure, lensing, depth of field, and lighting.
- An understanding of framing, composition will be the core areas of the course.
- An understanding of different genres of photography not restricted to any one genre in particular.

##### **HMVCR1022T/P**

Audiography I and Editing I

- Students will develop a basic understanding of sound levels and frequency content of a sound.
- Students will develop a basic understanding of the concepts of recording and reproduction of audio signal.
- Students will gain a basic historical perspective of the evolution of recording technology.
- Introduction to basic concepts of video editing terms and its applications
- Students get a a brief look into the evolution of editing.
- Students get a detailed study into the areas of choice of an editor

##### **Semester 2**

##### **HMVCR2031T**

Introduction to Media and Cultural Studies

- The course aims to discuss concepts related to culture and modernity.
- Basic texts, from the suggested reading list, will be selected so that the students have a holistic idea on culture, modernity, urbanity etc.

- The course will also aims to empower students with concepts like discourse, propaganda, representation and feminist understanding of ‘body’ in terms of representation.
- Introduce the students with concepts related to mass media and communication.
- Elucidate on aspects of globalization, both in national and global context.
- Focus on the Indian scenario especially in the context of post liberalization changes in the Indian mediascape

### HMVCR2042T/P

Audiography II and Videography I

- Students will learn the basic recording and reproduction signal chain.
- Students will gain an in-depth knowledge about the individual components of a signal chain.
- Students will gain a basic knowledge about the digital audio recording and reproduction technology.
- Students should achieve their understanding, reasoning and application of camera calibration technique for to create visual aesthetics.
- To help develop a sense of composition and mise-en-scene in cinematographic trans creation.
- To help the students achieve basic understanding on lights and lighting accessories.

### Semester 3

#### HMVCR3052T+P

Scriptwriting I

- To make students familiar with fundamentals of writing a short film script.
- To give students knowledge of proper script writing format
- To help students with finding and developing ideas for screenwriting
- To introduce concepts and elements of screenwriting like, story structure, character development, dialogue writing.
- Help students to learn how to build characters, including an understanding of how the characters are established in the film.
- To ensure completion of assignments which includes - writing of scenes, treatment and scripts, with special emphasis on the steps leading toward creating a final screenplay.

#### HMVCR3062T+P

Music and Sound Design

- Students will have a basic perspective about the evolution of music through the ages.
- Students will be introduced to basic technical aspects of music.
- Students will be introduced to some of the musical styles and instruments.
- Students will gain an understanding about how music works with images.
- Students will learn how to analyze the soundtrack of a given film.

- Introduction to all the stages and techniques of sound design and mix through practical projects.

#### HMVCR3072T+P

Videography II and Editing II

- To understand and apply the concept of compression in digital video workflow and its benefits
- Selection of memory cards and its compatibility with different formats
- To Help them to develop knowledge on waveform monitor and histogram reading techniques.
- To understand concepts of continuity and discontinuity editing
- Understanding various video formats.
- To instill a clear understanding of aspect ratio, scanning and analogue signals

#### Semester 4

#### HMVCR3082T

Script Writing II

- The course aims at discussing Script writing through the perspective of adaptation
- The course will discuss adaptation theories as a theoretical component
- To keep the students updated with present day television/cinema situations, along with cinematic texts the contemporary adapted television series will also be discussed.
- To demonstrate an understanding of narrative structure particular to the short film form.
- To develop an understanding of 'Three act structure' with examples from both feature length film and short film
- To give students an understanding of issues involved in adaptation of literary works for the cinematic screen.

#### HMVCR3092T+P

Videography III and Editing III

- To render essence of digital camera sensor and its application
- To understand composite and component signal
- To understand the colour harmony and its significance in the visual story telling.
- Concept of DSLR camera and its use in digital cinematography
- Advanced understanding of various editing techniques with exporting and transcoding.
- Understanding of codecs and containers.

#### HMVCR4102T

Marketing,Advertising and PR



- To render an understanding of the basic concept of Marketing and its application.
- Understanding the role, functioning and management of a marketing agency
- Understanding the concept and application of Advertising and Public Relations as a modern-day system of winning the market and audience.
- Understanding the role and functioning of advertising and communication agencies
- Understanding the relationship between the three verticals and thereby imbibing it into the practice of audience identification and capture, in mass communication.
- Helping the students develop creative skills in advertising

## **Semester 5**

HMVCR5122T/P

### **Documentary**

- Students will have an understanding about how Documentation evolved over the ages.
- Students will learn and understand the different sources of raw materials.
- Students will learn about the importance of research in Documentary.
- Students will have a perspective about all the modes of Documentary.
- Students will learn how to work in a team and develop a Documentary from script to screen.
- Students will have an understanding about the evolution of the Indian documentary scene.

HMVCR5111T/P

### **Visual and performing Arts**

- The course aim to introduce concepts related to visual arts
- The course aim to empower students with the history of painting and visual art, politics of representation of digital image, and critically read and analyse comic books and graphic novels.
- The course will culminate in the production of graphic narrative by the students.
- The course will discuss the history and evolution of theatre.
- The students will learn about the journey from ancients to modern theatre.
- The students will learn about Third theatre along with one eminent Indian play director.

## **SKILL papers**

### **Creative Writing**

HMVSE3012T+P

- The course aims at enabling students in fiction writing. Different literary genres, methods, devices, tools will be discussed.
- As a skill enhancement course this paper will try to involve the students as much as possible even in the theory classes.

- To keep the students updated with present day television/cinema situations, along with cinematic texts the contemporary adapted television series will also be discussed.

#### HMVSE4021T

##### Film Criticism

- Introduce students with basic aspects of film language
- Help students to interpret films through analytical and conceptual models.
- Address different film making practices and styles

#### Semester 5

#### HMVCR5111T

##### Visual and Performing Arts

- The course aim to introduce concepts related to visual arts
- The course aim to empower students with the history of painting and visual art, politics of representation of digital image, and critically read and analyse comic books and graphic novels. .
- The course will culminate in the production of graphic narrative by the students.
- History and evolution of theatre will be discussed.
- The journey from ancients to modern theatre will be traced.
- Third theatre along with one eminent Indian play director will also be discussed.

#### HMVCR5122T

##### Documentary

- Students will have an understanding about how Documentation evolved over the ages.
- Students will learn and understand the different sources of raw materials.
- Students will have a perspective about the different modes of Documentary.
- Students will learn about the evolution of the Indian documentary scene.
- Students will learn how to work in a team and develop a Documentary from script to screen.
- Students will understand the importance of research in documentary.

#### HPHCR6131P

##### Degree Film

- Students will go through the different stages of pre-production, production and post-production.
- Students will go through a pitching session and be more prepared for the market.
- Students will learn all the facets of production management and execution.
- Students will learn how to operate within given limited circumstances and get the most productive results.
- Students will go through all the technical stages of film post production and learn them in details.

- Students will understand and appreciate the division of labor and work in a team to develop a fiction film project from script to screen.

### **HMVCR6142T**

TV Production and Media Management

- To acquaint the students with the different production scenarios for on line and off-line productions, using Multi camera shooting techniques.
- To acquaint students with functioning of a television studio – roles crew involved and stages of production.
- The evaluations will challenge the understanding of the different cinematographic and audio post production scenarios.
- Students will develop practical skills for recording indoor and outdoor sounds using Single and Double systems.
- Students will develop skills for audio recording for simple online multi camera setups.
- Students will develop practical experience of handling multi camera shoots.

### **DSE Papers**

#### **HMVDS5011**

Television Studies

- The course aims at producing the key ideas of television studies.
- With a proper historical perspective, the course will make the students aware of the history of television in India.
- Different television genres will be discussed.
- The post-global television and the different television institutions will be discussed.
- The new streaming platforms and the contents produced will be discussed and analysed.

#### **HMVDS5021**

Reading Images

- Major film Theories will be discussed
- Melodrama and genres will be discussed along with selected texts
- The students will be made aware of feminist film criticisms and its' important essays.
- Make students familiar with major film theories and various approaches to film analysis.
- Have discussion focused on theoretical contributions from areas such as realism, semiotics and post modernism
- Combine theoretical discussion with exercises in film analysis.

#### **HMVDS6031**

Research Methods (T&P)

- The course aims to prepare students for the final dissertation by empowering them with different research methods and tools.
- The students will be taught the basics of research ethics and academic writing.
- By the end of the course, students will know what knowledge and research is.
- Different types of research will be discussed.
- Students will finally learn to write academic essay and will plan for their dissertation.
- By the end of the course, the students should be able to formulate their research topic and write their dissertation with proper citation rules and preparing bibliography.

#### HMVDS6043D

##### Dissertation

- The mentor, along with the external examiner, aims at evaluating the students' ability to write on the specialized area of his or her choice.
- The dissertation aims at providing the students' with the scope of practicing field work, conducting in-depth interviews as well as groups discussions and make a thorough literature survey on the selected topic.
- The paper helps the students get acquainted with sources and process of data collection
- The dissertation makes the students aware of academic ethics and plagiarism.
- The dissertation prepares the students to maintain the citation and bibliographic style.

#### **Generic Elective Mass communication**

##### **Semester 1**

Introduction to Mass Communication I

#### HMVGE1011T

- Introduction to the principles of Mass Communication
- Understanding the basic aspects, barriers and types of communication in the society
- Understanding print media and its role in imparting information in India
- Understanding television as a medium of mass communication in India
- Understanding radio as a medium of mass communication in India
- Understanding the role of TV and Radio in national development

#### **Generic Elective Mass communication**

##### **Semester 2**

Introduction to Mass Communication II

#### HMVGE2021T

- Introduction to the principles and practices in Advertising
- Understanding roles and functions of advertising and communication agencies
- Introduction to the principles and practices in Public Relations and its role in corporate communication

- Introduction to the fundamentals of film narrative
- Understanding new media as an evolving medium of mass communication
- Making the students familiar with various legal and ethical practices in the digital space

### **Journalism**

#### **Program Objectives of the course**

HJOGE3011T/P

Print and New Media

Semester 3

- Introduction to the principles and practices in print media
- Making the students familiar with the legal aspects and their implications
- Imparting creative skills of writing for news and non-news items in print media.
- Introduction to the principles and practices in new media
- Understanding the legal aspects and implications in the digital scape of India
- Helping the students understand the contribution of new media in national development.

HJOGE4021T/P

Television and Radio

Semester 4

- Understanding television as a medium of mass communication in India and its role in national development
- Understanding the functioning of a television channel in the digital era
- Helping the students develop writing skills for various types of television programmes.
- Understanding Radio as a medium of mass communication in India
- Understanding the role of radio in national development through its various formats and services

#### **Course Outcome of BSc (Hons.) Mass Communication and Videography**

- Students get an indepth knowledge of editing,sound design,music and camera theories and practices in filmmaking with the help of theory classes and practicals held in respective studios.
- Students will learn how to work in a team and develop a Documentary and fiction film from script to screen by going through the different stages of pre-production, production and post-production.
- The course aims to elucidate students with the theories of visual culture, modernity,discourse,propaganda ,mass communication ,theatre and other concepts.
- The students get familiarised with fundamentals of writing a short film script.
- Familiarising the students with the concept and application of Advertising and Public Relations as a modern-day system of winning the market and audience.

Students get acquainted students with functioning of a television studio – roles, crew involved and stages of production.

# ECONOMICS

## Dept: ECONOMICS

	CORE	DSE	GEN. ELEC	SKILL
1	HECCR1011T Introductory Microeconomics			
	HECCR1021T Mathematical Methods in Economics - I			
2	HECCR2031T Introductory Macroeconomics			
	HECCR2041T Mathematical Methods in Economics - II			
3	HECCR3051T Intermediate Microeconomics - I		<u>HECGE3131T</u> Introductory Economics	HECSE3011T Data Analysis
	HECCR3061T Intermediate Macroeconomics - I		<u>HECGE3231T</u> Introductory Microeconomics	
	HECCR3071T Statistical Methods for Economics			
4	HECCR4081T Intermediate Microeconomics - II		<u>HECGE4141T</u> Development Economics and Statistics	HECSE4021T Research Methodology
	HECCR4091T Intermediate Macroeconomics- II		<u>HECGE4241T</u> Introductory Macroeconomics	
	HECCR4101T Introductory Econometrics			
5	HECCR5111T Indian Economy	HECDS5011T Topics in Microeconomics		
	HECCR5121T Development Economics	HECDS5021T Input-Output Analysis		
6	HECCR6131T International Economics	HECDS6031T Money & Finance		
	HECCR6141T Public Economics	HECDS6043D Dissertation		

## **COURSE OBJECTIVES**

### **CORE PAPERS**

#### **HECCR1011T**

##### **Introductory Microeconomics**

Each Student will have a clear idea of

- 1) The subject matter of economics
- 2) How markets work
- 3) Household Behaviour
- 4) Behaviour of Firms in Product Markets that are Perfect
- 5) Behaviour of Firms in Product Markets that are Imperfect
- 6) Behaviour of Firms in Input Markets

#### **HECCR1021T**

##### **Mathematical Methods in Economics – I**

- (1) To understand two vital tools for all of mathematics namely set operations and functions.
- (2) To study sequences and series to gain intuition about the rather perplexing notions of infinity and infinitesimally small numbers. Economic applications of series and sequences, in particular the notion of discounting future stream of payments or receipts, which is a critical aspect of judging the value of an investment by a business or government.
- (3) In modelling economic problems we often assume that we can represent various economic concepts by continuous functions. So it is important to know precisely what is the content of this assumption, especially in many instances there is a natural reason to believe that the function will not be continuous everywhere, and in such cases this turns out to be an important consideration from an economic standpoint.
- (4) Much of economics is concerned with the study of a change in the level of one variable on the level of another variable. Hence the detailed study of derivative and differential for functions of one variable which is the cornerstone of economics.
- (5) Study of difference equations to analyze economic dynamics. In this sense, adding the dimension of time to economic models to make it more robust.
- (6) To get a taste of probability theory for studying theoretical distribution and sampling.

#### **HECCR2031T**

##### **Introductory Macroeconomics (Pending)**

- 1) Identification of the basic macroeconomic variables such as output, interest rate, employment, balance of payments and their measurement.
- 2) Understanding the role of money in the economy
- 3) Understanding the working of the central bank with respect to monetary policy through the process of creation of money.
- 4) Appreciation of the problems related to inflation and how to address the same
- 5) Developing the first step towards establishing causal relationships among macroeconomic variables
- 6) Understanding how an economy works in the short period and long periods, so as to appreciate the need for policy interventions for employment generation.

#### **HECCR2041T**

##### **Mathematical Methods in Economics – II**

- 1) A matrix provides a very powerful way of organising and manipulating data. So the students must be very well versed with matrix operations so as to apply in economic problems.
- 2) To introduce students to advance topics like vector space, eigen values and quadratic forms which are essential for studying multivariate optimisation and dynamics.
- 3) To make students grasp the idea and techniques of higher derivatives to study concavity, convexity, quasi concavity and quasiconvexity defined on  $\mathbb{R}^n$ . This will give them the tools to find extreme values and stationary values in case of functions of  $n$  variables.



4) Develop techniques for dealing with constraints which satisfy one or more functional equations while maximizing or minimizing a function. The fundamental objective in this section is the derivation and application of the method of Lagrange multiplier.
5) In line with the previous objective develop the concept of value function and envelope theorem so as to apply in economic problems.
6) Explain the techniques for solving and analyzing ordinary differential equations and techniques of analysis that are most common in economics.

#### **HECCR3051T**

##### **Intermediate Microeconomics – I**

- 1) To explain alternative theories of consumer behaviour, cardinal, ordinal theories and revealed preferences.
- 2) To explain consumer behaviour under risk and uncertainty and choice over time.
- 3) To discuss the concept of production with reference to production function, isoquants, law of variable proportions and returns to scale.
- 4) To study short run and long run cost function and their relation.
- 5) To study perfectly competitive market equilibrium: short run and long run.
- 6) Analysis of input market under different market structures.

#### **HECCR3061T**

##### **Intermediate Macroeconomics - I**

- 1) Learning analytical tools to model the macro-economy.
- 2) Understanding the interaction of demand-side and supply-side factors in the macro-economy.
- 3) Analyzing the trade-off between the twin maladies of inflation and unemployment.
- 4) Appreciation of the view-points alternative schools of thought on the effectiveness of policy interventions.
- 5) Understanding how international transactions affect the macroeconomics performance of an economy.
- 6) Learning to model the international flow of goods, service and capital and their impacts on the macro-economy under fixed and flexible exchange rates, so as to evaluate the effects of economic policies in the open economy.

#### **HECCR3071T**

##### **Statistical Methods for Economics**

- 1) To study what data are, how data are characterised and what tools are used to describe a set of data.
- 2) To study in detail numerical measures that provide descriptions of the characteristics of distributions, which can then be used to provide more readily interpretable information.
- 3) Analysis of bivariate data on the basis of descriptive statistical measures( correlation and regression). This is a stepping stone to study econometrics.
- 4) Index number is a widely used statistical device for comparing a group of related variables with another group of same variables over two different time periods. So the students are provided with a detail analysis of index number with special reference to cost of living index number and gross domestic product deflator.
- 5) The concept of random variables( from semester 1) allows to pass from the experiment outcomes the numbers to a numerical function of outcomes. The objective is to examine the basic properties and discuss the most important examples of discrete variables and continuous variables. Finally introduction of jointly distributed random variables.
- 6) As a prerequisite to statistical inference study of the methods of sampling.

#### **HECCR4081T**

##### **Intermediate Microeconomics – II**

- 1) To explain theoretical concepts pertaining to working of imperfect markets, general equilibrium, welfare economics and market failures.
- 2) Specific focus on techniques of game theory and its applications in oligopolistic markets.
- 3) To explain aspects of allocational efficiency using general equilibrium framework.
- 4) To explain reasons for market failures.

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| 5) To study the role of state including provision of public good and optimum tax subsidy schemes in presence of externalities. |
| 6) To analyze asymmetric information leading to market inefficiency.   |

<b>HECCR4091T</b>
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<b>Intermediate Macroeconomics- II</b>
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| 1) Development of macroeconomic thoughts and analysis of major debates.   |
| 2) To study the macroeconomic policies for stabilization and alternative theories.                                  |
| 3) To study the microeconomic foundations of macroeconomics including consumption, investment and demand for money. |
| 4) Exploring different dimensions of debt management with applications in Indian economy.                           |
| 5) To study the problem of time-consistency and monetary policy under rational expectation.                         |
| 6) Analyze long term trends and dynamic adjustments in terms of growth models.                                      |

<b>HECCR4101T</b>
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<b>Introductory Econometrics</b>
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| 1) To provide students with a background to understand and analyzedifferent chance phenomenon arising in different spheres of life and work.    |
| 2) To make student confident in using different inferential statistical technique for making meaningful decisions.                              |
| 3) Introducing students with the measurement of economic relationship by using 2 variable Classical Linear Regression Model(CLRM).              |
| 4) Expansion of the above model to accommodate multiple explanatory variable and the related statistical concepts.                              |
| 5) How to handle model where the assumptions of Classical Linear Regression Models are violated as far as estimation and testing are concerned. |
| 6) Introduce students to problem of specification errors in the model.  |

<b>HECCR5111T</b>
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<b>Indian Economy</b>
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| 1) To analyze the state of economy at time of independence.   |
| 2) Analysis of the importance and methods of planning with specific emphasis of second five year plan.  |
| 3) To study pre-reform development experience in India with reference to structural change, regional inequality and saving investment puzzle. |
| 4) To explain the rationality of economic reforms with emphasis on stabilization and structural adjustment programme.                         |
| 5) Analysis of post reforms experience in India.  |
| 6) To explain the demographic dividend and analyze the development of social sectors.   |

<b>HECCR5121T</b>
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<b>Development Economics</b>
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| 1) Introducing the difference between growth and development.                            |
| 2) To study the alternative measures of development.                                     |
| 3) To study the different measures of inequality like Gini coefficient and Lorenz Curve. |
| 4) To study the measures of poverty like head count ratio, poverty gap etc               |
| 5) To study the relevance of growth models in developing countries and convergence.      |
| 6) To study the political economy of development.  |

<b>HECCR6131T</b>
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<b>International Economics</b>
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| 1) To understand the factors determining the patterns of international trade. |
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2) To analyze if trade is beneficial to all, or, if there are winners and losers from trade
3) To study the structure, conduct and performance of trade policy.
4) To gain familiarity with the world trading system.
5) To analyze issues of open economy macroeconomics
6) To analyze aspects of international co-ordination.

<b>HECCR6141T</b>
<b>Public Economics</b>
1) To study government intervention in case of market failure and analysis of public expenditure to finance development.
2) To analyze private versus public good and to study the allocation of public goods with reference to Lindahl and voting equilibrium.
3) To study the principles of taxation and its impact on income distribution, work efforts, and on savings and optimal taxation.
4) To study the public finance in the macro framework.
5) To study the theory of public debt with special reference to internal and external borrowing.
6) To study fiscal federalism in India.

### **DISCIPLINE SPECIFIC ELECTIVES**

<b>HECDS5011T</b>
<b>Topics in Microeconomics</b>
1) This course introduces students to the advanced topics of microeconomics and its applications.
2) The emphasis will be on giving conceptual clarity to the student.
3) This is coupled with the use of mathematical tools and reasoning.
4) It covers optimization techniques and
5) It introduces the basic concepts of game theory in a way that allows students to use them in solving simple problems.
6) The concept of expected utility is also addressed.

<b>HECDS5021T</b>
<b>Input-Output Analysis</b>
1) Develop an understanding of inter-sector transactions through the flows of intermediate and final goods and services in an economy.
2) Learning the basic mathematical tools for constructing a framework to study multi-sector interactions under the static Leontief Input-Output model.
3) Learning the techniques of quantitative impact-analysis through various types of multipliers in a demand determined economy.
4) Understanding Supply-side interdependencies, interpreting price interactions and inter-sector linkages in an economy.
5) Develop analytical tools for decomposing the sources of change in an economy.
6) Analyzing the inter-relations between economic activities energy and environment, learning to model multi-regional interactions in an economy, develop the idea of social accounting and analysis of total factor productivity in a multi-sector framework

<b>HECDS6031T</b>
<b>Money &amp; Finance</b>
1) To explain role of money and credit in economy.
2) To explain determination of money supply.
3) To study objectives of monetary policy with specific reference to rule and discretion.
4) To analyze working of financial markets in a global perspective.
5) To explain financial crisis and to study different episodes of financial crisis.

6) Alternatively to explain equivalence and non equivalence between debt and equity.

### **Skill Enhancement Courses**

#### **HECSE3011T**

##### **Data Analysis**

- 1) To understand the sources of data and to understand the basic methods of sampling.
- 2) To have an understanding of the measures of frequency distribution and summary statistics.
- 3) Analysis of Indian Data: To have a basic idea about performing data analysis using MS-Excel
- 4) To know about the websites for obtaining secondary data e.g Economic Survey, RBI Bulletin on currency and finance, ASI DATA, Foreign Trade Statistics, NSS Consumer surveys.

#### **HECSE4021T**

##### **Research Methodology**

- 1) Understanding the nature of research and formulating the research topic
- 2) Approaches to research and research strategy
- 3) Using Secondary data and Primary data
- 4) To have an idea about Sample Selection Methods

### **Generic Elective Courses**

#### **HECGE3131T**

##### **Introductory Economics**

1. To understand the Different Types of markets and the market mechanism
2. To understand the basic concepts of elasticities.
3. To study Choice and Utility theory: cardinal and ordinal approaches
4. To study the basic Concepts of production and cost and study of Perfect Competition
5. To study National Income Accounting
6. To study the basics of money supply, banking system and inflation

#### **HECGE3231T**

##### **Introductory Microeconomics**

Each Student will have a clear idea of

- 1) The subject matter of economics
- 2) How markets work
- 3) Household Behaviour
- 4) Behaviour of Firms in Product Markets that are Perfect
- 5) Behaviour of Firms in Product Markets that are Imperfect
- 6) Behaviour of Firms in Input Markets

#### **HECGE4141T**

##### **Development Economics and Statistics**

1. To study distinction between economic growth and economic development
2. To study the theories of population.
3. To study the strategies of Development
4. To study the relation between Development & Environment
- 5) To study some basic issues of statistics
- 6) To study Diagrammatic representation of frequency distribution

#### **HECGE4241T**

##### **Introductory Macroeconomics**

- 1) To introduce to basic concepts of Macroeconomics and National Income Accounting
2. To study the functions of money and credit creation.
- 3) To study the basics of inflation.

4) To study the Closed Economy in the Short Run Classical and Keynesian systems;
5) To study simple Keynesian model of income determination;
6) To study IS-LM model; real balance effect, fiscal and monetary policy .

# POLITICAL SCIENCE

## COURSE OUTCOMES FOR POLITICAL SCIENCE GENERIC ELECTIVE

### **HHRGE1011 Introduction to Human Rights: History and Perspective**

After studying this course, students are expected to have a clear idea about:

1. The historical growth of the idea of human rights.
2. Awareness of the international context of human rights.
3. Awareness of the position of human rights in India and in the international scenario.
4. The importance and challenges of Human Rights.
5. The working of United Nations.
6. Concepts and ideas related to human rights

### **HHRGE2021 Human Rights, Good Governance and Redressal Mechanisms**

After studying this course, students are expected to have a clear idea about:

1. Problems relating to the realisation of human rights,
2. Strengthening ability to contribute to the resolution of human rights issues and problems.
3. Understand the human rights violations of the vulnerable groups in the society.
4. Develop human rights awareness.
5. Identify, contextualise and use information about the human rights situation in a given country,
6. Promote human rights through legal as well as non-legal means

### **HPSGE3031 Indian Constitution and Government**

After studying this course, students are expected to have a clear idea about:

1. Basic features of the Indian Constitution
2. The provisions and significance of Fundamental Rights and Directive Principles
3. Nature and pattern of Centre State relation in India
4. Amendment procedure
5. Compositions functions and role of the Election Commission
6. The working of the legislature, executive and judiciary in India

### **HPSGE4041 International Relations and Organisations**

After studying this course, students are expected to have a clear idea about:

1. The post-war arrangement of the state system and acquainting the students with the politics of the cold war.
2. The effects of globalisation on the modern arrangement of the state, concerning major debates on issues of sovereignty, autonomy and foreign policies.
3. The impact of traditional and non-traditional security threats situating the broader dynamics of deepening and widening of security agendas in the modern world.
4. Major powers and major issues in world politics to develop critical as well as policy perspectives

5. The structures and functions of the United Nations as an international organisation  
The idea of human rights and the notion of human-centered security.

### **Course Outcomes for Political Science Honors**

#### **HPSCR1011 – Understanding Political Theory**

After completion of the course, a student is expected to have a clear idea about:

1. Attempts at arriving at theories of politics since the time of the ancient Greeks.
2. An awareness regarding the identification of the ‘political’.
3. The basic postulates of contemporary political ideologies like liberalism, socialism, conservatism and anarchism.
4. Contemporary concerns of Political Theory.
5. Evolution of the idea of democracy from the time of the ancient Greeks who considered it to be a perverted form of government.
6. Mechanisms and instruments that make democracy in the contemporary world workable and realizable.

#### **HPSCR 1021- Constitutional Government and democracy in India**

After completion of the course, a student is expected to have a clear idea about:

1. The basic Constitutional structure and the provisions therein with respect to the topics of the syllabus; learning to read the Constitution as a text
2. Getting familiar with the basic conventional lines of analysis from existing standard literature
3. Being exposed to select Constituent Assembly debates
4. Being exposed to select contemporary debates among academicians researching on the field
5. Learning to read and interpret specialised research contributions to the field
6. Understanding the linkages between Constitutional issues and foundational questions confronting post-colonial Indian democracy

### **HPSCR 2031- Political Theory-Concepts and Debates**

After completion of the course, a student is expected to have a clear idea about:

1. Some of the fundamental concepts in political theory like freedom, equality, justice and rights.
2. Practical application of these concepts and certain important issues related to them.
3. Significance of the issue of political obligation in sustaining a political order and the role of resistance.
4. Appreciation of human rights with reference to the issue of cultural relativism.
5. Analysis of the various dimensions of multiculturalism as a way of accommodating diversity.
6. Understanding of the various perspectives on the idea of toleration and their limitations which is so crucial for democratic practice.

### **HPSCR 2041- Political Process in India**

After completion of the course, a student is expected to have a clear idea about:

1. Dynamics of political process in India
2. Nature of party functioning and their impact on coalition politics
3. Voting trends within a multicultural framework
4. Regional dynamics in a federal set up
5. Society and politics
6. The logic of affirmative policies
7. Changing nature of the Indian state

### **HPSCR 3051 Introduction to Comparative Government and Politics**

After completion of the course, a student is expected to have a clear idea about:

1. Comparative study or analysis of politics and government.
2. Governmental processes around the world.



3. Empirical and objective theory of politics/political processes.
4. How to compare and explain all political phenomena.
5. How to identify problems and processes on the basis of area-specific approach and also cross-national approach.
6. Political experiences within more than one nation state for the purpose of making systemic comparisons

### **HPSCR 3061 Perspectives on Public Administration**

After completion of the course, a student is expected to have a clear idea about:

1. The meaning significance and evolution of Public Administration as a discipline
2. Comprehend and differentiate between classical and neo-classical theories of administration
3. Understand contemporary approaches such as those of Riggs and Peter Drucker
4. Demonstrate critical thinking regarding various aspects of public policy
5. Explore diverse approaches in Public administration
6. Recent trends such as feminist perspective and good governance

### **HPSCR3071 – International Relations- Theories & Issues**

After completion of the course, a student is expected to have a clear idea about:

1. The scope of International Relations as an autonomous discipline.
2. Key concepts that aid understanding of international politics like national interest and collective security.
3. The instruments through which states pursue their foreign policy objectives and interests.
4. The changing contours of world politics since the Second World War.

5. The role of international organizations like the UN in contemporary global politics.
6. Professed political and ideological stances of major powers including India.

### **HPSSE3011 Research Methodology I**

After completion of the course, a student is expected to have a clear idea about:

1. Essential concepts and methods related to political research involving theory and practise.
2. Conceptualising a research project and analytically engaging with the literature of the discipline.
3. Developing an analytical and critical take on issues for framing good quality research questions and finding valid and reliable outcomes.
4. Quantitative and qualitative research techniques in imparting an essential skill set for research.
5. Different methods in collecting data from primary and secondary sources.
6. Operationalizing and developing ideas of students that could be shaped into researchable work.

### **HPSCR 4081-Political Processes and institutions in Comparative Perspective**

After completion of the course, a student is expected to have a clear idea about:

1. Acquiring basic knowledge of the approaches, concepts, and issues in comparative studies
2. Developing familiarity with the essential questions and arguments raised by the course
3. Getting acquainted with the relevant literature and major contributions of scholars researching in the field
4. Getting trained in the application of comparative methods to political questions
5. Developing the ability to assess contemporary issues and debates in comparative studies

6. Being able to reflect on the existing knowledge systems in the field and subsequently developing new insights based on the existing forms of knowledge

### **HPSCR 4091-Public Policy and Administration in India**

After completion of the course, a student is expected to have a clear idea about:

1. Various dimensions of policy making in India
2. The nature of decentralization: rural and urban
3. Understand the importance concept and types of budgeting
4. Avenues for redressal of citizens grievances
5. Appreciate the need for social welfare administration
6. Analyze social welfare policies pertaining to health, education, food and employment.

### **HPSCR4101 – Global Politics**

After completion of the course, a student is expected to have a clear idea about:

1. An understanding of the contemporary current of globalization and its political, economic, social, cultural and technological dimensions.
2. Impact of globalization on contemporary international relations, particularly in respect of the territoriality and sovereignty of nation states.
3. The major players who set the rules of the game in the institutional landscape of a globalized world – World Bank, WTO and IMF.
4. The working of the global economy and the changing nature of the relationship between the state and transnational actors and networks.
5. Contemporary concerns of global relevance like Climate Change and environmental degradation.
6. Key contemporary global issues such as proliferation of nuclear weapons, international terrorism and human security.

## **HPSSSE 4021 RESEARCH METHODOLOGY II**

After completion of the course, a student is expected to have a clear idea about:

1. The basic aspects of empirical research
2. The different approaches to research
3. The application of research methods to the social sciences
4. Existing literature in the field
5. How to conceptualise and operationalize actual research questions
6. Undertaking field research in order to test the applicability of existing knowledge and to generate new insights into the process of research

## **HPSCR5111 – Classical Political Philosophy**

After completion of the course, a student is expected to have a clear idea about:

1. The philosophic quest on part of ancient Greek thinkers to forge a better polity and the consequent birth of Political Science.
2. Attempts on part of Plato and Aristotle to provide a moral rearmament to the crisis-ridden civilization of ancient Greece.
3. Major issues in the political thought of the Middle Ages and the awareness that the Middle Ages were far from being 'apolitical'.
4. A modern conceptualization of 'politics' and its secularization at the hands of thinkers like Machiavelli.
5. The case for 'scientific' politics at the hands of Hobbes and an understanding of the state that is 'human' in its origin and implication.
6. The foundation of a theory of liberalism and the liberal state at the hands of Locke.

## **HPSCR5121T INDIAN POLITICAL THOUGHT-I**

After completion of the course, a student is expected to have a clear idea about:

1. A clear understanding of political ideas in ancient and medieval India
2. Principles of statecraft and governance in ancient India
3. Analysis of contemporary political ideas in ancient texts
4. To explore how relevant these texts are in contemporary times
5. Similarities and differences in Hindu and Islamic political thought
6. To examine the application of syncretism

### **HPSDS5011 Political sociology**

After completion of the course, a student is expected to have a clear idea about:

1. Major theoretical approaches in the field
2. The meaning and types of political culture.
3. Nature and agencies of political socialization.
4. Role of groups such as political parties and interest groups.
5. Impact of social cleavages such as caste, class, ethnicity on politics
6. Classical theories of religion
7. Understand the process of political development
8. Analyse the modes and form of military intervention in politics.

### **HPSDS5021 Politics of South Asia**

After completion of the course, a student is expected to have a clear idea about:

1. To familiarise with the conceptual categories essential to analyse the political history and economics of South Asia.
2. To critically reflect on the nature of politics in South Asia and situate it in post-colonial studies.
3. To interrogate and theorise the changing nature of politics and governance of the region owing to the forces of globalisation and the changing nature of sovereignty.

4. Familiarising with the geopolitics of South Asia and nature of conflicts of the region owing to traditional and non-traditional security threats.
5. Understanding the nature of regionalism by taking into account the study of important regional and sub-regional organisations to develop a policy perspective at the regional scale.
6. Correlating the study of the societies of the region with an assessment of the nature of political systems in the region and their performance invoking issues of identity politics, intra-region conflicts, citizenship and migration.

### **HPSCR6131(Modern Political Philosophy)**

After completing the course each student will have a clear idea of:

1. The theoretical understanding of modernity.
2. Comprehend Rousseau's ideas on general will, direct democracy.
3. Familiarize oneself with the conceptual framework of Hegel
4. Analyse the key ideas of liberals such as Bentham and Mill.
5. Understand the ideas of Marx, Lenin and Gramsci
6. Develop an understanding of the varieties of socialism.

### **HPSCR 6141 Indian Political Thought II**

After completion of the course, a student is expected to have a clear idea about:

1. Learning the basic concepts, ideas, and arguments of the thinkers included in the syllabus
2. Understanding the general themes of modern Indian political thought
3. Engaging in thematic comparisons between and among the different thinkers
4. Interrogating modernity in Indian philosophy and political thinking
5. Understanding the distinctiveness of modern Indian thinking

6. Being able to relate themes of colonial India with issues and debates of contemporary India and suggesting tentative resolution of debates

### **HPSDS6031T DEVELOPMENT PROCESS AND SOCIAL MOVEMENTS IN CONTEMPORARY INDIA**

1. To understand the development processes since independence
2. Clear conceptualization of the contemporary debates on industry and society
3. Agrarian strategies and impact on the social structure
4. Nature of social movements since the 1970s
5. The response of the state to the social movements
6. Transformative dimensions in the social movements pre and post globalization

### **Dissertation HPSDS6043D**

1. To systematically interrogate a research theme and prepare a dissertation.
2. To construct researchable questions and identify research gaps in forwarding arguments.
3. The paper involves use of research methods and techniques in collecting data from primary and secondary sources.
4. The process of writing the dissertation teaches one to analytically engage in the literature of the theme and also summarise and systematically arrange the review of the literature.
5. The dissertation brings together the aspects of creativity, criticality, method and flair in the manner of an on-the-job training pattern which is primarily an original work in advancing a new argument and adding to the literature of the subject.
6. The students are versed with actual notions of research involving the issues of ethics, plagiarism and referencing.

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### **COURSE OUTCOMES FOR POLITICAL SCIENCE GENERAL**

### **GPSCR1021T INTRODUCTION TO POLITICAL THEORY**

After completion of the course, a student is expected to have a clear idea about:

1. Basic political concepts
2. Conceptual clarity in linkages with state and civil society
3. Relationship between liberty, equality, justice
4. Awareness of rights
5. Awareness of the major debates around democracy and economic development
6. Understanding of the extent of state interference in family matters and freedom of the press

**Paper code: GPSCR 2051 INDIAN GOVERNMENT AND POLITICS**

After completion of the course, a student is expected to have a clear idea about:

1. The approaches to the study of Indian politics.
2. Features of the Indian Constitution.
3. The institutional functioning of the Indian political system.
4. The role of caste, religion and patriarchy in Indian politics.
5. The role of parties in India.
6. Various types of social movements in India
7. The nature of economic development in the pre and the post reform period.

**GPSCR3081 Comparative Government and Politics**

After completion of the course, a student is expected to have a clear idea about:



1. The nature, scope and development of the sub-discipline of comparative politics and engage with the important questions of why, what and how to compare between political culture, institutions and structures.
2. The methods of comparison involving the principles of comparison and the techniques of conducting case studies.
3. The notions of democracy and authoritarianism and develop an understanding of the process of democratisation and modern tendencies of authoritarianism.
4. The modern electoral and party systems functioning in different political systems across the world.
5. The differences between modern government systems on the basis of their executives and power sharing models using the reference of select cases.
6. The important debates concerning the effects of globalisation on the modern state systems along with the deepening and widening of the notion of security across the different theatres of the world

### **GPSCR4111 International Relations and Organisations**

After completion of the course, a student is expected to have a clear idea about:

1. The post-war arrangement of the state system and acquainting the students with the politics of the cold war.
2. The effects of globalisation on the modern arrangement of the state, concerning major debates on issues of sovereignty, autonomy and foreign policies.
3. The impact of traditional and non-traditional security threats situating the broader dynamics of deepening and widening of security agendas in the modern world.
4. Major powers and major issues in world politics to develop critical as well as policy perspectives
5. The structures and functions of the United Nations as an international organisation
6. The idea of human rights and the notion of human-centered security.

### **GPSDS5011 Public Administration**

After completion of the course, a student is expected to have a clear idea about:

1. The nature and scope of the discipline.
2. Major approaches in the field.

3. The perspectives on bureaucracy.
4. Key concepts and processes in administration.
5. Meaning and significance of public policy.
6. Steps involved in policy formulation and implementation.

### **GPSDS6031 Indian Administration**

After completion of the course, a student is expected to have a clear idea about:

1. Key central institutions in Indian administration.
2. The methodology of recruitment and training of civil servants.
3. Basic features of the Right to Information Act.
4. The need and significance of local government.
5. The composition and working of urban bodies.
6. The composition and role of panchayats.

### **GHRGE5011 Introduction to Human Rights**

After studying this course, students should be able to:

1. Have an advanced and integrated knowledge of international and domestic legal and institutional frameworks for the protection and promotion of human rights.
2. Analyse a country's situation or an international situation in terms of human rights and formulate human rights-based initiatives and policies.

3. Participate in legal, political and other debates involving human rights in a knowledgeable and constructive way
4. Critically appraise cases from human rights committees, tribunals, reports and summary records from treaty bodies.
5. Develop a cognitive and technical skills to independently examine and critically evaluate current issues by reference to international and domestic human rights standards.
6. Be engaged, informed and open-minded participant in debates about the contested universality of international human rights and its application in diverse domestic

### **GHRGE6021 Human Rights, Good Governance and Redressal Mechanisms**

After studying this course, students should be able to:

1. Understand and critically examine the interrelationships between international, regional and domestic histories, philosophies, policies and practices of human rights and human rights law.
2. Explain, distinguish and apply core and advanced concepts and terminology of international human rights law as used in the key primary and secondary sources;
3. Analyse, interpret and assess the challenges posed to the implementation of international human rights obligations in the context of globalisation, particularly the increased threat to human rights presented by non-state actors and efforts to develop and strengthen accountability protocols and other mechanisms
4. Demonstrate autonomy, expert judgment and responsibility as an advocate in the field of human rights law.
5. Explain and examine whether, and if so, to what extent, international human rights law provides coherent predictable consistent guidance to states, courts, lawyers, officials, and citizens.
6. Understand and address the issues of human rights violation

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### ***Course Outcomes for MA in Political Science Semester I***

#### ***PG Paper I: MPLS 4101 – Traditions in Western Political Thought***

After completion of the course, a student is expected to have a clear idea about:

1. The views of the main exponents of some of the main traditions in Western political thought.

2. Develop a broad understanding of political reality based on the different perspectives.
3. Analyse some of the main issues concerning the political community, like those of sovereignty, political obligation, rights etc.
4. Understand how political thought is a reflection of the times and the needs of certain classes in society.
5. Relevance of these ideas in contemporary times
6. Draw lessons from the implementation of these ideas.

### ***PG Paper II: MPLS 4102 – Political Theory***

After completion of the course, a student is expected to have a clear idea about:

1. An understanding of the liberal democratic order which seems to be the overwhelming framework on which most political systems of the world are based.
2. An overview of the perceptions of some of the sensitive minds on the issue of ‘justice’: ‘what is’ and ‘what is not’ fair for civilized human existence.
3. A critical understanding of contemporary political concerns that surface in the wake of a changing socio-political reality: problems relating to identity, pluralism and democratic participation.
4. To know, learn, identify, and present the core propositions of each of the theoretical positions included in the course content;
5. To enable students to analyse and assimilate the generalisations and predictive theoretical formulations therein in order to reflect upon contemporary issues and abiding questions of the social sciences;
6. To empower students to engage in critical ways with the paradigms of knowledge so as to critique given frameworks and suggest alternatives.

### ***PG Paper III: MPLS 4103 – India: Democracy and Development***

After completion of the course, a student is expected to have a clear idea about:

1. Concepts such as constitutionalism and federalism in the Indian context
2. Comprehend the diverse perspectives of Indian democracy
3. The nature of economic development since independence vis-à-vis political compulsions
4. Intellectual positions of Indian secularism

5. Role of the mainstream media and civil society in the Indian context
6. How democratic politics intensifies and accommodates ethnic conflicts

***PG Paper IV: MPLS 4104 – Comparative Political Analysis***

After completion of the course, a student is expected to have a clear idea about:

1. Familiarity with Political Science Subfields  
Demonstrate a familiarity with each of the four major subfields of political science:  
American politics, comparative politics, inter – state relations, and political philosophy.
2. Faith and Political Analysis; Reflect on the way religion affects politics: critical reasoning
3. Possess a factual and conceptual knowledge of countries and political processes; regional understanding.
4. Effective Research and Analysis; begin to develop skills of effective research, analysis and writing in social science by employing rigorous research methods and sound thinking.
5. Critical Thinking and Analysis; Think critically and analytically about politics, sound thinking and problem solving.
6. Participation in Political Processes Participate effectively in political processes by having an appropriate knowledge of international and national politics and political thought.

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# BA GENERAL

**BA GENERAL  
SEMESTER 1  
PAPER GENC1011T  
PAPER TITLE CORE MIL 1**

**Course outcome**

1. Able to fully grasp the fundamentals and basic application of effective communication.
2. Understood the methodology of verbal and non verbal communication.
3. Gained exposure to the usage of commercial vocabulary.
4. Developed ability to speak publically and build up self- confidence
5. Understood the principles of effective reading, writing listening and interpreting data (graphs) skills.
6. Ability to write basic correspondence.
7. Understood the basics of cross cultural etiquette ,norms and vocabulary used in the international forum

**BA GENERAL  
SEMESTER 3  
PAPER GENC3071T  
PAPER TITLE CORE MIL 2**

**Course outcome**

1. Fully comprehended the communication process.
2. Understood the concepts of teamwork and leadership through inter-active class work.
3. Developed interpersonal skills through group participation.
4. Gained exposure to a higher level of commercial correspondence with usage of specific commercial vocabulary.
5. Personality development was achieved and a build -up of self -confidence with a shift of focus to career planning (cv writing and job applications and mock interviews)
6. Development of analytical skills through the study of situational case studies.

**PROGRAM SPECIFIC OUTCOME OF BA GENERAL**

The BA General curriculum has been designed

- To strengthen knowledge of three core disciplines :English, Political Science and Sociology
- Take up any one of the disciplines for higher studies
- Proficiency in Computers
- Proficiency in Mass communication
- Proficiency in Journalism
- Give them a competitive edge in the job market
- Widen their opportunities in future career



# PG DEPARTMENT OF COMMERCE

## (M.Com)

### **Programme Outcome (PO):**

1. Responsible citizenship; sustainably contribute to the society
2. Practise ethical behaviour in all spheres of life
3. Have a research oriented mind-set and a quest for learning

### **Programme Specific Outcomes (PSO):**

1. Understand and analyse the developments going on in India and all over the globe on areas such as Corporate finance, Human Resource Management, Strategic Management, Concepts of Marketing Management, Sustainable development, Corporate social responsibility, Integrated accounting among others.
2. Understand the financial and other economic variables affecting the economy of a country and take sustainable investment decisions.

### **Course outcomes (CO):**

**SCMM 4301:** Each student will have a clear idea of

1. Concept of Strategic Cost Management
2. Globalized Competitive scenario and the role of Strategic Cost and Management Accounting
3. Various Strategic approaches to Cost Management
4. An elaborate idea about the Theory of Price and different pricing techniques
5. Different management control techniques
6. Concept of transfer pricing

**CFAM 4301:** Each student will have a clear idea of

1. Nature of accounting standards-and the process of setting standards
2. In-depth idea about Annual Reports
3. Idea about Group-companies
4. How to account for financial instruments
5. Idea and application of Financial Statement Analysis
6. Computation of value of business through various methods
7. Preparation of cash flow statements
8. Understand corporate failure

**FIMM 4301:** Each student will have a clear idea of

1. The financial system as a whole
2. Concepts of money market and capital market
3. How mutual funds work
4. Different financial services in India
5. Overview of the postulates and concepts of auditing
6. Planning the flow of audit work , audit strategy, planning programme and importance of supervision
7. Code of Ethics
8. Idea about auditor's report and the issues related to it.



**TBDM 4301:** Each student will have a clear idea of

1. Assessment of tax for various entities
2. Understand the Indian tax system
3. The upgradation policies in tax
4. Tax planning
5. The deductions and exemptions available
6. Importance of tax in taking management decisions
7. International taxation
8. GST

**RSMM 4301:** Each student will have a clear idea of

1. How to use SPSS
2. Meaning and types of research
3. Contribution by way of research
4. Different types of data
5. Idea about the usage of statistical tools
6. Ethics in research

**CBMM 4301:** Each student will have a clear idea of

1. What is consumer behaviour
2. Different factors affecting consumer behaviour
3. Consumer behaviour globally
4. Management uses of marketing research
5. Indian marketing research scenario
6. Project report writing

**SDRM 4301:** Each student will have a clear idea of

1. What is Sales Management
2. What is Sales organisation
3. What is Sales Force Management
4. What is Sales Motivation and Leadership
5. What is Vendor Development and Vendor evaluation
6. Evaluation of Channel member performance

**BMIC 4301:** Each student will have a clear idea of

1. Concept of Brand
2. Brand development
3. Brand Development and positioning
4. Concept of Integrated Marketing Communication
5. How to design advertisement
6. Tools used for Integrated Marketing Communication

**SAPM 4401 :** Each student will have a clear idea of

1. Concepts of risk, return and investment
2. Concepts of fundamental analysis and technical analysis and the difference between the two
3. How to determine the value of securities
4. Efficient Market Hypothesis (EMH)
5. How to determine the value of bonds

6. Concepts of portfolio and portfolio management
7. Capital Market Theory
8. Different management strategies for managing equity and bond portfolio

**DRMM 4401:** Each student will have a clear idea of

1. What are derivatives and its different types
2. How to manage market risk
3. The uncommon derivatives in India
4. What points should be kept in mind while trading derivatives
5. How does MNCs work
6. Concept of Balance of Payment
7. Concept of foreign exchange rate and the risks associated thereto
8. How to take international investment and financing decisions

**RMMS 4401:** Each student will have a clear idea of

1. Concepts of rural marketing
2. Agricultural marketing
3. How should be farm products packaged and marketed
4. What is product grading
5. Marketing of service
6. How to manage demand for and supply of service

**INMM 4401:** Each student will have a clear idea of

1. Concepts of international marketing
2. Concepts of EPRG GFRAMEWORK
3. What factors are important as regards to international marketing environment
4. Product and pricing decisions in the international market
5. How to promote a goods across the globe
6. Concepts of distribution and supply channels

# MANAGEMENT STUDIES

## Program Outcomes and Course Outcomes

### Program Outcomes (PO)-

- **PO1:** Students should be able to join the corporate sector and/or go for higher studies.
- **PO2:** Students should be able to apply innovative ideas and knowledge to start their own business.
- **PO3:** Students should be able to apply knowledge of management concepts to solve complex business problems in an organization.
- **PO4:** Students should be able to undertake research work in various functional areas of management.
- **PO5:** Students should be able to apply value-based leadership competencies or become an effective team player in an organization.
- **PO6:** Students should be able to showcase good communication skills, interpersonal skills, critical and analytical thinking abilities for data-oriented decision making.
- **PO7:** The programme 'Bachelor of Management Studies' aims at cultivating knowledge among students to be ideal managers and entrepreneurs and help students acquire knowledge about business and modern management practices which facilitate them to become effective professionals.

### Programme Specific Outcomes: PSO

1. After completion of management studies students develop skills and expertise to start their own business.
2. Students can join MBA or Masters in Marketing, Financial Economics within country and abroad.
3. Students joining MCom after completion of this course and can independently update their academic skills learnt from this course.
4. Students able to write articles for newspaper and magazines on political economic issues and also on contemporary business problems.
5. They develop skills related to public speech and conducting seminars.
6. They develop knowledge to understand real business events and can interpret it using the theoretical knowledge of microeconomics and macroeconomics.

### COURSE OUTCOMES (CO)

#### **BMHCR 110 Fundamentals of Management & Organizational Behaviour**

**CO1** Students should be able to manage business with an understanding about different forms of business ownership.

**CO2** Students should be able to do business forecasting and take Rational Decisions in an organization.

**CO3** Students should be able to practice the process of management's principal functions such as planning, organizing, and controlling in the corporate world.

**CO4** Students should be able to understand and apply concept and theories of motivation in an organizational set up.

**CO5** Students should be able to appreciate the complexities associated with management of individual and group behaviour in the organization.

**CO6** Students should be able to understand Organizational Culture and Organizational Change.

### **BMHGE 130 Entrepreneurship Development**

**CO1** Students should be able to have Conceptual clarity about various aspects of Entrepreneurship

**CO2** Students should be able to gain knowledge about various sources and stages of funding for new entrepreneurial ventures. (Start-ups)

**CO3** Students should be able to analyze in detail the feasibility of a business idea and draft a Business Plan.

**CO4** Students should be able to acquire knowledge about significance of creativity and innovation in entrepreneurship.

**CO5** Students should have an insight on managing family owned business by understanding its major issues and challenges and also strategies to overcome it.

**CO6** Students should be able to understand trend in Entrepreneurship in India, in context of Social Entrepreneurship.

### **BMHCR320 Principles of Marketing**

**CO1** Students should be able to have a holistic understanding of the nuances of the 4Ps of marketing, namely Product, Price, Place and Promotion.

**CO2** Students should be able to draft Segmentation, Targeting and Positioning Strategies for brands.

**CO3** Students should be able to understand and appreciate marketing environment with special reference to micro and macro environment.

**CO4** Students should be able to acquire knowledge and apply it in framing product strategy.

**CO5** Students should have an insight on pricing strategies of various brands.

**CO6** Students should be able to understand and develop distribution, promotional strategies and marketing strategies for services.

### **BMHGE 340 Production & Operations Management**

**CO1** Students should be able to understand the concept of PPC and its significance in Industry.

**CO 2** Students should be able to understand and identify the right location for setting up a Plant.

**CO 3** Students should be able to gain understanding about various types of Layouts and Production Processes applied in productions units.

**CO 4** Students should be able to understand Market demand forecasting techniques.

**CO 5** Students should be able to understand Lean management concepts to improve productivity and methods of performance rating.

**CO 6** Students should be able to understand and apply Statistical Quality Control techniques.

### **BMHCR 420 Human Resource Management**

**CO1** Students should be able to understand and apply concepts and techniques of essential functions of HRM.

**CO 2** Students should be able to apply concepts of HRP in the workplace.

**CO 3** Students should be able to understand different training methods practiced in the Industry.

**CO4** Students should be able to understand different Performance Appraisal methods and Compensation plans.

**CO5** Students should be able to understand concept of Employee Welfare System including Career Planning.

**CO 6** Students should be equipped with concept of Industrial Relation, including Employee Welfare and Grievance redressal mechanism.

### **BMHGE 440 Ethics and CSR**

**CO1** Students should be able to develop an understanding of ethical values and principles in business and its practical application.

**CO2** Students should be able to understand and apply different theories of Ethics.

**CO3** Students should be able to understand about Corporate governance and its importance.

**CO4** Students should be able to understand the role played by SEBI.

**CO5** Students should be able to develop awareness and insight about sustainability and various responsibilities of a business towards different social causes and mission.

**CO 6** Students should be able to understand and appreciate that businesses are a sub-system of the society and be apprised of the dynamics of the relationship between business and society through various models and frameworks of corporate social responsibility.

### **BMHSE 450 Internship and Term Paper**

**CO1** Students should be able to get basic Idea about research technique while doing term paper.

**CO2** Students should have opportunity for practical learning and gaining hands on experience in specific area chosen for their internship.

**CO3** Learn about the art of developing a questionnaire, developing the methodology and research design etc.

**CO4** Students should be able to develop know-how to search Research Database.

**CO5** Students should be able to use Library Software.

**CO6** Students should be able to develop an understanding about writing and presenting Research Report.

### **BMHDE 532 Consumer Behaviour**

**CO1** Students should be able to understand Individual behaviour, Group behaviour and Industrial buying behaviour.

**CO2** Students should be able to understand Consumer decision making process.

**CO3** Students should be able to understand the relevance of consumer behaviour theories and concepts to marketing decisions.

**CO4** Students should be able to understand the Influence of Culture in Consumer Behaviour Concept of Social Class.

**CO5** Students should be able to understand and apply the concept of opinion leadership and reference group while developing marketing communication.

**CO6** Students should be able to gain insight about Innovation, Diffusion and Adoption process.

## **BMHDE 542 Advertising and Brand Management**

**CO1** Students should be able to Plan and execute advertising campaign keeping social, ethical and economic aspects of advertising in mind.

**CO2** Students should be able to understand the functioning of the Advertiser, Advertising Agencies and Media houses.

**CO3** Students should be able to understand and apply different methods for determining Advertising Budget.

**CO4** Students should be able to understand and develop creative strategy and media strategies for brands.

**CO5** Students should be able to understand and implement sales promotion plans for brands.

**CO6** Students should be able to build brands highlighting positioning and personality of the brand.

## **BMHCR 611 Business Policy & Strategy**

**CO1** Students should be able to understand the vision and mission and formulate mission statement of the company.

**CO2** Students should be able to comprehend the factors that shape the internal and external analysis of a firm and develop an environment appraisal that will lead to formulation of strategic plans.

**CO3** Students should be able to understand and relate to the behavioural aspects of strategic management.

**CO4** Students should be able to understand and formulate competitive strategies.

**CO5** Students should be able to understand concepts of Balance Score Card & KPI.

**CO6** Students should be able to understand monitoring mechanism, control and evaluation.

## **BMHDE 632 Marketing of Services**

**CO1** Students should be able to understand about Service sector and contribution of service sector in economic growth.

**CO2** Students should be able to understand the unique challenges of services marketing, including the extended mix elements (product, price, place, promotion, processes, physical evidence, and people).

**CO3** Students should be able to understand and apply pricing and distribution strategies for service sector.

**CO4** Students should be able to understand different dimensions of service quality & GAPS model.

**CO5** Students should be able to understand and apply service marketing mix elements to various service sectors such as travel and tourism, education, banking etc.

**CO6** Students should be able to understand and develop Segmentation, Targeting and Positioning strategies for services.

### **BMHDE 641 Research Project**

**CO1** Students should be able to gain a practical and hands-on exposure to the theoretical concepts discussed in the class.

**CO2** Students should be able to understand and do research in any management related domain.

**CO3** Students should be able to understand and apply different data collection methods.

**CO4** Students should be able to understand and frame questionnaire for their research work.

**CO5** Students should be able to understand and apply various statistical concepts in practice.

**CO6** Students should be able to prepare research report and present it.

## **COURSE OBJECTIVES**

### **Business Accounting (Sem I)**

1. To give an insight into the basics of accounting concepts and principles
2. To familiarize students with the mechanics of preparation of Financial Statements
3. To help the students understand the contents of Corporate Annual Report
4. To understand, analyze and interpret Cash Flow Statements
5. To help the students acquire knowledge relating to various provisions of Companies Act, 2013 and relevant Indian Accounting Standards
6. To help the students learn the various techniques of Financial Statement Analysis and apply the same in evaluating corporate performance

### **Taxation and Tax Planning (Sem II)**

1. To acquaint the students with the Direct tax structure in India for individuals and corporates
2. To understand the provisions and procedures to compute the total income under five heads of income
3. To understand the provisions relating to clubbing of income and set-off and carry forward of losses
4. To know the various deductions to be made from Gross Total Income



5. To make the students aware of the Indirect taxation system in India with special emphasis on Goods and Services Tax.
6. To know the implications of tax planning enabling them to apply the same as managers and entrepreneurs

### **Management Accounting (Sem III)**

1. To understand basic managerial accounting concepts and their application to business situations
2. To understand revenues and costs relevant to decision making
3. To make the students aware about cost structure and cost elements
4. To understand planning and formulation of future policies and budgets
5. To help the students know the various cost reduction techniques
6. To acquaint the students with the role of Management Accountants in planning, control and decision making

### **Financial Management (Sem IV)**

1. To help students develop the knowledge of business finance and financial decisions
2. To enable students tackle different finance related issues in business
3. To analyze the degrees of risks associated with a business for effective management of business
4. To help students gain expertise in setting financial objectives & goals
5. To enable the students take various short term and long term investment decisions
6. To acquaint the students with the techniques of financial management and their application in financial decision making

### **Internship & Term Paper (Sem IV)**

1. To help the students gain industry exposure
2. To create research interest amongst students and motivate them to pursue advanced research on various management related issues
3. To create an understanding on various ethical issues related to research
4. To develop the data analytical skills enabling them to make solve business problems

### **Strategic Corporate Finance (Sem V)**

1. To provide students with an opportunity to develop in-depth expertise in various aspects of financial decision making
2. To help the students acquire basic knowledge in finance by means of combining theoretical cognitions and practical attitudes

3. To help the student understand the significance of various strategies involved in corporate decisions
4. To provide insights to the students relating to various business valuation methods
5. To provide knowledge to the students relating to the factors that lead to corporate failure and the measures to overcome such failure
6. To make the students aware of the various strategic cost reduction techniques

### **Investment Analysis & Portfolio Management (Sem V)**

1. To provide conceptual framework relating to construction of an optimal portfolio and illustrate the theory and application of asset pricing model
2. To familiarize the students with the fundamental and technical analysis of the securities market
3. To provide theoretical knowledge of the equity and fixed income portfolio management strategies with their implications in real world
4. To analyze and evaluate mutual fund schemes as an investment avenue
5. To help the students learn to measure return and risk and to analyze the various types of risks involved in effective securities management
6. To understand the basics of derivatives as a risk management tool

### **Project Appraisal (Sem VI)**

1. To explain identification of a project, feasibility analysis including market, technical and financial appraisal of a project
2. To understand the relevance of alternative project appraisal techniques, financial structuring and financing alternatives
3. To help students learn various investment appraisal tools and techniques
4. To help the students assess the projects under situations of risk and uncertainty
5. To help students get an insight regarding preparation of project appraisal reports
6. To give an insight into both financial and non-financial aspects of evaluation a project

### **Financial Institutions and Markets(Sem VI)**

1. To introduce the students to the world of financial markets and services
2. To enrich students' understanding of the fundamental concepts and working of financial institutions.
3. To provide students with an understanding regarding functionality of stock market
4. To understand the structure of the Indian Financial System
5. To provide students with an understanding of clearing and settlement procedures of securities transactions
6. To help them make rational decisions in financial environment.

### **Sem II: Paper Code [BMHCR210](#): Managerial Economics**

1. Students should be able to understand and appreciate the basic Intuition behind the theory of demand, supply and market structure.
2. Students should be able to understand that all the chapters of microeconomics deals with rational individuals who will always try to optimize its economic decision. For example in theory of production, firm is maximizing output given cost so in entire analyses of microeconomics, individuals are the optimizers.
3. Students should be made more aware about industrial trends and perspectives in India and world with the theoretical exposition of market structure.
4. Will have a clear understanding of the behavior of economic agents like consumers, producers, firms and government.
5. Discussions on market structures in short run and long run with government policy will help students to relate economic events government policies in recent time and they will be able to analyze the impact in the market.
6. Students will be aware of the problem of externality and market failure with case studies.

### **Sem III: Paper Code [BMHCR310](#): Macroeconomics**

1. Students will be able to analyze the problem of macroeconomic stability and (or) instability of business environment of the country and the world.
2. Will have clear idea on the measurement of macroeconomic performance in National Income Accounting, so that they can apply their knowledge to understand the real economic problems.
3. Students must acquire clear knowledge on different macroeconomic schools like Keynesian School and Classical School so that they can have clear understanding on the debate on Keynes and Classics and the synthesis of the two approaches.
4. They will be made aware on money market and different functions and theories of money in the economy so that they can analyze and interpret monetary policy if RBI in recent years.
5. Students will have exposure on open economy macroeconomic issues like foreign exchange, BOP, so that they can pursue their higher studies or specialization in international finance or they will be able to apply their theoretical knowledge in their business.
6. Students will be made more confident in interpreting Union and State Budget and also the RBI monetary policy of recent past.

### **SEMESTER II BUSINESS MATHEMATICS & STATISTICS BMHCR220**

To familiarize the students with various concepts and tools that can be used for effective decision making. Emphasis will be on the application of the concepts learnt.

### **SEMESTER IV BUSINESS RESEARCH BMHCR410**

1. To provide an exposure to the students pertaining to the nature and extent of research orientation, which they are expected to possess when they enter the industry as practitioners.

2. To give them an understanding of the basic techniques and tools of business marketing research.
3. This course aims at providing the general understanding of business research and the Methods of business research. The course will impart learning about how to collect, analyze, present and interpret data

#### **SEMESTER V    Quantitative Techniques for Management   BMHCR510**

To acquaint students with the construction of mathematical models for managerial decision situations and to use computer software packages to obtain a solution wherever applicable. The emphasis is on understanding the concepts, formulation and interpretation.

# ENGLISH.

## I. COURSE: SKILL ENHANCEMENT (B.A. ENGLISH)

Semester: 3	Paper Number: 1
Paper Code: HENSE351	Paper Title: Understanding Poetry
Course Objectives	This course has evolved out of class room interactions with students who have been intimidated by the preconception that the study of poetry is an arcane, esoteric discipline that is difficult to decipher or master. The purpose of this course is to deconstruct these notions by suggesting a set of practices and response protocols. Through an exhaustive reading of primary texts taken from a wide range of poetry traditions and forms, the student will be made to recognise and appreciate that poetry is essentially narrative, and like all narratives, it tells stories. This course is an exploration of the narrative strategies of poetry story telling. Beginning with questions of structure and developing through narrators, voices, point of view, to culminate through analysis of rhetoric and style in the business of interpretation and meaning.
Course Outcomes	At the end of the course the student will have learned how to read a text, in this case poetry, and so mastered the ability to reduce the original to its essential skeleton of main points. This exercise then has empowered the student to launch into detailed reading and analysis. The student has learned to do this by being introduced to the main components etc. of poetry. He has learned how to identify structures, narrative discourse, voice and point of view along with poetic devices, language and rhetoric. The development of these skills has helped the student to be more independent and original in core and discipline elective poetry courses.

Semester: 4	Paper Number: 2
Paper Code: HENSE451	Paper Title: Creative Writing
Course Objectives	This course is an introduction to the craft of writing with particular focus on the art of the short story and lyric poetry. Readings, critical analysis, writing exercises and projects are designed to provide students with the tools and techniques of creative writing and to foster both an appreciation of literary craft and the development of an individual voice and style through the practice of writing.
Course Outcomes	At the end of the course students will have acquired the basic techniques of creative writing. They will be able to turn their knowledge of literary techniques to the ends of personal expression and finding a voice. They will be able to produce and present an original work of short fiction or poetry.

## M.A. ENGLISH: COURSE OBJECTIVES AND COURSE OUTCOMES

Semester: 1	Paper Number: 1
Paper Code: MENG4101	Paper Title: Medieval and Renaissance Poetry and Prose
Course Objectives	This course is designed to make students analyse and appreciate two types of literature: first, the literature of the Medieval Period, a product of a European society that lived its life revolving around concepts such as God, religion, sin, repentance, penance, romance, courtly love, chivalry and politics; second, the literature of the Renaissance Period pervaded with classical antiquity and humanist philosophy.
Course Outcomes	At the end of the course students will be firmly grounded in an understanding and appreciation of the importance of the so-called Dark Ages. This will serve as a platform for subsequent mastery of the literature of the Middle Ages vis-à-vis the Dark Ages. This will empower them to dig into the Renaissance with sharper sensibilities provided by their introduction to what came before. In this way they will grasp the period holistically. The outcome will be tested by the evaluations designed for the paper.

Semester: 1	Paper Number: 2
Paper Code: MENG4102	Paper Title: Medieval and Renaissance Drama
Course Objectives	This course is designed to give exposure to the nature and extent of British Drama during Renaissance – the trends proposed to the University Wits, presented by them and perfected by Shakespeare. The course will seek to trace the changes that have come down to the culmination of the drama at its apex in the Renaissance.
Course Outcomes	The evaluation at the end of the semester will enable a student to inculcate and cultivate the culture of Renaissance, as represented in Drama. This will also prepare them for further research in this area of studies.

Semester: 1	Paper Number: 3A (Elective)
Paper Code: MENG4113	Paper Title: Theatre, Performance, Text
Course Objectives	The course is designed to combine the text with the interpretation, performance and the stage all together and trace the origins of drama. The Greek theatre to the medieval stage, down to the Elizabethan and Jacobean theatre as well as the Restoration down to the modern theatre, the course is designed to acquaint the students with the changes that have happened with the theatre structure, the evolution of the stage, and the forms and movements and the tenets that govern the performance studies.
Course Outcomes	At the end of the course students will be able to approach literary texts from both a theoretical and practical perspective as performance texts. They will be familiar with the history of theatre and oral traditions of poetic practice. They will be conversant with the issues involved in theatrical direction/adaptation and have a working knowledge of staging practices. Through the perspective of performance studies they will be able to read texts as the products of cultures and strategies of performance.

Semester: 1	Paper Number: 3B (Elective)
Paper Code: MENG4123	Paper Title: Literature and Other Arts

Course Objectives	This first module on 'Literature and Cinema' introduces the students into exploring the dynamics of the relation between literary works and their cinematic adaptation with reference to the three different literary genre — novel, drama and short story. The second module is for students who enjoy literature as well as music. It will open up new ways of responding to and thinking about the creative arts. Music is deeply embedded in poetry, which is the most obvious, but this course will attempt to establish new ways of looking at film, painting, fiction and poetry in their use of and relationship to music.
Course Outcomes	The student will be trained to engage sensitively and intelligently in new readings and responses to literature. The module on music is intended to make the student receptive to patterns, modes, possibilities and structures by looking at one art form through the refracted illuminations of another. The module on painting will train the student in appreciation of a work of art in order to correlate it with literature.

Semester: 1	Paper Number: 3C (Elective)
Paper Code: MENG4133	Paper Title: Europe in the classical and the Middle Ages-A Contextual Study
Course Objectives	The course aims to introduce students to the cultural and intellectual underpinnings of the classical age and the middle ages by guiding them through significant changes in the religious, artistic and architectural tradition. It will help them to understand the primary features of the evolving European culture within the stated time frame in order to better appreciate the art and literature it produced. The course will give them a sense of history not as a series of clean breaks and fresh beginnings but rather as a flowing and shifting current. The course is designed to create a structure of comparative studies of contemporary cultural practices in order to deepen their comprehension of literature in relation to other artistic achievements.
Course Outcomes	By the end of the course the student will be able to understand the overall chronological and stylistic progressions within the western architectural tradition. The course will give the students exposure to understand the evolution of western philosophical and religious thought and the knowledge of where to place works of art or literature within their proper context. The students are meant to study the steady interplay of several factors that eventually led to the birth of pre-modern/Renaissance Europe. The students will have awareness of the basic assumptions of the classical world view that would inform much of the beliefs of the neo-classical 18 <sup>th</sup> century. C.S Lewis' "discarded image" that played a significant role in the evolution of English literature will be understood as a corollary to this course.

Semester: 1	Paper Number: 4
Paper Code: MENG4104	Paper Title: Special Area, Special Author
Course Objectives	This course is designed to introduce the students to a detailed study of forms and movements in literature along with allowing them to specialise about an author of their choice.
Course Outcomes	At the end of the course, students are more familiar with the area of literature taught to them. Their understanding of the course makes them aware of the detailed features of whichever area they opt to study. The second module is study of special author in which the students will be acquainted with the literary styles of the author of their choice. Students will have

	grasped the major thrust of their works and their imagination that conceived the major motifs of their works.
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Semester: 2	Paper Number: 5
Paper Code: MENG4201	Paper Title: 17 <sup>th</sup> and 18 <sup>th</sup> Century Poetry
Course Objectives	The course is designed to introduce students to the poetry of the 17 <sup>th</sup> and 18 <sup>th</sup> century within the context of the literary, cultural, religious and political developments of the age. Through a reading of major texts they will discover the key ideas and formal qualities of Neoclassical writing and the Age of Enlightenment. Buttressing critical discussion of the poetry with a study of the art of the age, the course also traces the rise of sentiment and the cult of sensibility and the shift away from Neoclassicism towards Romanticism and a study of the canonical texts of the Romantic period.
Course Outcomes	The course facilitates a thorough understanding of the intellectual basis and formal elements of Neoclassical and Pre-romantic poetry and the Romantic poetry. The students would have an understanding of the philosophic and intellectual bent of the ages having read Locke and Hume as well as the idea of the 'sublime'. The students would be capable to understand and explain the shifting trends in the poetry and the different style and form in which each heavyweight of the Romantic genre compose their artistic oeuvre.

Semester: 2	Paper Number: 6
Paper Code: MENG4202	Paper Title 17 <sup>th</sup> and 18 <sup>th</sup> Century Drama and Prose Fiction
Course Objectives	The course has been designed to enable the students gather a comprehensive understanding of the evolution of drama, the novel, and non-fictional writings during the turbulent 17 <sup>th</sup> and 18 <sup>th</sup> centuries. The representative texts chosen for this course trace the evolution of English literature through the turbulent 17 <sup>th</sup> and 18 <sup>th</sup> centuries. It covers the puritanical literature of the commonwealth and the licentious reaction to it during the Restoration. It goes on to study the shift in tastes and genres due to the rise of the middle class after the Glorious Revolution. It explores the conditions that led to the rise of the novel and analyses the works of the major prose writers of the age. The purpose of the course is to cover the literary output of an era of significant changes primarily motivated by the great political and social shifts brought about by the events that started with the reign of the Commonwealth and continued till the aftermath of the Glorious Revolution.
Course Outcomes	At the end of the course, the student will have a deep understanding of the evolution of English drama after the Restoration straight through to the 18 <sup>th</sup> century. She will also have a clear understanding of the socio-political contexts that were responsible for the primary trends in the development of the major genres of the era. She will have a comprehensive knowledge of the factors that led to the rise of the novel, and the major narrative techniques and thematic concerns of the form. The course will allow the student to understand the importance of periodical essays and why satire was a representative form during the politically turbulent 18 <sup>th</sup> century. It will also lead to an understanding of how religious concerns and shifts in power through the social spectrum were largely responsible for the rise and decline of genres as well as the governing literary tenor of the era.

Semester: 2	Paper Number: 7A (Elective)
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Paper Code: MENG4213	Paper Title: American Literature
Course Objectives	The course is designed to enable students to get a nuanced perspective on a significant cross-section of American literary studies. The different modules highlight the multiple creative dimensions of American literature including poetry, drama, musicals and fiction. The course aims to enrich the students' understanding of American cultural and literary history from a critical perspective.
Course Outcomes	The course aims to enrich the students' understanding of the multi-cultural social dimensions of American literature and culture. The evaluative methods are structured to sharpen the students' analytical skills and critical understanding of the chosen texts.

Semester: 2	Paper Number: 7B (Elective)
Paper Code: MENG4223	Paper Title: Classical Literature
Course Objectives	Furthering the exposure to classical concepts and literatures – extending dimensions of understanding texts and contexts. This course is designed to give exposure to the students about the canonical texts that form a part of the classical period.
Course Outcomes	With extensive and deepened response to classical literature, a student may conduct further research in related areas. The students when evaluated on this course will be prepared with the knowledge of the forms, movements, styles, and also the classical tenets that should later be emulated in the different periods in English literature.

Semester: 2	Paper Number: 7C (Elective)
Paper Code: MENG4233	Paper Title: British Women Poets
Course Objectives	The course aims to introduce students to the range and variety of British Women's poetry of the nineteenth and the twentieth centuries and its place in the canon. Evoking the sense of a tradition of women's poetry, discussions will turn on issues related to gender, writing and publishing, poetic voice, creativity and aesthetics. The course opens up the works of representative and established women poets as well as the writing of lesser known original voices by studying selected poems by these poets in their literary and socio-cultural contexts.
Course Outcomes	At the end of the course students will have an acquaintance with a rich and diverse body of women's poetry. They will be able to trace an evolving tradition of women's poetry. They will have acquired new strategies of reading and learned to think critically and creatively about gender, genre and the canon. They will be able to address and interrogate issues tied to voice, poetic roles, representation and self-fashioning.

Semester: 2	Paper Number: 8A (Core)
Paper Code: MENG4204	Paper Title: Literary Theory I
Course Objectives	This course is designed to expose students to literary theory and criticism. Students will read material that cover key components of literary analysis in three different timelines- namely the classical school of criticism that extends to the

	Renaissance, the Romantic and Victorian periods and the Modern school of criticism. The students would be familiarised with the canonical texts in literary theory and criticism and overall study the trends and patterns and movements that foresee these theories.
Course Outcomes	The student would be equipped with theoretical approaches towards literary texts and the knowledge of critical theoretical thinking of major figures. The students will be able to describe how literary theory is connected to various social and cultural movements. The students would be able to employ the use of these theories to discover newer frontiers of knowledge when writing academic papers. The course would thus equip students with practical tools for reading and analyzing literature.

Semester: 2	Paper Number: 8B (Core)
Paper Code: MENG4204	Paper Title: British Literature and Culture of the First World War(1914-18)
Course Objectives	The course on British Literature and Culture of the First World War will examine the responses of those writing about the Great War (1914-18) as it unfolded—whether as combatants (British or Imperial), or as civilians at the home front. It will also examine the responses of those writing about the war in retrospect—through memoir, or autobiography or through fictional representations. The course intends to focus on questions of literary form as well—on the ways the writers improvised existing genres to narrate the unique experience of the war.
Course Outcomes	The course will encourage students to explore the myriad forms of literary expressions exploring the changes facilitated by the Great War to the existing concepts of nationhood, class identity, gender roles and the challenges it posed to the dominant notions of civilization, selfhood and human reason.

## **. B.A. ENGLISH: COURSE OBJECTIVES AND COURSE OUTCOMES**

### **I. COURSE: DISCIPLINE SPECIFIC CORE (CBCS)**

Semester: 1	Paper Number: 1
Paper Code: HENCR1011T	Paper Title: British Poetry 14 <sup>th</sup> to 17 <sup>th</sup> Century
Course Objectives	The course is designed to introduce the student to the first truly modern poet in English Literature, Chaucer. This will entail a look at poetry before Chaucer, including but not limited to Anglo-Saxon poetry, the Alliterative tradition, and Romance literature, to examine the significance of Chaucer's work. Traversing forward into the 16th and 17th C. the course will then take the student through the Petrarchan/courtly tradition to Shakespeare and forward to the Metaphysicals. Focus will be placed on techniques, formulas, language to trace the poetic engagements with tradition and modernity. The Petrarchan segment will be used as a platform to introduce basic Feminist theory so that early in the course the student can begin to learn how to use theory to develop ways of looking at and writing about poetry. The Shakespeare and Metaphysical segments will also open up discussions about the notion and grammar of modernity.
Course Outcomes	At the end of the course the student will have a firm grasp of the medieval literary context so that he can independently understand the nature of Chaucer's poetry, why it is important and different and how and he is the first 'Modern'. The student's first encounter with the idea of the 'modern' will make it easy for him to evaluate Shakespeare's relation to his contemporaries, and so understand Elizabethan poetry in the context of its 2 main movements.

	<p>This prepares the student to understand the modernity of the Metaphysicals and the nature of their reaction to the outmoded Petrarchan tradition. Further to this the student has learned how to conduct in-depth textual analysis in the process of learning the fundamentals of poetic form, devices, language and style.</p> <p>The outcome of the 3 modules of the paper will be measured qualitatively by internal assessment tests and the semester examination, the questions of which are designed to determine the extent to which the course objectives have been fulfilled.</p>
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Semester: 1	Paper Number: 2
Paper Code: HENCR1021T	Paper Title: European Classical Literature
Course Objectives	<p>This course aims to familiarize students with the classical literary tradition through representative texts. It explores the genesis of the primary genres in classical literature thus creating a suitable context for understanding their subsequent appropriation in English literature. Since the course covers the entire span of classical literature, it includes an intensive examination of the Greek epic, Greek and Roman drama, and Latin narrative poetry and satires. The course places these texts within a broad chronological framework in order to demonstrate their place in an evolving tradition. The student is also trained to examine the socio-historical background that produced these texts and study them in a critically informed manner.</p>
Course Outcomes	<p>At the end of the course, the student will have a basic understanding of the origins of the western literary tradition. They would have acquired a broad understanding of the main genres of classical literature. A thorough understanding of the texts prescribed in the syllabus and learned to place these genres and texts in their correct context within the classical tradition. The students are also expected to develop a sound foundation for understanding classical influences in English literature and acquire a basic critical acumen in their approach to texts.</p>

Semester: 2	Paper Number: 3
Paper Code: HENCR2031T	Paper Title: Indian Writing in English
Course Objectives	<p>The course is designed to introduce students to the history and the development of Indian writing in English and to enable them to understand the origin and growth of Indian writing in English, especially in the context of Indians' problematic relations with the English race and language. The course will acquaint students with major movements and figures of Indian Literature in English through a close study of select literary texts. Students are expected to analyse the themes and contexts of Indian English Fiction and critically explore the aesthetics of Indian English poetry and to trace and explore the evolution of the nature of readership for Indian writing in English. The course also aims at a close study of problems of modernization in Indian writing in English, the Diaspora and the quest for identity.</p>
Course Outcomes	<p>Students will gain an understanding as regards the origin and growth of Indian writing in English, especially in the context of Indians' problematic relation with the English race and language.</p> <p>Students will also be familiarised with the major movements and figures of Indian literature in English through a close study of literary texts.</p> <p>Students would be able to trace and explore the evolution of the nature of readership for Indian Writing in English in India. In the process of doing so they would also explore the quest for identity in the global market.</p>

Semester: 2	Paper Number: 4
Paper Code: HENCR2041T	Paper Title: British Drama 14 <sup>th</sup> to 17 <sup>th</sup> Century
Course Objectives	The course is designed to introduce the student to Renaissance humanism and the cultural ferment that produced it. The course will examine the dialogues, historical, political, religious, artistic, that voice the period's encounters with new and changing world views and consciousness. The student will be introduced to the traditions of English drama, including comedy and tragedy, to examine how they culminate in the work of Marlowe and Shakespeare.
Course Outcomes	<p>At the end of the course the student will have a working knowledge of Elizabethan tragedy and comedy. He will have learned the traditions and influences that shaped it. He will understand the plays both as performance and text, and have got to know about the Elizabethan stage and audience. He will also be acquainted with the basics of Renaissance humanism so that he is able to appreciate how it shaped the thinking and philosophy that underpins the tragedy. He will be informed in the Morality tradition and so can independently appreciate its bearing on Marlowe.</p> <p>He will also have a working knowledge of the form of comedy, its methods, devices, and theory. He will have his first encounter with the portrayal of women in Elizabethan drama and so received his first introduction to feminism which will provide him with new approaches to understanding Shakespearean comedy.</p> <p>The student will thus have a basic knowledge of the ideas of Aristotle, Bergson and Bakhtin. The student has also learned how to analyse plot structures, dramatic techniques, language, and theme. He is also empowered to understand the open-endedness of text as performance. These outcomes are measured by internal assessments and semester examination questions that qualitatively determine the depth of the students acquired knowledge and skills.</p>

Semester: 3	Paper Number: 5
Paper Code: HENCR3051T	Paper Title: American Literature
Course Objectives	The course aims to enable students to comprehend the key issues in American literary and cultural studies. The diverse components in poetry, fiction and drama highlight the uniqueness of the varied themes such as individualism, the Frontier Myth, the Puritan ethic of nation building together with the American dream. The course also focuses attention on the issues of race, class, gender for detailed study and analysis.
Course Outcomes	The students will obtain a panoramic perspective of American literary compositions through a plurality of approaches. The variations in evaluative methods aim to test the students' ability to internalize the significant facets of American literature.

Semester: 3	Paper Number: 6
Paper Code: HENCR3061T	Paper Title: Popular Literature
Course Objectives	The course is designed to encourage the student to think critically about popular literature. Through the study of set texts, students will debate the categories of the "popular" and the "canonical," and identify the conventions, formulas, themes and styles of popular genres such as detective fiction, the gothic, children's literature and nonsense literature. An assessment of the literary and cultural value of these popular texts will sensitise students to the ways in which popular fiction reflects and engages with questions of caste, gender, identity, ethics and education.

Course Outcomes	At the end of the course students will be able to clearly define the categories of the “popular” and the “canonical”. They will be conversant with the conventions and formulas of fantasy and children’s literature, detective fiction and the gothic and will be able to judge the literary merit of popular texts. They will have acquired strategies of reading to decode the cultural and social value of such texts. Thus they will be able to think and write in a critically informed manner about popular literature.
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Semester: 3	Paper Number: 7
Paper Code: HENCR3071T	Paper Title: British Poetry and Drama 17 <sup>th</sup> and 18 <sup>th</sup> Centuries
Course Objectives	The course will introduce students to British poetry and drama of the Seventeenth and Eighteenth centuries through both canonical and non-canonical texts, presenting poetic forms and styles in the epic and mock-epic and forms and developments in seventeenth century theatre through decadent drama and the comedy of manners. Studied within the literary, cultural and political context of the age, the texts provide insights into seventeenth century religious and secular thought, gender issues, the literary marketplace and the rise of the middle class.
Course Outcomes	The students would be tested with both long and short answer questions on each of the modules and therefore will have identified important speeches, passages. The students would also possess knowledge about the socio-political and economic and religious/secular background of the Restoration period followed by the Augustan or the Neo-classical age and the general trends and characteristics of the age that is reflected in literature. They have been exposed to different forms of writing like the epic and the mock-epic and will be able to distinguish these genres on the basis of their characteristic features vis-à-vis the texts.

Semester: 4	Paper Number: 8
Paper Code: HENCR4081T	Paper Title: British Literature 18 <sup>th</sup> century
Course Objectives	This course is designed to introduce students to Neoclassicism in literature while examining its connection to the social and cultural conditions of the age of Enlightenment. Representative texts present the range and variety of Neoclassical literature, enabling a study of forms and the attitudes and conventions which shape them. The syllabus covers Restoration comedy, eighteenth century prose satire, trends in eighteenth century poetry and the rise of the novel, and encourages a wider acquaintance with periodical literature.
Course Outcomes	At the end of the course students will have a clear conceptual understanding of Neoclassicism in literature. They will be able to apply their knowledge of Enlightenment ideas and the social and cultural conditions of the age to the analysis of representative texts. They will be able to recognise the forms, conventions and stylistic features of 18 <sup>th</sup> century drama, poetry and prose. They will be able to write critically about texts within their literary and cultural contexts.

Semester: 4	Paper Number: 9
Paper Code: HENCR4091T	Paper Title: British Romantic Literature
Course Objectives	The British romantic Movement occupies a significant place in the literary history of England. Through a close study of prescribed texts, students would explore the key constituent feature of British romantic writing: Conceptions

	of nature, solace in reconciliation with the natural world through art; revolt against the neo-classical aesthetics; renouncement of rationalism; celebrating the power of imagination and other lyrical experimentations.
Course Outcomes	Students would develop an understanding of the British Romantic Movement, through a close critical study of prescribed texts. The paper would also aid the students to develop an understanding of various issues connected with the world of nature and environment. Reading poems would encourage them to explore the healing power of imagination and the conception of the sublime. Students would also gain an understanding of allied issues of exploration of medievalism and the supernatural element.

Semester: 4	Paper Number: 10
Paper Code: HENCR101T	Paper Title: British Literature-19 <sup>th</sup> Century
Course Objectives	The course on 19th century British Literature aims to highlight the range of variety of fiction and poetry of the Romantic and Victorian period. The texts chosen from the two most creative and complex periods in literary history represent the multiple cross currents influencing the shaping of a specific sensibility. The students are expected to gain a critical understanding of the social, historical, economic and cultural milieu of the times with reference to issues such as gender, and identity formation, and forms of poetry like the dramatic monologue.
Course Outcomes	Upon completion of this course, the students will be more familiar with the social, political and economic issues related to post industrialized England. The first two modules of the paper which are on fiction will have informed the students about the manners of the time. Screening of adaptation of texts help students to form opinions about themes and characters. Module 3 is poetry which will have taught the students about styles of Victorian poetry. To ensure these outcomes there are several modes of assessments involved along with the end semester exams.

Semester: 5	Paper Number: 11
Paper Code: HENCR5111T	Paper Title: Women's Writing
Course Objectives	The course aims to familiarise the students with women's writings in multiple literary traditions. The course components are designed to enrich the students' understanding of the seminal issues in woman-centric texts. The course is structured to cater to the students' needs to acquaint themselves with the fundamental conceptual issues reflected through the many voices in woman-authored texts.
Course Outcomes	The course aims to enrich students' understanding of gender issues associated with the gender ideology of the authors located in diverse literary traditions. The evaluative methods are aimed to test the students' analytical skills with reference to the students' ability to think and interrogate the range and variety of issues in different literary texts.

Semester: 5	Paper Number: 12
Paper Code: HENCR5121T	Paper Title: British Literature-The Early 20 <sup>th</sup> Century
Course Objectives	The course is designed to situate Modernism in its historical and cultural context while indicating the factors that led to the development of its aesthetic practices and technical innovations. Through the study of key modernist writers and representative texts, students will be introduced to the modernist sensibility and the thematic concerns, forms and stylistic aspects of avant-garde writing. Particular emphasis will fall on the development of the

	psychological novel and the stream-of-consciousness novel. Yeats and Eliot define the tradition of modernist poetry. While the course focuses on the modernist literature of the early twentieth century discussions will indicate its role in shaping future developments and departures from high modernist tradition, to wit, post-modernism.
Course Outcomes	At the end of the course students will have an appreciation of the historical development of modernism and an acquaintance with its major writers and key texts. They will have an understanding of modernist features, techniques and stylistic practices. They will be able to relate this knowledge to their reading of texts to identify and analyse essential modernist qualities.

Semester: 6	Paper Number: 13
Paper Code	Paper Title: Modern European Drama
Course Objectives	This paper will introduce students to the modern artistic movements such as Realism and Naturalism, and the ideological movement called Existentialism and its offshoot Absurdism that held sway over Europe from mid-nineteenth century until mid-twentieth century. As the students acquire a good grounding into these modern trends, they will be introduced to Ibsen's 'Realistic Theatre,' Brecht's 'Political Theatre,' and Beckett's 'Absurdist Theatre.'
Course Outcomes	Students' familiarity with the European artistic and ideological trends from mid-nineteenth century until mid-twentieth century; and their comprehensive understanding of the theatres influenced by them.

Semester: 6	Paper Number: 14
Paper Code: HENCR6141T	Paper Title: Postcolonial Literatures
Course Objectives	The course offers a critical enquiry into the interaction between imperial culture and the complex indigenous cultural practices. The poems and fiction address all aspects of the colonial experience from the beginning of colonial contact. The concerned texts also highlight the overt or subtle forms of neo-colonial domination involving elements of migration, slavery, suppression, resistance, representation, difference, race, gender and nationality.
Course Outcomes	The course aims to expose students to the basic conceptual tenets of new literatures with reference to a variety of texts chosen from multiple cultures. It will enhance the students' critical understanding of the various phases of the postcolonial historical experience mediated through the works. The different evaluative methods will help the students interrogate the stereotypes associated with older models of writing and will enhance students' critical interrogation of experiments in context and form.

## II. COURSE: DISCIPLINE SPECIFIC ELECTIVE

Semester: 5	Paper Number: DSE 1
Paper Code: HENDS53	Paper Title: British Literature-Fiction and Poetry
Course Objectives	To expose and familiarise students with post-modernist British Literature. In course of studying the prescribed texts, the students will be encouraged to critically explore and discover new modes of experimentations in form and content (both in prose and verse). In the

	process of undertaking a nuanced reading of the prescribed texts they would also indirectly trace the evolution of the respective genres.
Course Outcomes	The students when evaluated will have an understanding of how the periods of modernism and postmodernism differ culturally and how there seemed to be a newness and experiment in the form, content and style. The presentation of the working class youth to metanarratives, the transition is visible. The students see a shift from the effect of the war, the loss, the alienation, the memory, the fragment and the postmodern ideas of irony, humour, playfulness, metafiction, neurosis and paranoia. These definite ideas would be understood vis-à-vis the poetry and the fiction.

Semester: 5	Paper Number: DSE 2
Paper Code: HENDS54	Paper Title: American Literature-Poetry and Fiction
Course Objectives	The course is designed to introduce the students to poetry and fiction in American literature. A selection of poetry and fiction has been carefully compiled to help the students understand the diversity of style and content which make the study of American Literature an enriching experience.
Course Outcomes	At the end of the course, the student will be able to trace the evolution of American literature from the late 19 <sup>th</sup> century to 20 <sup>th</sup> century modernism through representative poems, novels and short stories. The students are expected to read, analyse and discuss texts from a wide range of genres and forms and place the texts in the syllabus in the wider social, historical and cultural contexts of the times. The students will be able to identify formal and thematic features that make the texts characteristically ‘American’. They will also be able to identify the development of a truly indigenous American literature and discern the history and character of American modernism.

Semester: 6	Paper Number: DSE 3
Paper Code: HENDS63	Paper Title: Critical Thinking and Writing
Course Objectives	This course will introduce students to some important modern and post-modern literary theories, and teach them how to apply them while analysing and critiquing literary works so as to ignite their hermeneutical skills that are imperative for a comprehensive and in-depth understanding of complex literary works.
Course Outcomes	Student’s familiarity with some important modern and post-modern literary theories and their proficiency in applying them in order to analyse and critique literary works.

### III. COURSE: GENERIC ELECTIVE

Semester: 1 and 3	Paper Number: 1
Paper Code: HENGE1011T HENGE3031T	Paper Title: Academic Writing
Course Objectives	The course is designed to help the students enhance their skills in academic writing through a practice of analysis, synthesis and editing of passages. It will also help students take a critical approach towards literature and cinema through film and book review that may come in handy for those trying to pursue a career of it.



Course Outcomes	Students would be tested on their ability to identify and correct mistakes in the passage (editing) which ensures sound knowledge of grammar, spellings and punctuation. Additionally testing them with prose/verse analysis ensures that they have a template in mind, of the structure with which they are equipped to go for any critical reading. They are also familiarised with the rules for editing, writing reviews, critical analysis, so they can put these to use whenever required.
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Semester 2 and 4	Paper Number: 2
Paper Code: HENGE2021T HENGE4041T	Paper Title: An Introduction to British and Romantic Poetry
Course Objectives	The course is designed to introduce students to the range and variety of British and American poetry. The components in Module 1 orient the students to the theoretical conceptual issues such as poetry and its many elements. The theoretical exposition is supplemented with appropriate textual illustrations. Module 2 of the course includes poems chosen from the British and American poetic traditions. The poems highlight a plurality of issues such as the phenomena of the war, concepts of gender, race, politics and women's writings.
Course Outcomes	Both the modules in British and American poetry aim to familiarise the students with the primary creative impulse illustrated in selected poetic works. The evaluative methods have been designed to test the critical understanding gained through the analytical exercises done with relation to the chosen texts.

#### IV. COURSE: B.A. GENERAL

Semester: 2	Paper Number: 1
Paper Code: GENCR210	Paper Title: Language through Literature 1
Course Objectives	English literature being a resourceful and effective means to introduce non-native speakers of English to standard English, and creative ways of using it effectively, this course, through the study of carefully chosen literary works (novels, short stories and poems) will enhance the students' familiarity with and proficiency in standard English.
Course Outcomes	Students' enhanced familiarity with and proficiency in standard English.

Semester: 4	Paper Number: 2
Paper Code: GENCR410	Paper Title: Language through Literature 2
Course Objectives	The course aims to offer the students of B.A. General an extensive exposure to the understanding and practice of language through the literary texts selected for this purpose.
Course Outcomes	At the end of the course students will have developed reading strategies and comprehension skills suited to several genres of literary writing: the memoir, the short story, drama, the essay and the speech. They will be able to rewrite passages of the text creatively. They will have a greater grammatical competency and improved reading and elocution skills.

Semester: 5	Paper Number: 1
Paper Code: GENGE530	Paper Title: Literature & Language 1
Course Objectives	The choice of the plays for B.A. General was done keeping in mind their familiarity with the language of the playwright and those which

	would be exemplary in studying the thematic and stylistic characteristics of the genre, and the components as pointed out by Aristotle. The short story module is designed to give them exposure to a modern genre of writing and the creative writing component will help them learn about the features of the short story through their own experiments with the form. The poetry module is designed to acquaint them with as enormous a range and variety as possible, both in theme and form.
Course Outcomes	The students would have a correlation with the literary terms related to the drama by being tested on the two classic examples of the 5-act play. They would have not only theoretically approached the short stories but gone into the field practically. The students when tested with both long and short answer formats will give them a comprehensive understanding of a range of Romantic poetry to war poetry to the dramatic monologue.

Semester: 6	Paper Number: 2
Paper Code: GENGE630	Paper Title: Literature & Language 2
Course Objectives	The course will allow the students of B.A. General to acquire a comprehensive understanding of English Literature. A component of review and travelogue writing has also been included to help them improve their writing skills.
Course Outcomes	The students would have an understanding of the basic variations in theme and style that can be read through the selected texts. The Indian social context and milieu will appeal differently to the students having read fiction and poetry from this module. The module on book review, film review and travelogue writing would make them skilled to perceive the subject critically.

#### V. COURSE: ABILITY ENHANCEMENT LANGUAGE (MIL)

Semester: 2	Paper Number: --
Paper Code: CENAE2011T	Paper Title: Modern Indian Language (Alternative English)
Course Objectives	Since contemporary literature is a storehouse of the creative use of modern language, the study of modern English literature can enrich one's necessary linguistic competencies in Modern English language that one requires in daily practical life. Through short stories and poems, this course will innovatively unravel for the students the dynamics of English language and enhance their proficiency in the same.
Course Outcomes	Students' enhanced ability to understand the structure and subtleties of English language, and their augmented proficiency in the handling of the same language.

#### VI. B.A. GENERAL (NEW SYLLABUS)

Semester: 1	Paper Number
Paper Code	Paper Title: Literature I
Course Objectives	The course is designed to give exposure to the B.A. General students on a wide variety of texts that include excerpts from newspaper articles to fairy tales, from a travel diary to a comic strip. There is also an introduction to literature via a reading of excerpts from poems, plays as well as popular literature. The second and third modules are

	intended to introduce them to short fiction and novel and discuss the basic characteristics of each genre with regard to the text in concern.
Course Outcomes	Evaluation in this paper is differently styled as the students are tested on the language component in the mid-term assessment as the literature component in the end-semester. The language component prepares them to critically approach unseen passages. The students will have a thorough understanding of features like the plot, narrator and point of view, setting, character, as the basic elements of fiction.

Semester: 2	Paper Number
Paper Code	Paper Title: Literature II
Course Objectives	This course acquaints students with the novel and the short story through representative texts. It also discusses elements of poetry by taking up a wide variety of texts for discussion in class. It would explore the role of the poet, the nature of storytelling and genres like the folk ballad or the popular song. It would also analyse the different ways in which language can be utilized for poetic ends. This is meant to generate interest in literary techniques and poetic craft. It looks at the different ways in which a poet can choose from existing literary techniques to suitably convey the theme of the work. This will be supplemented by a detailed study of novels and short stories from the point of view of narrative techniques and primary thematic concerns. The texts in the modules on the novel and short story represent a wide selection, and will be studied in terms of both form and subject matter.
Course Outcomes	At the end of the course the student will have an understanding of the manner in which language is used, adapted and shaped in response to the requirements of the theme. A study of the different elements will lead to a keener appreciation of the role played by them in creating meaning in a text. The student will also have a basic understanding of how form can dictate artistic interpretation of subject matter. The student will have a detailed knowledge of how novels and short stories function in their treatment of a wide variety of thematic concerns. A detailed analysis of the texts will enable them to develop a basic critical acumen which will allow them to approach texts in a critically informed manner. The texts selected will also give the students a general understanding of how literary approaches have changed and evolved over time.

# MATHEMATICS

## *Course Outcome for the 14 Core papers in the CBCS Curriculum*

### **C1.1 Foundation in Calculus and Geometry [HMTCR1011T]**

- Discusses how Calculus models and controls real life systems as the study of continuous change to give us power over material world
- Explains how things may be broken up into smaller quantities to determine how small changes affects the whole
- Explains how first order ODE may be used in Compartmental Models to study physical phenomenon.
- Discusses an important application of integral calculus through solving typical definite integral problems with the help of reduction formulae.
- Familiarize students with practical application of calculus by calculating area under curves, finding length of plane curves and finding volume and surface area of solids of revolution.
- Enables students to handle geometrical entities like straight lines, planes, spheres, cone and cylinders.

### **C1.2 Foundation in Algebra [HMTCR1021T]**

- Theory of Equations serves historically as the concrete introduction to many mathematical abstract concepts, techniques and theories like Group Theory, Galois Theory.
- Acquaints students to Fundamental Theorem of Classical Algebra which states that complex numbers is algebraically closed assuring , in particular, [algebraic solutions](#) for the roots of [cubic](#) and [biquadratic polynomials](#)
- Introduces equivalence relation as a means of abstraction.
- System of homogeneous & inhomogeneous linear equations in 2/3 variables gives a geometric visualisation of what is going on in course of solving the system. This enables us to draw some analytical properties of vectors in  $R^2$  or  $R^3$  that are extendable to higher dimensional space  $R^n$  .
- Idea of rank of a matrix and its determination helps in checking consistency of any system of linear equations involving any number of unknowns. It also naturally paves way to the concept of linear dependence and independence of vectors in  $R^n$  .
- Linear transformations from  $R^n$  to  $R^m$  is fundamental to the study of linear algebra because any  $m \times n$  real matrix is the representation of a linear transformations from  $R^n$  to  $R^m$  w.r.to some ordered bases.

- Eigenvectors of a  $n \times n$  matrix tell us about possible existence of any invariant subspace of  $R^n$  and helps us to check its invertibility and also find its inverse whenever it exists by use of matrix polynomials.

### **C2.3 Real Analysis-I [HMTCR2031T]**

- First exposure to axiomatic definition of  $R$ , its ordering property & its completeness expected.
- Archimedean property introduced as a consequence of LUB axiom and its need in developing idea of convergence of real sequences emphasized.
- Imbibing the true meaning of convergence of real sequences and its equivalence to idea of Cauchyness in  $R$ .
- $\limsup$  &  $\liminf$  ideas of real sequences introduced to emphasise the fact that from every sequence a monotone sequence can be always extracted.
- To render the notion that convergence of series is a direct follow up of the convergence of real sequences and that all tests of convergence of positive term series is a consequence of comparison tests.
- Convergence of arbitrary term series is either conditional or absolute. Absolute convergence is stable as it's not susceptible to rearrangement while the conditional convergence is unstable as it may get disturbed once rearrangement is executed. Thus difference in nature of convergence of a series is to be clarified through examples.

### **C2.4 Differential Equations-I and Group Theory-I [HMTCR2041T]**

- Basic idea of equivalent relation, partition of a set and binary operations.
- Concept of Groups and its basic properties associated to the binary operation, order of a group an element of a group and concept of subgroup.
- Examples of different types of groups, abelian, non-abelian, cyclic, roots of unity, matrix groups
- Application of Group theory in Number Theory.
- To familiarize with  $2^{\text{nd}}$  and higher order linear ordinary differential equation with constant coefficient and coefficient as a function of  $x$ . Also system of ODE.
- To learn various methods of solving and to find general solution.
- To learn existence and uniqueness of solution of system of ODE and various methods of solving specially for two dependent variable.
- To learn application to S.H.M.

### **C3.5 Real Analysis-II [HMTCR3051T] [PD]**

- Learning the concept of calculus namely the limit, continuity of real valued functions.
- Studying differentiability of real valued functions defined on an arbitrary subset of the set of real numbers.

- Using the sequential method in the study of calculus.
- Learning the salient properties and important theorems of continuity defined on intervals and its applications.
- Learning the salient properties and important theorems of differentiable functions defined on intervals and application.
- Learning the salient properties of differentiable functions, extreme value and series expansion of differentiable functions.

### **C 3.6 Group Theory-II and Linear Algebra-I [HMTCR3061T]**

- Concept of group identification via homomorphism, isomorphism related results.
- Concepts of normal subgroup, quotient group, product groups.
- Analyzing groups via Cauchy's theorem, Cayley's theorem, direct product etc.
- Study of Important subgroups like normalizer centralizer center, kernel etc.
- Learning about abstract vector spaces and their dimension.
- Learning linear transformations between abstract vector spaces and their matrix representations with respect to ordered bases.
- Learning about the rank-nullity theorem and its application.

### **C3.7 Differential equations-II and Mechanics [HMTCR3071T]**

- To study non- linear differential equation qualitatively and get acquainted with stability and phase plane diagram.
- To study total differential equation.
- To study first order PDE and its genesis and geometrical interpretation using Monge's cone.
- To learn Lagrange's method for solving first order PDE .
- Course of vector algebra is designed to act as a prerequisite to the study of mechanics, especially to statics component involving forces in 2D and 3D acting on a rigid body. Moment of a force about a point and about a line and linear dependence /independence of vectors in  $R^3$  are given main thrust.
- Problems involving one dimensional motion under variable forces and gravity and modelled resisting medium are exposed as direct applications of first and second order differential equations. Variety of problems is solved to see how the boundary conditions control the physics involved.
- Conditions of translational and rotational equilibrium of forces in 2D and 3D acting on a rigid body are determined. Idea of astatic equilibrium of forces in 2D is studied to

check the stability of equilibrium. Vector treatment is preferred to emphasize the frame independence of physics.

#### **C4.8: Probability Theory and Multivariate Calculus [HMTCR4081T]**

- Introduction to the idea of an random experiment and introduce “probability” as a quantification of uncertainty by means of the doublet (Sample space, sigma-algebra).
- To study the classical definition / approach to probability thereby solving finite sample spaces with equally likely outcomes problems using combinatorial approach.
- To give an acquaintance with the axiomatic development of probability theory by A.N.Kolmogorov [i.e. introduce probability as a particular type of (totally) finite measure] and develop an induced probability space by introducing random variable as a measurable function.
- To introduce the idea of distribution function of a random variable and study probability distributions of some discrete and continuous random variates.
- Learning continuity and differentiability of functions with more than one variable and knowing the derivative as a linear transformation.
- Learning the Inverse Function theorem and Implicit Function theorem and their geometric application.
- Learning about the extremum of more than one variable function.

#### **C4.9: Riemann Integration and Metric Spaces-I [HMTCR4091T]**

- Different notions of Integrations: Darboux, Riemann, Newton, equivalences and differences.
- Concepts of Partition, refinement, algebra of Riemann integrability
- Connection of integrability with continuity, concepts of measure, mean value theorem and Fundamental theorem of Calculus
- Improper Integration and definitions of log, gamma and Beta functions.
- Altering order of integrals for two variables, commutativity of integration with continuity differentiability.
- Learning and application of: topology of metric spaces,
- Geometrical view in metric space.
- Concept of convergence of a sequence and completeness.

#### **C 4.10 Ring Theory-I and Linear Algebra-II [HMTCR4101T]**

- The course introduces Ideals as generalization of, say, subset of even integers of the set of integers that is closed under addition and multiplication by an integer and its use in formation of quotient ring much in line with formation of quotient group.

- It discusses The Chinese Remainder theorem over a [principal ideal domain](#) and hints at how it can be generalized, using ideals, to any [commutative ring](#).
- The course includes the isomorphism theorems that describe the relationship between [quotients](#), [homomorphisms](#), and subrings.
- The course introduces the Cayley–Hamilton theorem, which is an effective tool for computing the minimal polynomial of algebraic integers.
- It discusses diagonalizability of a linear operator in connection with its minimal polynomial.
- The course discusses the Gram-Schmidt orthogonalisation process which allows obtaining an orthonormal basis of a given vector space starting from an arbitrary basis to conveniently compute expansions of arbitrary vectors within that space.

#### **C :5.11 Numerical Methods( Theory and Practical)[HMTCR5112T+HMTCR5112P]**

- Learning different type of error and its source and propagation.
- To be acquainted with different linear operators like  $\Delta$   $\nabla$   $\delta$   $\mu$   $E$ .
- To estimate value of unknown function and its derivative and corresponding error management.
- To find the value of an integral whose analytical solution is not known.
- To solve transcendental equation and linear system of equations and corresponding error estimation.
- To be acquainted with various technique of solving ODE.
- To understand the numerical method of finding eigen value and eigen vector of a matrix by Power series method.

#### **C.5.12 : Vector Calculus and Ring Theory-II [ HMTCR5121T]**

- Polynomial rings and their basic properties.
- Concept of factorization in rings with study of ID, UFD, PID and ED and their inter-relations
- Application of ring theory in Number Theory.
- Vector calculus course designed to visualise the interrelationship between vector ,linear algebra and functions of several variables by defining differentiability of vector functions.
- Arc length parameterisation & orientability of curves studied as it is basic to study of line & surface integrals.
- Distinction between irrotational and conservative vector fields and connection with exact & non exact linear odes to be explored.
- Application oriented treatment of classical integral theorems of vector calculus,including Fundamental Theorem, Green's theorem, Stokes' theorem & divergence theorem to promote problem solving ability.



### C 6.13 Differential Equations-III and Metric Spaces-II. [HMTCR6131T]

- To learn the existence and uniqueness of solutions of ODE.
- To study the classifications of second order PDE and their simple methods of solutions.
- To study some simple Cauchy problems and their geometric insights.
- Learning and application of concept of Continuity
- Concept of compactness with reference to metric space and it is preserved under homeomorphisms.
- Concept of connectedness with reference to metric space and it is preserved under homeomorphisms.

### C 6.14: Series and Sequences of Functions and Complex Analysis [HMTCR6141T]

- Explains how concept of uniform convergence helps formation of many theorems of [functional analysis](#), such as the [Weierstrass approximation theorem](#) and some results of [Fourier analysis](#); and how it we can be used to construct a [nowhere-differentiable continuous function](#).
- Discusses how passage to limit under uniform convergence preserves desirable properties like continuity, integrability and (with additional hypotheses) differentiability of constituent functions and how it allows term-by-term integration and differentiation of a series of functions which has several use in application
- Explains how concept of uniform convergence allows defining well-known functions in terms of power series and how their salient properties can be derived using term-by-term integration and differentiation.
- This course introduces Complex Analysis as one of the classical branches in mathematics which has useful application in many branches of mathematics, including [algebraic geometry](#), [number theory](#) and [analytic combinatorics](#).
- It introduces Complex Analysis (as compared to real analysis) having a wealth of beautiful and surprising results which are often strikingly different from results about analogous concepts for functions of a real variable, e.g. if  $f:G \rightarrow \mathbb{C}$  ( $G$  open) is differentiable at all points of  $G$ , then  $f$  is not only continuous as in the real case, but  $f$  is automatically differentiable infinitely often in  $G$ .
- Counter to our intuition (and not having a counterpart in Real Analysis), the course discusses Cauchy's integral formula which surprisingly expresses the value of a holomorphic function at an interior point of a disc in terms of the values on the circumference: Knowing just a tiny bit of a holomorphic function is enough to determine it in a much bigger set.
- It studies Holomorphic functions exhibiting some remarkable features. For instance, [Picard's theorem](#) asserts that the range of an entire function can only take three possible forms:  $\mathbb{C}$ ,  $\mathbb{C} \setminus \{z_0\}$ , or  $\{z_0\}$  for some complex  $z_0$ .

### *Course Outcome for Skill Enhancement Courses*

#### SEC3.1: Computer Programming with C language [HMTSE3021T+ HMTSE3021P]

- To be acquainted with basics of Computer.

- To study C programming Language.
- To develop the skill of writing basic programming like sum of finite and infinite series.
- To learn to find sequence and its convergence using computer programme.
- To learn to use one and two dimensional array.
- To find various quantity like product, trace etc of matrices using C.
- To introduce various method for solving first order ODE numerically using C.

#### **SEC4.1 R programming [HMTSE4022T+HMTSE4022P]**

- To familiarize students how to run R( Interactive mode and Batch mode)
- Introduction to functions: variable space, default arguments. and preview of some important R data structures ( Vectors, Character Strings, Matrices, Lists, Data Frames , Classes)
- Introduction to Vectors: Scalars, Vectors, Arrays and Matrices
- To write functions in R and applying them to sampling distributions and simulation problems.
- Studying Linear Models and application to Statistical Inference.

### ***Course Outcome for Department Specific Electives***

#### **DSE5.1: A.: Linear Programming and Game Theory [HMTDS5011T]**

- Explains the role of LPP in modelling diverse types of problems in [planning](#), [routing](#), [scheduling](#), [assignment](#), and design.
- Discusses basic assumptions of LPP with emphasis on linearity of constraints and objective function and discusses, through examples, the non-linear case.
- Discusses how historically ideas from linear programming have inspired many of the central concepts of optimization theory, such as *duality*, *decomposition*, *convexity* and its generalizations.
- Discusses economical and intelligent Simplex Method to solve LPP
- Explains how LPPs always occur in maximization-minimization dual pairs and its application to Transportation Problem , Assignment problem and Game Theory
- Introduces Game theory as the study of mathematical models of strategic interaction in between rational decision-makers and discusses its applications in different fields of social sciences

#### **DSE 5.1: B: Topology & Functional Analysis [HMTDS5011T]**

- Learning and application of. Topological Space as generalization of metric spaces

- Study of compactness, connectedness, completeness with reference to topological spaces and their (non-) preserving nature under continuity and homeomorphism
- Countability and separation properties with reference to topological spaces and their (non-) preserving nature under continuity and homeomorphism
- Comparison between (a) linear space and normed linear space and (b) finite and infinite dimensional NLS.
- Criteria of closed and bounded subsets of an n.l.s. to be compact in terms of dimensionality of the space
- Equivalent criteria of continuity of linear transformations

#### **DSE 5.1: C: Discrete Mathematics [HMTDS5011T]**

- To learn basic principles of counting process.
- To learn Fundamental quantities of Graph Theory
- Motivation of Graph Theory and its application from algebraic and combinatorial point of view.
- To be acquainted with coding theory.
- To learn some advanced coding technique like Reed Solomon code and BCH code.
- To apply coding in real life like on security of communication.

#### **DSE-5.2: A: Advanced Algebra [HMTDS5021T]**

- To learn the group action as a tool for counting and applying it in the context of group theory.
- To learn about the product of groups
- To learn about the partial break through on the converse of Lagranges theorem.
- Learning the simplicity of  $A_n$ ,  $n \geq 5$ .
- Learning some computational aspects of number theory.
- Basics of field extension.

#### **DSE 5.2: B: Advanced Probability Theory and Statistics [HMTDS5021T]**

- To familiarize the students with the probability distribution of an n dimensional random vector through the n dimensional distribution function and studying its properties.
- Introduction to functions of n dimensional random variables and finding their probability distributions either in form of joint p.m.f. or p.d.f.
- Introduction of Covariance to study the interdependence between random variables and to study the connection between uncorrelated and independent random variables.
- To introduce the idea of regression curves through conditional expectation and use principle of least squares to study regression lines, curves etc.
- To introduce the concept of convergence of a sequence of random variables and study different forms of convergence, to get acquainted with the law of large numbers by dint of certain moment inequality and study Central –limit theorem along with applications.

- To introduce the concept of sampling and sample (empirical) distribution function and to study sampling distributions of different statistics.
- To introduce the idea of point as well as interval estimation and the theory of testing of hypotheses as an introductory exposition to statistical inference.

### **DSE 5.2: C: Theory of Measure and Integration [HMTDS5021T]**

- To learn the measurable sets and the existence of non-measurable sets.
- To learn measurable functions
- To learn the theory of Lebesgue Integration and its basic differences with the Riemann integration.
- To learn the interaction of Lebesgue Integration with the convergence of sequence of functions.
- To learn about  $L^p$  spaces.
- To learn about the Borel sigma algebra and Borel measure.

### **DSE-6.3: A: Differential Geometry of Curves and Surfaces [HMTDS6031T]**

- To study Plane Curves, space Curves and parametrized curves.
- Learning Curvature of plane curves and space curves.
- To get acquainted with Serret-Frenet formula.
- To study curvature of surfaces and its various forms when surfaces are embedded in three dimensional Euclidean spaces.
- To study vector fields, integral curves and geodesics.
- To study Gauss-Bonnet theorem.

### **DSE-6.3: B: Advanced Mechanics [HMTDS6031T]**

- Two dimensional motion is studied looking into Cartesian system, polar coordinate system and tangent-normal system as manifestation of different choices of basis of  $\mathbb{R}^2$ .
- Problem specific basis choice realization is the primary goal. Motion in a resisting medium is a direct use of Cartesian system. The study of central orbit through polar coordinates and its stability through manifestation of effective potential is another objective. Constrained motion is studied as an application of tangent-normal system.
- Solving variety of simple problems to explore physical insight of the problem
- Translation and rotational motion of a rigid body is seen as evolving from Isometry in  $R^3$ .

- Vectorial treatment done in developing the subject as it helps treat motion in 2D and in 3D on the same footing and tools of linear algebra used in the treatment of inertia matrix and its physical findings.
- Equations of motion of a rigid body derived from D'Alembert's principle. Motion about a fixed axis, compound pendulum and motion in 2D studied as its particular applications.
- Principles of conservation of linear momentum, angular momentum and energy under finite forces studied.

### **DSE-6.3: C: Logic and Set Theory [HMTDS6031T]**

- Axiomatic first order predicate logic will be introduced
- Getting acquainted with the meaning of truthfulness, validity soundness of a set.
- Axioms of equality with examples in Groups fields etc
- Model of the axioms of Number Theory
- Syntactic derivations in the theory of numbers.
- Zermelo Fraenkel Choice Axiom
- Idea of class model, ordinal numbers
- Cardinal arithmetic, continuum hypothesis
- Equivalence of Choice and Zorn's Lemma and its applications.

### **DSE-6.4 [Project Paper]**

- To promote the idea of self- learning among the students.
- To provide an opportunity to learn beyond the syllabus thereby getting exposed to higher Mathematics.
- To increase the communication skill and getting acquainted with audio-visual skills.
- To enable students to gain academic independence.
- To provide a proper orientation to students to pursue research in Mathematics.
- To promote team work as well as group activity.

### ***Course Outcomes for the Generic Elective:***

#### **GE1 (GE3) Introduction to Algebra and Calculus [HMTGE1011T/HMTGE3031T]**

- Learning simplified expression for rational power of a complex number.
- To solve cubic and biquadratic equation and properties related to that.
- Equivalence relation and partition and their connection.
- To be acquainted with different type of function and binary relation.
- To understand real number system and its properties specially least upper bound axiom.
- To be acquainted with notion of sequence and series in connection with convergence and various methods to investigate.
- To learn continuity derivatives and properties related to it.

- To introduce notion of improper integral and application to Beta Gamma functions.

## **GE 2 (GE4) Advanced Algebra and Calculus [HMTGE2021T/HMTGE4041T]**

- To study the concept of matrix and determinant over real or complex numbers of arbitrary finite order, in particular, symmetric and skew-symmetric matrices, Orthogonal, Unitary & Hermitian matrices and its applications.
- Evaluation of determinant (Laplace's method) and studying consistency and solution of system of linear equations.
- To study definition, examples, elementary properties of group and subgroup, concept of external binary operation, vector space, linear dependence and independence of finite set of vectors, basis and dimension.
- To get acquainted with Cayley-Hamilton Theorem and the process of reduction of real quadratic form to its normal form.
- To study Rolle's and MVTs (Lagrange and Cauchy) and their applications, Taylor's and Maclaurin's finite and infinite series expansion of elementary functions and their use in determining optimum value of real valued function of real variable.
- To introduce the idea of limit, continuity, partial derivatives and differentiability of function of two real independent variables, Euler's theorem on homogeneous differentiable functions and the process of finding optimum of function of not more than three independent variables along with constrained optimization.
- To study formation of ODE, introduction of first order first degree ode both exact and non-exact forms and studying integrating factors for non-exact differential equations.

To study first order higher degree differential equations and linear second order differential equations by the method of variation of parameters.

### **Programme Specific Outcome:**

- **Mathematical techniques help to understand and control the physical universe around us.**
- **Exposing students to the arena of higher Mathematics.**
- **Inculcating the inherent abstraction of Mathematics along with the computational aspects.**
- **Making students aware of the ability to find similarity among seemingly different premises.**
- **Increasing analytical and critical thinking thereby making people rational.**
- **Helps in interlinking of computational and abstract mathematical objects.**
- **Giving an opportunity to inculcate the passion and love for the essence of Mathematics.**
- **Helping students in interlinking / interconnecting with other fields of study.**
- **Preparing students for pursuing their career in diverse fields such as data-science, artificial intelligence /machine learning, quantum computation to name a few.**

# MICROBIOLOGY

## **Programme Outcome: Annexure I**

PO1: Extensive knowledge of Classical Microbiology

PO2: Hands on training of microbiological laboratory

PO3: Microbes handling skills

PO3: Extensive knowledge of molecular biological techniques used in research works

PO4: Critical thinking

PO5: Hands on training in Biochemical analysis needed for diagnostic technician purposes

PO6: Social interaction for database collection regarding diseases

PO7: Knowledge on medicines and therapies

PO8: Medical approach

PO9: Industrial knowledge

PO10: Scientific Ethics

PO11: Knowledge of Environmental degradation and possible remedies from microbiological aspects

PO12: Development of Entrepreneurship skill

PO13: Self learning and coordination in lab based work

PO14: Research aptitude towards novel and innovative works

## **Programme specific outcome: -Annexure II**

- To know the introductory microbiology and microbial diversity
- To know the bacteriology including the nutrition patterns and structural characters
- To know the Bioenergetics, macromolecular biochemistry, thermodynamics related to metabolic pathways
- Characterization of biogeochemical cycle and waste management
- Characterization of anerobic and aerobic respiration
- understanding of cell biological processes including cell cycle, cellular transport and cellular architecture
- Understanding of the central dogma and gene regulation of the prokaryotes and eukaryotes
- Understanding of genetic exchange in bacteria
- PO 9: Characterization of structure and functions of viruses
- Understanding of food spoilage and food borne diseases and the use of microbes in food industry.

- Understanding of different types of bioreactors and downstream process for purification of products in case of industrial microbiology
- Understanding of immune system, hypersensitivity
- Characterization of different microbial diseases and possible therapies.
- Knowing different applications of recombinant DNA technology

Programmes are given below:

**Course: Discipline Specific Core**

Semester	1
Paper Number	HMBCR1012T/P
Paper Title	<b>Introduction to Microbiology and Microbial Diversity</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4;Pr: 3
Evaluation	CIA: 20 End-Sem:80 (Th:50 and Pr:30) Question paper format of Th paper (Mod 1 & 2: 25 Marks each) For each module: Objective questions 5 marks (5 questions out of 7) 2 questions of 10 marks each (2 questions out of 3)

Semester ____	1
Paper Number	HMBCR1022T/P
Paper Title	<b>Bacteriology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Evaluation	CIA: 20 End-Sem:80 (Th:50 and Pr:30) Question paper format of Th paper (Mod 1 & 2: 25 Marks each) For each module: Objective questions 5 marks (5 questions out of 7) 2 questions of 10 marks each (2 questions out of 3)

Semester ____	2
Paper Number	HMBCR2032T/P
Paper Title	<b>Biochemistry</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Evaluation	CIA: 20 End-Sem:80 (Th:50 and Pr:30)



	<p>Question paper format of Th paper (Mod 1 &amp; 2: 25 Marks each)</p> <p>For each module:</p> <p>Objective questions 5 marks (5 questions out of 7)</p> <p>2 questions of 10 marks each (2 questions out of 3)</p>
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Semester ____	2
Paper Number	HMBCR2042T/P
Paper Title	<b>Environmental Microbiology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4, Pr: 3
Evaluation	<p>CIA: 20</p> <p>End-Sem: 80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1: 30 Mod 2: 20 Marks)</p> <p>Module 1 with 30 marks:</p> <p>Objective questions 6 marks (6 questions out of 8)</p> <p>3 questions of 8 marks each (3 questions out of 4)</p> <p>Module 2 with 20 marks:</p> <p>Objective questions 4 marks (4 questions out of 6)</p> <p>2 questions of 8 marks each (2 questions out of 3)</p>

#### Course: Discipline Specific Core

Semester ____	3
Paper Number	HMBCR3052T/P
Paper Title	<b>Microbial Physiology and Metabolism</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4, Pr: 3
Evaluation	<p>CIA: 20</p> <p>End-Sem:80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1 &amp; 2: 25 Marks each)</p> <p>For each module:</p> <p>Objective questions 5 marks (5 questions out of 7)</p> <p>2 questions of 10 marks each (2 questions out of 3)</p>

Semester ____	3
Paper Number	HMBCR3062T/P
Paper Title	<b>Cell biology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Evaluation	CIA: 20

	End-Sem:80 (Th:50 and Pr:30) Question paper format of Th paper (Mod 1: 30 Mod 2: 20 Marks) Module 1 with 30 marks: Objective questions 6 marks (6 questions out of 8) 3 questions of 8 marks each (3 questions out of 4) Module 2 with 20 marks: Objective questions 4 marks (4 questions out of 6) 2 questions of 8 marks each (2 questions out of 3)
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Semester ____	3
Paper Number	HMBCR3072T/P
Paper Title	<b>Molecular Biology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Evaluation	CIA: 20 End-Sem:80 (Th:50 and Pr:30) Question paper format of Th paper (Mod 1: 20 Marks Mod 2: 30 marks) Module 1 with 20 marks: Objective questions 4 marks (4 questions out of 6) 2 questions of 8 marks each (2 questions out of 3)  Module 2 with 30 marks: Objective questions 6 marks (6 questions out of 8) 3 questions of 8 marks each (3 questions out of 4)

Semester ____	4
Paper Number	HMBCR4082T/P
Paper Title	<b>Microbial Genetics</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Evaluation	CIA: 20 End-Sem: 80 (Th:50 and Pr:30) Question paper format of Th paper (Mod 1: 20 Marks Mod 2: 30 marks) Module 1 with 20 marks: Objective questions 4 marks (4 questions out of 6) 2 questions of 8 marks each (2 questions out of 3)

	Module 2 with 30 marks: Objective questions 6 marks (6 questions out of 8) 3 questions of 8 marks each (3 questions out of 4)
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Semester ____	4
Paper Number	HMBCR4092T/P
Paper Title	<b>Virology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4.Pr: 3
Evaluation	CIA: 20 End-Sem:80 (Th:50 and Pr:30) Question paper format of Th paper (Mod 1 & 2: 25 Marks each) For each module: Objective questions 5 marks (5 questions out of 7) 2 questions of 10 marks each (2 questions out of 3)

Semester ____	4
Paper Number	HMBCR4102T/P
Paper Title	<b>Food and Dairy Microbiology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Evaluation	CIA: 20 End-Sem: 80 (Th:50 and Pr:30) Question paper format of Th paper (Mod 1 & 2: 25 Marks each) For each module: Objective questions 5 marks (5 questions out of 7) 2 questions of 10 marks each (2 questions out of 3)

Semester ____	5
Paper Number	HMBCR5112T/P
Paper Title	<b>Industrial Microbiology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4,Pr: 3
Evaluation	CIA: 20 End-Sem: 80 (Th:50 and Pr:30)

	<p>Question paper format of Th paper (Mod 1: 30 Mod 2: 20 Marks)</p> <p>Module 1 with 30 marks:</p> <p>Objective questions 6 marks (6 questions out of 8)</p> <p>3 questions of 8 marks each (3 questions out of 4)</p> <p>Module 2 with 20 marks:</p> <p>Objective questions 4 marks (4 questions out of 6)</p> <p>2 questions of 8 marks each (2 questions out of 3)</p>
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Semester ____	5
Paper Number	HMBCR5122T/P
Paper Title	<b>Immunology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4, Pr: 3
Evaluation	<p>CIA: 20</p> <p>End-Sem: 80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1 &amp; 2: 25 Marks each)</p> <p>For each module:</p> <p>Objective questions 5 marks (5 questions out of 7)</p> <p>2 questions of 10 marks each (2 questions out of 3)</p>

Semester ____	6
Paper Number	HMBCR HMBCR6132T/P
Paper Title	<b>Medical Microbiology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4, Pr: 3
Evaluation	<p>CIA: 20</p> <p>End-Sem: 80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1: 20 Mod 2: 30 Marks)</p> <p>Module 1 with 20 marks:</p> <p>Objective questions 4 marks (4 questions out of 6)</p> <p>2 questions of 8 marks each (2 questions out of 3)</p> <p>Module 2 with 30 marks:</p> <p>Objective questions 6 marks (6 questions out of 8)</p> <p>3 questions of 8 marks each (3 questions out of 4)</p>

Semester ____	6
Paper Number	HMBCR6142T/P
Paper Title	<b>Recombinant DNA technology</b>

No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4, Pr: 3
Evaluation	<p>CIA: 20</p> <p>End-Sem: 80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1: 30 Mod 2: 20 Marks)</p> <p>Module 1 with 30 marks:</p> <p>Objective questions 6 marks (6 questions out of 8)</p> <p>3 questions of 8 marks each (3 questions out of 4)</p> <p>Module 2 with 20 marks:</p> <p>Objective questions 4 marks (4 questions out of 6)</p> <p>2 questions of 8 marks each (2 questions out of 3)</p>

### Course: Discipline Specific Elective

Semester ____	5
Paper Number	HMBDS5012T/2P
Paper Title	<b>Bioinformatics and Biostatistics</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4, Pr: 3
Evaluation	<p>CIA: 20</p> <p>End-Sem:80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1 &amp; 2: 25 Marks each)</p> <p>For each module:</p> <p>Objective questions 5 marks (5 questions out of 7)</p> <p>2 questions of 10 marks each (2 questions out of 3)</p>

### Course: Discipline Specific Elective

Semester ____	5
Paper Number	HMBDS5022T/2P
Paper Title	<b>Chemical biology, instrumentation and biotechniques</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4,Pr: 3
Evaluation	<p>CIA: 20</p> <p>End-Sem:80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1 &amp; 2: 25 Marks each)</p> <p>For each module:</p> <p>Objective questions 5 marks (5 questions out of 7)</p> <p>2 questions of 10 marks each (2 questions out of 3)</p>

### Course: Discipline Specific Elective

Semester ____	6
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Paper Number	HMBDS6032T/2P
Paper Title	<b>Inheritance Biology</b>
No. of Credits	6 (Th:4, Pr:2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Evaluation	<p>CIA: 20 End-Sem:80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1 &amp; 2: 25 Marks each) For each module: Objective questions 5 marks (5 questions out of 7) 2 questions of 10 marks each (2 questions out of 3)</p>

**Course: Discipline Specific Elective**

Semester ____	6
Paper Number	HMBDS6043D
Paper Title	<b>Project</b>
No. of Credits	6
Theory/Composite	Theory
Name of Faculty member(s)	All faculty members
Evaluation	<p>CIA: 20 End-Sem:80 :</p>

**Course: Skill enhancement (Semester 3)**

Semester ____	3
Paper Number	HMBSE3011T
Paper Title	<b>Biosafety and intellectual property rights</b>
No. of Credits	2
Theory/Composite	Theory
No. of periods assigned	Th: 2
Evaluation	<p>CIA: 20 End-Sem: 80 Objective questions 20 marks (10x2) (10 questions out of 12) 6 questions of 10 marks each (6 questions out of 8)</p>

**Course: Skill enhancement (Semester 4)**

Semester ____	4
Paper Number	HMBSE4022T/2P
Paper Title	<b>Biofertilizer and Biopesticide</b>
No. of Credits	2
Theory/Composite	Composite
No. of periods assigned	Th: 1 Pr: 2
Evaluation	CIA: 20 End-Sem:80 (Th:50 and Pr:30)  Objective questions 10 marks (5x2) (5 questions out of 7) 4 questions of 10 marks each (4 questions out of 6)

## Generic elective

Semester ____	3
Paper Number	HMBGE3032T/2P
Paper Title	<b>Introductory Microbiology</b>
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th: 4, Pr: 2
Evaluation	<p>CIA: 20 End-Sem:80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1: 30 Mod 2: 20 Marks) Module 1 with 30 marks: Objective questions 6 marks (6 questions out of 8) 3 questions of 8 marks each (3 questions out of 4)</p> <p>Module 2 with 20 marks: Objective questions 4 marks (4 questions out of 6) 2 questions of 8 marks each (2 questions out of 3)</p>

## Generic Elective:

Semester ____	4
Paper Number	HMBGE4042T/2P
Paper Title	Microbes and Environment
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th: 4; Pr: 2



Evaluation	<p>CIA: 20</p> <p>End-Sem:80 (Th:50 and Pr:30)</p> <p>Question paper format of Th paper (Mod 1 &amp; 2: 25 Marks each)</p> <p>For each module:</p> <p>Objective questions 5 marks (5 questions out of 7)</p> <p>2 questions of 10 marks each (2 questions out of 3)</p>
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# EDUCATION

## Program Specific Objective(PSO)

1. To make the course professional and practical
2. To bring about effective integration of different units of knowledge and corresponding training essentials for future teachers.
3. To make the trainee teachers competent to meet the social, academic and national needs.
4. To develop in the trainee teachers a positive attitude towards life in general and teaching in particular.
5. To bring about all round development of trainee teachers to meet the challenges of the modern era.
6. To inculcate in the trainee teachers a sense of discipline, develop their moral values and awaken in them a thirst for knowledge.
7. To motivate the trainee teachers to inspire and guide the future generations.
8. To equip the trainee teachers with the skills needed in the age of Globalization, Liberalization and Privatization

## Course Objective (CO)

Semester	I
Paper Code	CG41012T
Paper Title	CHILDHOOD AND GROWING UP [1ST & 2ND HALF]
No. of Credits	4
Theory / Composite	Composite
No of periods assigned	72 (60 teaching hours)
Course descriptions/ Objectives	This course is designed to expose the students to the various factor, concept and theories related to growth and development and stages of development of children with special emphasis on the stage of adolescence.

### Course Objectives of the Paper CG41012T

The student teachers will be able to,

1. Explain the concept of growth and development and stages of development with special reference to the stage of adolescence.
2. Know about the developmental characteristics
3. Be aware of influence of heredity, environment including socio-cultural factors on developmental process
4. Develop the skills of applying the principles of development in improving the teaching learning process.
5. Know about various aspects related to development.
6. Acquainted with theories, types and factors of motivation, attention and interest.
7. Understand the nature of intelligence and know various theories related to it.
8. Develop skills for identifying and nurturing creativity.

Semester	I
Paper Code	CG41012P
Paper Title	CHILDHOOD AND GROWING UP [1ST & 2ND HALF]
No. of Credits	1

Theory / Composite/ Practicum	Practicum
No of periods assigned	36 (30 teaching + field engagement hours)
Course descriptions/ Objectives	The students are expected to learn the process of case study and do it with taking a case related to school and learners.

#### Course Objectives of the Paper CG41012P

The student teachers will be able to:

1. Understand the concept and process of case study.
2. Engage them in doing a case study.

Semester	I
Paper Code	AL41022T
Paper Title	ASSESSMENT FOR LEARNING [1 <sup>ST</sup> & 2 <sup>ND</sup> HALF]
No. of Credits	4
Theory / Composite	Theory
No of periods assigned	72 (60 teaching hours)
Course descriptions/ Objectives	The students are expected to learn about various kinds of assessment technique and application along with simple computation using statistics in first half and in second half they will be engaged in learning about various resources related to school system and its management.

#### Course Objectives of the Paper : AL41022T

The student teachers will be able to:

1. Get basic knowledge of assessment for learning.
2. Know the process of evaluation and its uses.
3. Write educational objectives.
4. Know different techniques of evaluation, tools of evaluation and their uses.
5. Know different characteristics of instruments of evaluation.
6. Know different types of teacher made tests and will construct them.
7. Compute simple statistics to assess the learning.
8. Understand different aspects of the complexities of the learning system.
9. Know various school records designed for specific purposes.
10. Understand the relationship between school and the community.
11. Acquire knowledge about physical, infrastructural and human resources available in the schools.
12. Understand the curricular process in the school.
13. Evaluate the school effectiveness and other functional aspects of the schools.
14. Explore the students support services available and achievements of the schools.

Semester	I
Paper Code	AL41022P
Paper Title	ASSESSMENT FOR LEARNING [1 <sup>ST</sup> & 2 <sup>ND</sup> HALF]
No. of Credits	1
Theory/practicum	Practicum
No of periods assigned	36 (30 hours for field engagement and teaching)

Course descriptions/ Objectives	The students are expected to write an Achievement Test
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Course Objectives of the Paper: AL41022P

The student teachers will be able to:

1. Write an Achievement Test following the format.

Semester	I
Paper Code	LC41032T
Paper Title	LANGUAGE ACROSS THE CURRICULUM
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	36 (30 teaching hours)
Course descriptions/ Objectives	This paper is designed to expose the students to the importance of language behind teaching any subject and importance and effectiveness of first and second language, multilingualism on precise.

Course Objectives of the Paper:LC41032T

The student teachers will be able to:

1. Recognize nature, function and role of language across the curriculum
2. Acquaint with obstacles in language usage while using the language and ways to overcome them.
3. Understand importance and use of first and second language, multilingualism and impact of culture.
4. Acquire knowledge about the communication process and verbal and nonverbal communication skills.
5. Familiarize the students with of barriers to (Listening, Speaking, Reading, Writing) LSRW skills and activities for developing these skills)

Semester	I
Paper Code	LC41032P
Paper Title	LANGUAGE ACROSS THE CURRICULUM
No. of Credits	2
Theory / Practicum	Practicum
No of periods assigned	72 (60 field engagement and teaching hours)
Course descriptions/ Objectives	The students are expected to apply the theoretical knowledge of language in preparing a presentation and writing a term paper.

Course Objectives of the Paper:LC41032P

The student teachers will be able to:

1. Prepare a presentation on issue related to language or use of it teaching learning process.
2. Write a term paper on issue related to language.

Semester	I
Paper Code	SU41042T
Paper Title	YOGA EDUCATION: SELF UNDERSTANDING AND DEVELOPMENT

No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	36 (30 TEACHING HOURS)
Course descriptions/ Objectives	The students will be introduced yoga, yogic practices, yogic texts, yoga and health along with the self-concept and self-esteem

#### Course Objectives of the Paper: SU41042T

The student teachers will be able to:

1. Understand the meaning and importance of self-concept and self-esteem.
2. Be aware of different factors related to self-concepts and self-esteem.
3. Understand the concept and importance of yoga and well-being.
4. Be sensitized about the interrelationships of yoga and well-being.
5. Record a brief history of development of yoga through the ages.
6. Discuss how yoga and yoga practices are important for healthy living.
7. Explain some important principles of yoga.
8. Know and develop their personality through various practices.

Semester	I
Paper Code	SU41042P
Paper Title	YOGA EDUCATION: SELF UNDERSTANDING AND DEVELOPMENT
No. of Credits	2
Theory / Practicum	Practicum
No of periods assigned	72 (60 hours of teaching and engagement in field work)
Course descriptions/ Objectives	The students are expected to do student activity followed by report writing

#### Course Objectives of the Paper: SU41042P

The student will be able to:

1. Perform student activity followed by report writing

Semester	I
Paper Code	DA41052T
Paper Title	DRAMA AND ARTS IN EDUCATION
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	36 (30 teaching hours)
Course descriptions/ Objectives	This course is designed to introduce the concept of arts (performing and visual) and drama to future teachers along with the various forms of it so that the students can understand the importance of it in human life and culture and use it during teaching.

#### Course Objectives of the Paper: DA41052T

The student will be able to:

1. Understand the use of 'Drama' as Pedagogy.
2. Use 'Role play' technique in the teaching learning process.

3. Understand the importance of dramatic way of presentation.
4. Integrate singing method in teaching learning process.
5. Understand various 'Dance forms' and their integration in educational practices.
6. Use art of drawing and painting in teaching learning process.
7. Develop creativity through different creative art forms.
8. Understand the efficacy of different art forms in education.

Semester	I
Paper Code	DA41052P
Paper Title	DRAMA AND ARTS IN EDUCATION
No. of Credits	2
Theory / Practicum	Practicum
No of periods assigned	72 (60 hours of teaching and engagement in field work)
Course descriptions/ Objectives	The students are expected to do student activity followed by report writing using the theoretical knowledge of this specific course.

#### Course Objectives of the Paper: DA41052P

The student will be able to:

1. Do student activity followed by report writing using the theoretical knowledge of this specific course.

Semester	II
Paper Code	LT42012T
Paper Title	LEARNING AND TEACHING [1ST & 2ND HALF]
No. of Credits	4
Theory / Practicum	Theory
No of periods assigned	72 (60 teaching hours)
Course descriptions/ Objectives	This course is designed to make the students aware of different concept and theories related to learning and teaching so that they can use it during teaching learning process in real classroom situation

Course Objectives of the Paper:

The student will be able to:

1. Comprehend the range of cognitive capacities among learners.
2. Reflect on their own implicit understanding of the nature and kinds of learning.
3. Gain an understanding of different theoretical perspectives on learning
4. Demonstrate his/her understanding of different skills at different phases of instruction
5. Understand the process of teaching
6. Understand and efficiently used different models of teaching.
7. Engage in teaching with proper approach.
8. Develop skills required for teaching

Semester	II
Paper Code	LT42012P
Paper Title	LEARNING AND TEACHING [1ST & 2ND HALF]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	36 (30 hours of teaching and engagement in field work)
Course descriptions/ Objectives	The students are expected to demonstrate their teaching in a simulated situation in front of their peers and teacher educator along with preparing a file on the same.

Course Objectives of the Paper:

The student will be able to:

1. Demonstrate their teaching in a simulated situation in front of their peers and teacher educator along with preparing a file on the same.

Semester	II
Paper Code	PS42052T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [LANGUAGE]
No. of Credits	2
Theory / Practicum	THEORY
No of periods assigned	36 (30 TEACHING HOURS)
Course descriptions/ Objectives	The course is designed to expose students to various methods and approaches of teaching LANGUAGE, skills and various practical aspects of LANGUAGE as a teaching subject.

Course Objectives of the Paper: PS42052T

The student will be able to,

Semester	II
Paper Code	PS42052P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [LANGUAGE]
No. of Credits	1
Theory / Practicum	PRACTICUM
No of periods assigned	36 (30 TEACHING HOURS+ ENGAGEMENT IN FIELD WORK)
Course descriptions/ Objectives	The students are expected to apply the theoretical knowledge related to language to do an activity followed by report writing.

Course Objectives of the Paper: PS42052P

The student will be able to,

1. Do activity followed by report writing.

Semester	II
Paper Code	PS42032T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [SOCIAL SCIENCE]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	36 (30 teaching hours)
Course descriptions/ Objectives	The course is designed to expose students to various methods and approaches of teaching SOCIAL SCIENCE, skills and various practical aspects of social science as a teaching subject.

Course Objectives of the Paper PS42032T

The student will be able to :-

- Appreciate the significance of teaching Social Science.
- Be acquainted with the approaches & Methods of Teaching Social Science.
- Be used to the application of knowledge and skills in Social Science.
- Be acquainted with various practical aspects of Social Science.
- Acquire practical expertise in pedagogical analysis and develop behavioural competencies in teaching skills



- Apply principles abstracted from the study of various methods and approaches as regards purpose and procedure of planning lesson.
- Become efficient in construction of Test and Test Items
- Be aware of teaching & learning of the subject concern.
- Examine critically the major concept, ideas, principles & values relating the subject concern.
- Engage the students into the methods of Teaching & learning the subject.
- Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	II
Paper Code	PS42032P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [SOCIAL SCIENCE]
No. of Credits	1
Theory / Practicum	PRACTICUM
No of periods assigned	36 (30 teaching + field engagement hours)
Course descriptions/ Objectives	The course is designed to expose students to various methods and approaches of teaching social science, skills and various practical aspects of science as a teaching subject.

Course Objectives of the Paper: PS42032P

The students will be able to,

1. Do activity followed by report writing.

Semester	II
Paper Code	PS42032T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [SCIENCE]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	36 (30 teaching hours)
Course descriptions/ Objectives	The course is designed to expose students to various methods and approaches of teaching science along with the practical application of scientific knowledge and skills and various practical aspects of science as a teaching subject.

Course Objectives of the Paper: PS42032T

The student will be able to,

1. Appreciate the significance of teaching Science.
2. Be acquainted with the Approaches & Methods of Teaching Science.
3. Be used to the application of scientific knowledge and skills.
4. Be acquainted with various practical aspects of science.

Semester	II
Paper Code	PS42032P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [SCIENCE]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	36 (30 teaching + field engagement hours)

Course descriptions/ Objectives	The students are expected to do student activity followed by report writing like preparation of working model for teaching science.
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Course Objectives of the Paper: PS42032P

The student will be able to,

1. Prepare a working model for teaching science followed by writing a report on the same.

Semester	II
Paper Code	PS42042T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [MATHEMATICS]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	36 (30 teaching hours)
Course descriptions/ Objectives	The course is designed to expose students to various methods and approaches of teaching mathematics along with the practical application of mathematical knowledge and skills and various practical aspects of mathematics as a teaching subject

Course Objectives of the Paper: PS42042T

The student will be able to,

1. Appreciate the significance of teaching Mathematics.
2. Be acquainted with the Approaches & Methods of Mathematics Science.
3. Be used to the application of Mathematical knowledge and skills.
4. Be acquainted with various practical aspects of Mathematics.

Semester	II
Paper Code	PS42042P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – I [MATHEMATICS]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	36 (30 teaching + field engagement hours)
Course descriptions/ Objectives	The students are expected to apply the theoretical knowledge related to mathematics to do an activity followed by report writing.

Course Objectives of the Paper: PS42042P

The student will be able to,

1. Do activity followed by report writing.

Semester	II
Paper Code	SI42511P
Paper Title	SCHOOL INTERNSHIP
No. of Credits	4
Theory / Practicum	PRACTICUM
No of periods assigned	120 Hours of engagement in internship school
Course descriptions/ Objectives	The students are expected to learn about the various processes and system followed in the school including observation of teaching learning process, and other activities in school.

Course Objectives of the Paper: SI42511P

The student will be able to,

1. Learn of actual teaching process by observing their respective subject's class.
2. Participate in various curricular activities.
3. Participate in various co-curricular activities.
4. Learn about administrative process and support system of school.

Semester	II
Paper Code	KC42032T
Paper Title	KNOWLEDGE AND CURRICULUM PART – I
No. of Credits	2
Theory / Practicum	THEORY
No of periods assigned	30 HOURS
Course descriptions/ Objectives	The Course is designed to make the students aware of Epistemological bases of Education, Philosophical and Sociological bases of Education, concepts and scope of education and dynamics of curriculum development.

Course Objectives: KC42032T

The students will be able to:

1. Introduce themselves to perspectives in education focusing on epistemological, philosophical and sociological bases of education.
2. Distinguish between knowledge and skill, teaching and training, knowledge and information and reason and belief.
3. Understand education in relation to constitutional goal, social issues and modern values.
4. Understand the concept, scope and objectives of education.
5. Realize the concepts of curriculum and syllabi.
6. Design curriculum in the context school experiences, evaluation, power, ideology, process and practice & its transactional modes.

Semester	II
Paper Code	KC42032T
Paper Title	KNOWLEDGE AND CURRICULUM PART – I
No. of Credits	2
Theory / Practicum	PRACTICUM
No of periods assigned	60 hours of teaching and engagement with the field work
Course descriptions/ Objectives	The students are expected to prepare a project on the basis of the theoretical knowledge of paper ‘KNOWLEDGE AND CURRICULUM PART – I’

Course Objectives: KC42032P

The students will be able to:

1. Prepare a project.

Semester	II
Paper Code	CI42042T
Paper Title	Contemporary India and Education
No. of Credits	4
Theory / Practicum	THEORY
No of periods assigned	60 TEACHING HOURS
Course descriptions/ Objectives	The course is designed to make the students aware and learn about the Educational provision in the Constitution of India, Recommendations of various commissions after independence, Equalization and universalization of Elementary and Secondary Education, Inequality, Discrimination and Marginalization in education and Issues of Contemporary relevance and National Values.

Course Objectives of the Paper: CI42042T

The student will be able to,

1. Comprehend the various constitutional provisions
2. Develop the knowledge about the recommendations of various commissions and National Policies of Education.
3. Examine the problems and solutions of elementary and secondary education and find out probable solution.
4. Acquire the skill to eradicate inequality, discrimination and marginalization in education.
5. Develop an idea about National Values
6. Realize the policy framework for Education in India
7. Know the contemporary issues in education
8. Develop the knowledge about various policies on education
9. Examine the role and functions of different monitoring agencies of education
10. Understand community participation and development in education
11. Acquire skill to develop educational planning and management.

Semester	II
Paper Code	CI42042P
Paper Title	Contemporary India and Education

No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 teaching and engagement with field hours
Course descriptions/ Objectives	The students are expected to conduct an action research on any contemporary issues related to school education.

Course Objectives of the Paper: CI42042P

The student will be able to,

1. Conduct an action research on any contemporary issues related to school education.

Semester	II
Paper Code	RR42052T
Paper Title	READING AND REFLECTING ON TEXTS
No. of Credits	2
Theory / Practicum	THEORY
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to learn the importance and process of reading and developing reading skill.

Course Objectives of the Paper: RR42052T

The student will be able to,

1. Know the meaning, process, importance and characteristics of reading.
2. Appreciate and apply different levels, types, techniques and methods of reading.
3. Acquaint with the skills of reading different types of texts.
4. Develop different types of reading skills through various activities and metacognition
5. Learn the skills of reading comprehension and to enhance vocabulary.
6. Acquaint with the problems of reading across curriculum

Semester	II
Paper Code	RR42052P
Paper Title	READING AND REFLECTING ON TEXTS
No. of Credits	1
Theory / Practicum	PRACTICUM
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected to do activity followed by report writing.

Course Objectives of the Paper: RR42052P

The student will be able to,

1. To do activity followed by report writing.

Semester	III
Paper Code	PS43012T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [BENGALI]
No. of Credits	2
Theory / Practicum	THEORY
No of periods assigned	30 TEACHING HOURS

Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in language, evaluation in language education.
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Course Objectives of the Paper: PS43012T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43012P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [BENGALI]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43012P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43022T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [ENGLISH]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in language, evaluation in language education.

Course Objectives of the Paper: PS43022T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43022P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [ENGLISH]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43022P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43032T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [GEOGRAPHY]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in geography and evaluation.

Course Objectives of the Paper: PS43032T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43032P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [GEOGRAPHY]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43032P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43042T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [HINDI]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in language, evaluation in language education.

Course Objectives of the Paper: PS43042T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be



component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43042P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [HINDI]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43042P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43052T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [HISTORY]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in history and evaluation.

Course Objectives of the Paper:

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43052P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [HISTORY]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43052P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43062T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [LIFE SCIENCE]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in life science and evaluation.

Course Objectives of the Paper: PS43062T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43062P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [LIFE SCIENCE]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43062P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43072T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [MATHEMATICS]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in mathematics and evaluation.

Course Objectives of the Paper: PS43072T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43062P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [MATHEMATICS]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43062P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43082T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [PHYSICAL SCIENCE]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in physical science and evaluation.

Course Objectives of the Paper: PS43082T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.

3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43082P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [PHYSICAL SCIENCE]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43082P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43092T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [POLITICAL SCIENCE]
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in political science and evaluation.

Course Objectives of the Paper: PS43092T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43092P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART – II [POLITICAL SCIENCE]
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD

Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII
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Course Objectives of the Paper: PS43092P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code	PS43102T
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART - II [ECONOMICS]
No. of Credits	2
Theory / Practicum	THEORY
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	The students are expected to acquire knowledge of pedagogical analysis, learning design, activities in economics and evaluation.

Course Objectives of the Paper: PS43102T

The student will be able to,

1. Be aware of teaching & learning of the subject concern.
2. Examine critically the major concept, ideas, principles & values relating the subject concern.
3. Engage the students into the methods of Teaching & learning the subject.
4. Provide the students authentic historical knowledge with the proposed content & make them to be component to do pedagogical analysis of the subject.

Semester	III
Paper Code	PS43102P
Paper Title	PEDAGOGY OF A SCHOOL SUBJECT PART - II [ECONOMICS]
No. of Credits	1
Theory / Practicum	PRACTICUM
No of periods assigned	HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected use the acquired knowledge of the respective theory paper in preparing a concept mapping and writing an pedagogical analysis on either Class IX-X or XI-XII

Course Objectives of the Paper: PS43102P

The student will be able to,

1. Prepare a concept map
2. Write a pedagogical analysis on either Class IX-X or XI-XII

Semester	III
Paper Code(s)	SI43511P, SI43521P, SI43531P, SI43541P, SI43551P, SI43561P, SI43571P, SI43581P, SI43591P, SI43601P
Paper Title(s)	SCHOOL INTERNSHIP [Bengali, English, Geography, Hindi, History, Life Science, Mathematics, Physical Science, Political Science, Economics]

No. of Credits	14
Theory / Practicum	Practicum
No of periods assigned	420 hours of engagement in school
Course descriptions/ Objectives	The students are expected to take class in school along with participate in various curricular, co-curricular and administrative activity in school.

Course Objectives of the Paper(s): SI43511P, SI43521P, SI43531P, SI43541P, SI43551P, SI43561P, SI43571P, SI43581P, SI43591P, SI43601P

The student will be able to,

1. Take class in school with approved learning design
2. Participate in various curricular, co-curricular and administrative activity in school.

Semester	IV
Paper Code	GS44012T
Paper Title	GENDER, SCHOOL AND SOCIETY
No. of Credits	2
Theory / Practicum	THEORY
No of periods assigned	30 TEACHING HOURS
Course descriptions/ Objectives	This course is designed to aware the students about the concept related to gender and gender studies, how the issue is addressed in curriculum and its relation with school and society.

Course Objectives of the Paper: GS44012T

The student will be able to,

1. Develop gender sensitivity among the studentteachers.
2. Understand the gender issues faced by the schools.
3. Understand the paradigm shift with reference to gender studies.
4. Understand how gender, power and sexuality relate to education (in terms of access, curriculum and pedagogy).

Semester	IV
Paper Code	GS44012P
Paper Title	GENDER, SCHOOL AND SOCIETY
No. of Credits	1
Theory / Practicum	PRACTICUM
No of periods assigned	30 HOURS OF TEACHING AND ENGAGEMENT WITH FIELD
Course descriptions/ Objectives	The students are expected to perform presentation in class on any relevant issue related gender, society and school.

Course Objectives of the Paper: GS44012P

The student will be able to,

1. Perform a presentation on issue related to gender, society and school.

Semester	IV
Paper Code	KC44022T
Paper Title	Knowledge and Curriculum-Part-II
No. of Credits	2
Theory / Practicum	Theory

No of periods assigned	36 (30 teaching Hours)
Course descriptions/ Objectives	This course is designed to expose the students to the concept of curriculum, relationship of among curriculum framework, curriculum and syllabi. This course will help the students to understand the process of curriculum design, its types, evaluation and various factors related to curriculum along its relation with power and structure of society.

Course Objectives of the Paper: KC44022T

The student teachers will be able to:-

1. Realize the concepts of curriculum and syllabi.
2. Discover the relationship between power, ideology and curriculum.
3. Design curriculum in the context of school experiences, evaluation, power, ideology, process and practice & its transactional modes.

Semester	IV
Paper Code	KC44022P
Paper Title	Knowledge and Curriculum-Part-II
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 hours of teaching and engagement with field
Course descriptions/ Objectives	The students are expected to do an activity followed by report writing.

Course Objectives of the Paper: KC44022P

The student will be able to,

1. To do an activity followed by report writing on any relevant issue related to curriculum.

Semester	IV
Paper Code	IS44032T
Paper Title	CREATING AN INCLUSIVE SCHOOL
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	36 (30 teaching Hours)
Course descriptions/ Objectives	This course is designed to make the students learn about the importance of creation of inclusive school, legal and policy perspective of inclusive school, learners with special needs, Teacher preparation for inclusive school:

Course Objectives of the Paper: IS44032T

The student will be able to,

1. Sensitize to the concept of inclusive education and social inclusion
2. Familiarize with the legal and policy perspectives behind inclusion in education
3. Understand the types, probable causes, preventive measures and characteristics of different types of disability.
4. Understand street children, platform children, and orphans, children born and brought up in correctional homes, child labour and other Socio-economically backward children.
5. Know how inclusion can be practiced in mainstream class.

Semester	IV
Paper Code	IS44032P
Paper Title	CREATING AN INCLUSIVE SCHOOL
No. of Credits	1
Theory / Practicum	Practicum
No of periods assigned	30 hours of teaching and engagement with field
Course descriptions/ Objectives	The students are expected to conduct a case study on any relevant issue related to inclusive school.

Course Objectives of the Paper: IS44032P

The student will be able to,

1. Conduct a case study on any relevant issue related to inclusive school.



Semester	IV
Paper Code	HP44042T
Paper Title	HEALTH AND PHYSICAL EDUCATION
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 teaching hours
Course descriptions/ Objectives	This is an optional paper. This course is designed to expose the students to the various factor, concept and theories related to health issues and physical education.

Course Objectives of the Paper: HP44042T

The student will be able to,

1. Build a scenario of Health Education in India.
2. Develop a Knowledge Base of the Most Common and Uncommon Diseases in India; their Diagnosis & Remediation.
3. Learn the Tech Related Health Risks & Learn How to Fix These.
4. Study the Health Education Vision & Mission of India.

Semester	IV
Paper Code	HP44042P
Paper Title	HEALTH AND PHYSICAL EDUCATION
No. of Credits	2
Theory / Practicum	Practicum
No of periods assigned	60 teaching hours and engagement with field
Course descriptions/ Objectives	The students are expected to do prepare One Inventory and to perform an activity followed by report writing

Course Objectives of the Paper: HP44042P

The student will be able to,

1. Prepare One Inventory, and
2. Perform an activity followed by report writing.

Semester	IV
Paper Code	PE44042T
Paper Title	PEACE EDUCATION
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 teaching hours
Course descriptions/ Objectives	This is an optional paper. The students are expected to learn various concepts related to peace and value education along with the methods and process of evaluation of value education.

Course Objectives of the Paper: PE44042T

The student will be able to,

1. Understand the meaning and role of peace education and value education in present context.
2. Understand the components of peace education.
3. Understand different perspectives of peace education.
4. Be acquainted with methods and evaluation of value education.

Semester	IV
Paper Code	PE44042P
Paper Title	PEACE EDUCATION
No. of Credits	2
Theory / Practicum	Practicum
No of periods assigned	60 teaching hours and engagement with field
Course descriptions/ Objectives	The students are expected to do prepare One Inventory and to perform an activity followed by report writing

Course Objectives of the Paper: PE44042P

The student will be able to,

1. Prepare One Inventory, and
2. Perform an activity followed by report writing.

Semester	IV
Paper Code	GC44042T
Paper Title	GUIDANCE AND COUNSELLING
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 teaching hours
Course descriptions/ Objectives	This is an optional paper. The students are expected to learn about the various concepts related to guidance and counseling, mental health, adjustment & maladjustment abnormal behaviour and mental illness.

Course Objectives of the Paper: GC44042T

The student will be able to,

1. Understand guidance and counseling in details
2. Understand the mental health
3. Develop the knowledge about adjustment and maladjustment.
4. Acquire skill to develop tools and techniques.
5. Understand the idea about Abnormal Behaviour and Mental illness.

Semester	IV
Paper Code	GC44042P
Paper Title	GUIDANCE AND COUNSELLING
No. of Credits	2
Theory / Practicum	Practicum
No of periods assigned	60 teaching hours and engagement with field
Course descriptions/ Objectives	The students are expected to do project work and submit a file on the same on the basis of the related knowledge of the theoretical paper.

Course Objectives of the Paper: GC44042P

The student will be able to,

1. Do a project work and submit a file on the same on the basis of the related knowledge of the theoretical paper.

Semester	IV
Paper Code	EP44042T
Paper Title	ENVIRONMENTAL AND POPULATION EDUCATION
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 teaching hours
Course descriptions/ Objectives	This is an optional paper. This course is designed to expose the students to the various factor, concept, theories, policies and issues related to environmental and population education.

Course Objectives of the Paper: EP44042T

The student will be able to,

1. Understand the concept of population and environmental education.
2. Know the objectives and methods of teaching environmental and population.
3. Be aware of population and environmental education policies.
4. Help teachers students analyse the various issues related to population and environmental education.

Semester	IV
Paper Code	EP44042P
Paper Title	ENVIRONMENTAL AND POPULATION EDUCATION
No. of Credits	2
Theory / Practicum	PRACTICUM
No of periods assigned	60 teaching hours and engagement with field
Course descriptions/ Objectives	The students are expected to conduct an action research on any relevant issue related to environmental and population education.

Course Objectives of the Paper: EP44042P

The student will be able to,

1. Understand the concept and process of action research.
2. Execute Action Research in regard to the topic such as school, administration, learners' as well teaching learning process.

Semester	IV
Paper Code	IC44052T
Paper Title	CRITICAL UNDERSTANDING OF ICT
No. of Credits	2
Theory / Practicum	THEORY
No of periods assigned	30 teaching hours
Course descriptions/ Objectives	This course is designed to understand the social, economic, security and ethical issues associated with the use of ICT and develop various skills to use computer technology, software system and elucidate the application of ICT for Teaching Learning.

Course Objectives of the Paper: IC44052T

The student will be able to,

1. Understand the social, economic, security and ethical issues associated with the use of ICT
2. Identify the policy concerns for ICT
3. Describe a computer system;
4. Operate the Windows and/or Linux operating systems;
5. Use Word processing, Spread sheets and Presentation software;
6. Acquire the skill of maintaining the computer system and the skill of trouble shooting with the help of Anti-Virus and Other tools.
7. Operate on Internet with safety
8. Elucidate the application of ICT for Teaching Learning
9. Develop various skills to use computer technology for sharing the information and ideas through the Blogs and Chatting groups

Semester	IV
Paper Code	IC44052P
Paper Title	CRITICAL UNDERSTANDING OF ICT
No. of Credits	2
Theory / Practicum	PRACTICUM
No of periods assigned	60 teaching hours and engagement with field
Course descriptions/ Objectives	The students are expected to learn the process of Project and do it with taking a particular topic related to theory of critical understanding of ICT

Course Objectives of the Paper: IC44052P

The student will be able to,

1. Understand the concept and process of Project.
2. Engage them in doing a Project.

Semester	IV
Paper Code	UD44062T
Paper Title	UNDERSTANDING DISCIPLINE AND SUBJECTS
No. of Credits	2
Theory / Practicum	Theory
No of periods assigned	30 teaching hours
Course descriptions/ Objectives	This course is designed to make the students aware of the concept 'discipline' as an academic term, various kinds of discipline and development and importance of language, science, social science and mathematics as specific discipline.

Course Objectives of the Paper: UD44062T

The student will be able to,

1. Know the basis of knowledge and branches of emerging knowledge.
2. Be aware of the emergence of various disciplines
3. Develop among the teacher-trainees and understanding of science as a discipline.
4. Understand nature of Mathematics as a discipline.
5. Develop among the teacher trainees an understanding of language as a discipline.
6. Develop among the teacher trainees an understanding of social science as a discipline.

Semester	IV
Paper Code	UD44062P
Paper Title	UNDERSTANDING DISCIPLINE AND SUBJECTS
No. of Credits	2
Theory / Practicum	Practicum
No of periods assigned	60 teaching hours and engagement with field
Course descriptions/ Objectives	The students are expected to understand the process of doing project and prepare a project on any relevant topic.

Course Objectives of the Paper: UD44062P

The student will be able to,

1. Understand the process of doing project
2. Prepare a project on any relevant topic.

# PHYSICS

## Programme Specific Outcome (PSO)

### *Course Objectives for CBCS in Physics*

The essential objective of the Choice-Based-Credit-System in Physics at St. Xavier's College (Autonomous) is to cultivate knowledge about the fundamental laws and phenomena as well as that occur in various branches in Physics and to generate awareness about their deep interconnections and mathematical harmony. In the different semesters, the students are introduced to various subject areas – Mathematical Methods, Mechanics, Thermal Physics, Electricity & Magnetism, Waves & Optics, Electronics etc. to the more advanced areas like Quantum Mechanics, Statistical Physics, Solid State Physics - to name a few. The students have the privilege to choose skill-based and discipline-specific elective subjects from a pool of subjects offered to them.

Beginning with a brief introduction to each course, the students are exposed to the fundamental concepts and the related laws. This helps them to apply these theories in solving numerical and analyse real problems in Physics. The courses equip the students to learn laboratory skills, enabling them to perform experiments in the laboratory and, in some courses, also acquire computational skills along with numerical simulation. In the laboratory-based courses, students study the experimental set-up, record and process data, analyse the result with relevant outcomes. The dissertation in the final semester is a project, theoretical, experimental or computational that enables the student learn and understand a new area, often not included in the undergraduate course. This gives them the opportunity to explore, study and understand advanced and challenging problems in Physics. The courses aim at broadening the horizon of the students and encourages them to take up the subject at an advanced level, in future.

## Annexure 2

### Course Outcome(CO)

## Semester-I

Core Paper 1: [HPHCR1012T](#) Mathematical Physics I:

- 1) To familiarize the students with different types of differential equations.
- 2) To teach them the aspects connected to the existence and uniqueness of their solutions.
- 3) To teach them how to form differential equations for various problems of physics and other fields.
- 4) To teach them how to solve these equations analytically and interpret the results.
- 5) To teach them how to find the extremum of a function of more than one variables.
- 6) To teach them some important features of the probability theory.
- 7) To teach them various probability distribution functions and applications.
- 8) To teach them the properties of Dirac delta function and its applications.
- 9) This course is an exposition on vectors in three dimensions in the right handed rectangular co-ordinate system and how they serve as one of the primary mathematical tools for expressing physical concepts quantitatively.
- 10) It aims at relating vectors to the concepts of symmetry, invariances under rotation, translation, reflection or parity and conservation laws in physics.
- 11) We also try to incorporate the language of indices and index notation for vectors and thus facilitate a student to become comfortable in this compact form of notation. This will also allow him/her to make a foray into tensors, tensor algebra and calculus with ease at a later stage.
- 12) At a later stage the course aims at exposing a student to vector calculus and how physical principles are related to vector calculus theorems.
- 13) It introduces a student to the concepts of continuum fields and how scalar and vector fields can be used to represent physical quantities.
- 14) Finally, the course ends with a short foray into generalizing vectors and their treatment in generalized orthogonal curvilinear co-ordinates, with special emphasis on spherical polar and cylindrical polar co-ordinate systems. The aim of this is to make a student equipped to exploit the natural geometrical symmetry of a problem to simplify the formulation and thus the solution of it.

Core Paper 2: [HPHCR1022T](#) Mechanics :

Mechanics is one of the most important foundation areas in physics. A proper exposure helps the student in strengthening ideas to study the phenomenology of physics and other related disciplines. In the following course, the student

- 1) Acquires a thorough understanding of the principles of Newtonian Mechanics through reviewing the plus 2 level knowledge like Newton's laws of motion, free body diagram etc.
- 2) Gets familiar with the ideas of Galilean transformation and Reference frames.
- 3) Is able to understand the conceptual intricacies of both linear and rotational motion.
- 4) Understands the energy approach to solve problems and use of lab frame in simplifying many collision problems.
- 5) Being empowered with the tools, can take up future courses on Advanced level.
- 6) Provide a basic idea on classical Mechanics and its application for the undergraduate students

## Semester-II

Core Paper 3: [HPHCR2032T](#) Electricity & Magnetism :



The objectives of the course are as follows :

- 1) To teach the basic principles in Electrostatics and Electrodynamics to the students.
- 2) To help the students learn the basic laws.
- 3) To familiarize the students with the various applications of the related laws.
- 4) To discuss the theoretical background of the experiments in the practical paper.
- 5) To enhance problem solving capacity.
- 6) To enable the students to acquire a comprehensive knowledge and understanding in this field.
- 7) The broad objective of this course is to make students understand the physics of Electrostatic fields and potentials and be aware of its application in different areas of science.
- 8) A mathematical treatment starting from fundamental theories like Coulomb's law and Gauss' law is introduced.
- 9) The Laplace's and Poisson equations along with the applications are discussed.
- 10) The understanding of Uniqueness theorem is introduced.
- 11) The electrostatic polarization of charges in a dielectric material and the application of this phenomenon in the capacitors of various geometries, and thereby estimating the energy stored in those systems.
- 12) The vector relation between  $E$ ,  $P$  and  $D$  and Gauss' law in dielectric is introduced.

Core Paper 4: [HPHCR2042T](#) Waves & Optics :

- 1) The broad objective of this course is to make students understand the physics of waves and to be aware of its application in different areas of science. The students extend this concept to understand different optical phenomena in the optics part of this course.
- 2) A mathematical treatment starting from simple harmonic motion to the superposition of two waves along the same line, along perpendicular directions along with Lissajous figures is covered.
- 3) The wave equation is studied and the concept of the plane progressive wave is introduced. Longitudinal waves as well as transverse waves are covered.
- 4) The understanding of standing waves along with the modes and energy of such waves is also introduced in this course.
- 5) The concept of coherence is introduced. The phenomena in optics which can be explained by the wave nature of light uses the above knowledge to mathematically explain the observed effects due to interference and diffraction.
- 6) Application in interferometers and their advantages are covered. The understanding of the phenomenon of diffraction and application of diffraction gratings are also dealt with in some detail. Resolving power of some instruments and their importance is also highlighted.
- 7) The basic principle behind the phenomenon of holography is introduced to the students.

### **Semester-III**

Core Paper 5: [HPHCR3052T](#) Mathematical Physics II :

This course deals with the methods of solving second order Ordinary Differential Equations (ODE)'s, partial differential equations (PDE)'s and linear systems of ODE's and offers an overview of their application in physics.

On completion of this course, the students will be able to do the following:

- 1) Describe the applications of differential equations in Physics.
- 2) Obtain power series solutions about ordinary points of second order linear ODE's.
- 3) Solve linear, second order ODE's with variable coefficients using the Frobenius method and recall the classical functions (Bessel, Laguerre, etc.).
- 4) Perform operations with Bessel, Legendre, Hermite and Laguerre differential equations along with the corresponding recurrence formulas of different functions.
- 5) Use the Wronskian to determine if a set of functions is linearly independent or not.
- 6) Demonstrate their understanding of how physical phenomena are modeled by second order differential equations and dynamical systems.
- 7) Solve linear PDE's using the method of separation of variables.
- 8) Solve the wave equation for vibration of stretched strings and membranes.
- 9) Analyse the phenomenon of diffusion and solve mathematically the diffusion equation.
- 10) The discussion on beta and gamma functions will prepare a student to handle special kind of integrals which occur frequently in physics.
- 11) The subpart on theory of errors will provide very useful insights on the measure of dependability of an experiment.
- 12) The theory of errors will also expose a student in the correct way of graphical representation of the experimental data.
- 13) The subpart on variational calculus will introduce the idea of Lagrangian and Hamiltonian formulation as a parallel formulation to Newtonian mechanics.
- 14) The students will be exposed to the concept of Legendre transformation used in various areas of physics, most commonly in classical mechanics and thermodynamics.
- 15) The subpart on Fourier series will equip the students to apply this technique in the relevant areas and will teach them to appreciate the power and efficiency of this technique.

Core Paper 6: [HPHCR3062T](#) Thermal Physics :

- 1) The broad objective of this course is to make students understand the principles of Thermodynamic and to be aware of its application in different areas of science.
- 2) Zeroth law of thermodynamics and concept of temperature, extensive and intensive variables, concepts of heat and work is introduced.
- 3) The 1<sup>st</sup> law of thermodynamics and it's applications in various processes
- 4) Reversible and irreversible processes, Carnot efficiency and refrigerator is introduced.
- 5) The 2<sup>nd</sup> law of thermodynamics, the concept of entropy and the 3<sup>rd</sup> law of thermodynamics is discussed.
- 6) Thermodynamic Potentials and 1<sup>st</sup> and 2<sup>nd</sup> order phase transitions is discussed.  
In the second module of the course student will learn about
- 7) Maxwell Boltzmann distribution of velocities.
- 8) Degrees of freedom and law of equipartition of energy
- 9) molecular collisions
- 10) Transport phenomena in ideal gases
- 11) Van der Waal's equation of state
- 12) law of corresponding states
- 13) Low temperature physics
- 14) Maxwell's thermodynamic relations and its applications

Core Paper 7: [HPHCR3072T](#) Digital Systems & Applications:

Digital electronics is one of the very popular application areas in physics and has become part & parcel of modern day life. A proper exposure helps the student in strengthening ideas to follow practical approach towards this fast developing field. In the following course, the student

- 1) Acquires a thorough understanding of the principles of Binary Numbers and the Boolean Algebra.
- 2) Gets familiar with the basic concepts of Integrated Circuit technology and its history of development.
- 3) Is able to understand the conceptual foundation of different circuits like analog & digital data processing, arithmetic etc.
- 4) Understanding the importance of digital circuits in electronics.
- 5) Understanding CRO as an important signal detection instrument.
- 6) Understanding the basic design of a computer hardware system.
- 7) Understanding the concepts and applications of sequential circuit building blocks which are fundamental to digital circuits.
- 8) Understanding a popular timing signal generator (555 timer) as a source of clock in sequential circuit and as other timing sources.
- 9) Getting exposed to the basic features of microprocessors using 8085 as an example.

SEC 1: [HPHSE3011T](#) Applied Optics :

- 1) To teach students the principle behind optical modulators.
- 2) To acquaint students with the application of interferometers on inertial navigation.
- 3) To teach students the basic principles of holography.
- 4) To acquaint students with the basic principle of LCD displays.
- 5) To train students with modern methods of describing polarized light.
- 6) To give an overview of different types of interferometers.

### Semester-IV

Core Paper 8: [HPHCR4082T](#) Mathematical Physics III:

This course aims at:

- 1) Enabling students to extend their knowledge of real analysis to the complex domain.
- 2) Equipping the students with techniques of Contour Integration enable the students to evaluate a very broad class of definite integrals, whose indefinite forms cannot be evaluated using analytical means.
- 3) Helping students to learn Fourier integrals at an early stage, which will enable students to appreciate concepts of wave packets, dispersion relations and the like when they appear in Quantum Mechanics.
- 4) Enabling a student to move between time and frequency (or energy) domain which is an extremely valuable skill for solving Differential Equation & appreciating spectral analysis
- 5) In the second module of the course, Linear Algebra is introduced which forms the mathematical framework of a wide array of subjects, most importantly Quantum Mechanics. The idea is to equip the students enough to be able to make use of it to apply it for solving QM problems at a later stage.
- 6) A combination of strategies are developed to address diverse area in Mathematics & Physics which rely on the principle of superposition.

Core Paper 9: [HPHCR4092T](#) Elements of Modern Physics:

**The objectives are:**

- 1) To acquaint the students with the concepts of wave-particle duality through a discussion of experimental findings regarding the particle properties of waves and the wave properties of particles.
- 2) To impart knowledge regarding the properties of waves associated with a particle (i.e. matter waves), through an elaborate discussion of de Broglie hypothesis.

- 3) To establish (or verify) the wave nature of this matter wave, through a discussion of experiments showing the diffraction of this wave. It includes the experimental verification of de Broglie hypothesis.
- 4) To familiarize the students with the uncertainties (originating from wave nature) in the simultaneous determination of two canonically conjugate variables, through an elaborate discussion of Heisenberg's uncertainty principle.
- 5) To make the students understand the importance of the uncertainty principle by discussing its various applications.
- 6) To acquaint the students with the mathematical ways to represent (or describe) the de Broglie wave through a function (wave function).
- 7) To show them how to determine the work function by solving Schrodinger equation.
- 8) To make them learn the techniques of extracting information regarding a system from its wave function.

**In the second module of the course student will learn about**

- 9) The nuclear size and structure
- 10) The nuclear models
- 11) Radioactivity
- 12) Fission and fusion
- 13) Spontaneous and stimulated emission
- 14) Three level and four level lasers

**Core Paper 10: [HPHCR4102T](#) Analog Systems & Applications:**

- 1) The course introduces the physics of semiconductors including that of a junction of extrinsic semiconductors which forms the basis of several devices such as the diode and transistors.
- 2) The characteristics of a semiconductor diode, its operation under different bias conditions as well as a few of its applications will be covered.
- 3) Bipolar junction transistors, their characteristics, its DC biasing and an equivalent AC model for its analysis will be dealt with in some detail.
- 4) Enable the students to design and analyse circuits using BJT in the case of amplifiers and oscillators.
- 5) The characteristics of an operational amplifier along with its application in achieving numerous mathematical operations will enable students to understand the potential of an integrated circuit.
- 6) The students will also have the knowledge of effects of feedback in a circuit and its advantage in the design of amplifiers and oscillators, when chosen appropriately.

**SEC 2: [HPHSE4021P](#) Circuit design & Simulation :**

- 1) Understanding the basics of circuit simulation software.
- 2) Understanding concepts of electrical circuit design, interconnects, parasitic elements etc. through simulation software.
- 3) Understanding the analysis that is performed on a circuit such as AC, DC, Noise, Transient etc.
- 4) Studying the electrical behaviour of important circuits such as rectifiers, amplifiers, switches etc.
- 5) Understanding the importance of circuit simulation for Integrated Circuit design
- 6) Getting awareness of other software of similar nature present in the market

**Semester-V**

## Semester 5

### Core Paper 11: [HPHCR5112T](#) Quantum Mechanics & Applications

- 1) This course will expose a student to the formulation of quantum mechanics.
- 2) The exposure to the formulation of a theory with a completely different philosophy from classical mechanics will enable a student to appreciate the various diverse ways in which physical reality can be perceived.
- 3) This course will underline the relevance of learning the language of linear vector space as the mathematical tool to frame the theory of quantum mechanics.
- 4) This course will expose the students to various applications of quantum mechanics.
- 5) In this course, first some applications of quantum mechanics for simple systems will be dealt with. This will initiate the idea of how a theoretical framework is applicable to real life problems.
- 6) At the last section of this course, more advanced applications of quantum mechanics will be discussed which arise in atomic physics, nuclear physics and in other areas of physics.

### Core Paper 12: [HPHCR5122T](#) Solid State Physics - (C)

- 1) Able to explain the structural (crystallographic), mechanical (elastic), thermal (lattice vibration), electrical (Free electron theory) & electronic (band theory) and magnetic (Dia, Para and Ferro ) properties of solid matter and special phenomena like superconductivity by the knowledge developed in this course.
- 2) Have insight into classical and quantum mechanical laws which can be applied to explain the properties of the solid state.
- 3) Formulate and understand theories explaining the behaviour of the solid state.
- 4) Know the role of solid state physics in important technological developments.
- 5) Read and be able to understand research articles in certain fields of physics
- 6) Enables the student to critically evaluate the approximations needed to build models to understand the solid state

### DSE 1: [HPHDS5011T](#) Classical Dynamics (T)

The objectives of this course are:

1. The primary objective of this course is to present an integrated view of the physics of a system of particles and consequently studying its continuum limit, viz. the classical theory of fields.
2. New techniques like the Lagrangian and the Hamiltonian Principle as a way to treat problems in mechanics have been introduced and their utility is discussed.
3. This course aims to present a modern treatment of classical mechanical systems in such a way that the transition to the quantum theory of physics can be made easily.
4. A complete and logically connected theory of electromagnetic fields can only be presented through an inclusion of the special theory of relativity. Thus this has been focussed upon as one of the major areas in this course.
5. An attempt is being made to create a basis in which a student can later go on to look at both the electromagnetic field and the gravitational field as examples of classical field theories. This would hopefully provide a good foundation to understand advanced field theoretic material in the later courses.

6. Finally, the course also aims at enabling a student to incorporate the language of four vectors or tensors allowing them to understand quantitatively compact versions of field theories, with special emphasis on the electromagnetic field theory.

DSE 2: [HPHDS5021T](#) Nuclear and Particle Physics (T)

#### Course Objective

- 1) To teach the principles of nuclear radiation detectors like GM tubes and multi wire chambers.
- 2) To teach the principles of operation of both circular and linear accelerators.
- 3) To introduce the elementary particles, quarks and leptons, their properties, the quark model description of baryons and mesons.
- 4) To acquaint the students with the size, shape, structure of a nucleus and their effects upon its binding energy, magnetic and electric moments.
- 5) To teach various Nuclear Models to explain the energetics of a nucleus and its stability.
- 6) To make them understand the processes of various radioactive decays.
- 7) To teach them the mechanism of nuclear reactions and the corresponding production of energy.
- 8) To make them learn the interaction of nuclear radiation with matter and the loss of energy due to ionization.

DSE 3: Nano materials and Applications (C)

- 1) Explain the effects of quantum confinement on the electronic structure and corresponding physical and chemical properties of materials at nano scale.
- 2) Choose appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties.
- 3) Correlate properties of nanostructures with their size, shape and surface characteristics.
- 4) appreciate enhanced sensitivity of nanomaterial based devices and their novel applications in industry.
- 5) Able to explain the reduced dimensionality (3D, 2D, 1D and 0D), basic understanding of synthesis of nanomaterials and their characterization, explain electrical and optical properties and finally the wide areas of applications.
- 6) Emphasizes the connections between emerging domain of physics with interdisciplinary flavour having interface with practically all major areas of science & technology like Chemistry, Biology, Medicine etc.

### Semester VI

Core Paper 13: [HPHCR6132T](#) Electromagnetic theory:

- 1) In this course the Maxwell's equations are reviewed, and obtained in the general form for electrodynamics. The potential formulation is also introduced here which will be beneficial to the student in future courses in classical electrodynamics.
- 2) The wave equation and the plane wave solutions are studied. The concept of an electromagnetic wave is hence introduced with a study of its properties.
- 3) The study of conservation principles in electrodynamics leads to the understanding of the energy and momentum carried by electromagnetic field.
- 4) This is followed by the study of propagation of electromagnetic waves in free space, dielectrics, conductors and the behaviour of the waves at boundaries. This includes

the understanding of several important parameters which decide the optical properties of the medium.

- 5) To discuss quantitatively the propagation of electromagnetic waves in anisotropic media.
- 6) To teach the principles of production of polarized light.
- 7) To discuss the principles of analysis of polarized light using wave plates and retarders.
- 8) To discuss quantitatively optical activity and principles of operation of polarimeters.
- 9) To discuss quantitatively the propagation of electromagnetic waves in optical fibers.
- 10) To introduce different types of optical fibers.

Core Paper 14: [HPHCR6142T](#) Statistical Mechanics

- 1) Establish the position of statistical mechanics between Quantum Mechanics and Thermodynamics.
- 2) Ergodic hypothesis and the concept of equal a priori probability as fundamental hypothesis
- 3) Idea of macro and microstates.
- 4) The idea of ensembles and their suitable choice to describe systems
- 5) Establishing The link between thermodynamic parameters from statistical physics
- 6) Maxwell -Boltzmann Statistics, Bose-Einstein statistics and Fermi-Dirac statistics, their applicability criteria, applications as examples

DSE 4: [HPHDS6031T](#) Laser & Fiber Optics :

Course objectives for Laser Physics & Fiber Optics:

- 1) To teach the principles of operation of gas lasers and solid state lasers
- 2) To acquaint students with applications of lasers
- 3) To educate students about safety precautions while handling lasers
- 4) To teach the principles of light propagation in optical fibers
- 5) To discuss the different types of optical fibers
- 6) To teach students the principles of communication systems using lasers
- 7) This course includes an introduction to the area of fiber optics (which is of current significance due to its application in innumerable areas of science and technology). The different kinds of fibers as well as the parameters of importance are categorised in viewpoint of their application in communication.
- 8) Using the concepts of EM theory, the planar waveguide is studied to introduce the general concept of modes in an optical waveguide.
- 9) The different loss mechanisms and their measurement method are studied to give a practical approach in understanding the use of an optical fiber. Fabrication methods and different connection techniques are also covered in brief.
- 10) With the basic understanding of the fiber, the students are introduced to the building blocks of an optical fiber communication system including the fiber amplifier, which plays a key role.

DSE 5: Astrophysics and Cosmology (C)

The objectives of this course are:



1. This course aims to introduce the subject of Astrophysics and Cosmology at the undergraduate level.
2. It gives the student an exposition to the idea of scales, masses and measurements of these in the near and far Universe, starting from our Solar System to the far reaches of our Universe.
3. The idea that the metric system is extremely different since the scales involved to the nearest star like the Sun or to the Galactic centre or to extragalactic objects is something which a student should be able to appreciate at the end of this course.
4. The course aims at exposing a student to the beauty of order of magnitude physics and how this can facilitate the understanding of many important truths about the evolution of stars
5. This course exposes the students to the physics of galaxies and the interstellar medium and how stars are born from the ISM.
6. Finally, it also gives the student a short exposition to the different exotic components of our Universe like the dark matter and dark energy and how their existence is predicted through observations.

DSE 6: [HPHDS6043D](#) Dissertation

### **Semester-I (Ancillary)**

[HPHGE1012T](#): Mathematical Methods, Mechanics, General Properties of Matter:

- 1) This course will provide an exposure to important concepts of Physics for students pursuing honours course in other basic sciences.
- 2) Study of vectors and coordinate systems are relevant for different fields. This course aims to provide an elementary training in that area.
- 3) Studying Newtonian Mechanics will expose a student to the beauty of the formulation of a theory explaining nature.
- 4) Studying general properties of matter will equip a student to apply these concepts in relevant area of his/her field of interest.
- 5) This course should provide a basic help to students who will pursue interdisciplinary work in the later years of their academic life.
- 6) The diversity in the topics of this course is enable to touch upon various apparently different but interconnected concepts in Physics, giving a broad perspective of the subject.
- 7) The objective of this module of generic elective physics paper aims to give the students a basic idea on thermal physics.
- 8) Students will learn about law of atmosphere, Maxwell's law of velocity distribution, equipartition of energy.
- 9) Students will learn about first and second law of thermodynamics.
- 10) Student will learn about different laws regarding blackbody radiation.

### **Semester-II (Ancillary)**

[HPHGE2022T](#) : Vibrations, Waves and Optics & Electromagnetism



- 1) The course aims at imparting a basic knowledge in the branch of Vibrations, Waves and Optics at the undergraduate level.
- 2) To impart the knowledge about some basic features / experimental findings of electrostatics and the fundamental theories like Coulomb's law and Gauss' law.
- 3) To teach the students to appreciate the importance of these laws by discussing their applications in various systems to determine the electric field and potential.
- 4) To familiarize them with the electrostatic polarization of charges in a dielectric material and the application of this phenomenon in the capacitors of various geometries, and thereby estimating the energy stored in those systems.
- 5) To discuss the basic features/ experimental findings of electrodynamics such as the magnetic effects produced by a flow of charges.
- 6) To discuss Biot-Savart's law in details to show how the magnetic field depends mathematically upon the electric current.
- 7) To teach the students the ways of determining the magnetic field for different simple geometries of current flow, through various applications of Biot-Savart's law and Ampere's circuital law.
- 8) To impart the knowledge regarding the calculation of current and voltage for various electrical networks, through a detailed discussion of Norton's and Thevenin's theorems and their applications.

### **Annexure 3:**

1. Multi-scale patterns formed by sodium sulphate in a drying droplet of gelatin: experiment and simulation in 2-dimensions; Tapati Dutta, Sujata Tarafdar and Tajkera Khatun; 2018 J. Phys. Commun. <https://doi.org/10.1088/2399-6528/aac341> ; **IF: 3.748**
2. Existence of convective threshold and its role on temperature in reactive flow through fractured rocks: a simulation study in 2D, S Sadhukhan and T Dutta, J. Phys. Commun. 2 (2018) 045033, [doi.org/10.1088/2399-6528/aab5a8](https://doi.org/10.1088/2399-6528/aab5a8); ; **IF: 3.748**
3. . An insight into Newton's cooling law using fractional calculus, Adreja Mondol, Rivu Gupta, Shantanu Das, and Tapati Dutta, Journal of Applied Physics 123, 064901 (2018);, [doi.org/10.1063/1.4998236](https://doi.org/10.1063/1.4998236) ; **IF: 2.328**
4. Crack formation in desiccating Laponite® films under AC field: Effect of varying frequency, Sudeshna Sircar, Sujata Tarafdar, Tapati Dutta, Applied Clay Science 156 (2018) 69–76 ; **IF: 3.931**
5. Crack patterns in drying Laponite®- NaCl suspension : Role of the substrate and a static electric field" Author(s): Sircar, Sudeshna; Dutta Choudhury, Moutushi; Karmakar, Sanat; Tarafdar, Sujata; Dutta, Tapati,, Langmuir, MANUSCRIPT NUMBER: 1a-2018-00501q.R1, Accepted on 11.5.2018 ; **IF:3.789**
6. Formation of desiccation crack patterns in electric fields: a review, Sujata Tarafdar, Tapati Dutta, Phil. Trans. R. Soc. A 2019 377 20170398; DOI: 10.1098/rsta.2017.0398. Published 26 November 2018, **IF: 3.093**
7. Tree-like Crack Patterns in Clay Dried in a Uniform DC Electric Field" by Ghosh, Ankita; Sircar, Sudeshna; KHATUN, TAJKERA; Dutta, Tapati; Tarafdar, Sujata, Materials Research Express, <https://dx.doi.org/10.1088/2053-1591/aaed0b>; **IF:1.449**
8. A spring network simulation in 3 dimensions for designing optimal crack pattern template to fabricate transparent conducting electrodes. by Supti sadhukhan, Ankush Kumar, Giridhar Kulkarni, Sujata Tarafdar and Tapati Dutta, accepted for publication in Bulletin of Materials Science, 12<sup>th</sup> December, 2018. **IF: 1.264**
9. Droplet Drying Patterns on Solid Substrates: From Hydrophilic to Superhydrophobic Contact to Levitating Drops: Sujata Tarafdar , Yuri Yu. Tarasevich, Moutushi Dutta Choudhury, Tapati Dutta, and Duyang Zang, Hindawi, Advances in Condensed Matter Physics, Volume 2018, Article ID 5214924, 24 pages, <https://doi.org/10.1155/2018/5214924> ; **IF:0.653**

10. Evaporation of a Droplet: From physics to applications Duyang Zang , Sujata Tarafdar , Yuri Yu. Tarasevich , Moutushi Dutta Choudhury, Tapati Dutta , Physics Reports (2019), <https://doi.org/10.1016/j.physrep.2019.01.008>; **IF:20.033**
11. *Five-dimensional warped product space-time with time-dependent warping and a scalar field in the bulk*, **Sarbari Guha, Gravitation and Cosmology, July 2018.**
12. Mathematical Model of Ingested Glucose in Glucose-Insulin Regulation, Sourav Chowdhury, Sourabh K. Manna, Suparna Roychowdhury, Indranath Chaudhuri, J. Appl Computat Math 2019, 8: 2, doi:10.4172/2168-9679,1000444
13. Title: Time evolution of the matter content of the expanding universe in the framework of Brans-Dicke gravity Author: Sudipto Roy Journal: Research in Astronomy and Astrophysics, RAA 2019 Vol. 19 No. 4, 61(14pp). doi: 10.1088/1674-4527/19/4/61
14. Optical Properties Of  $\text{Cu}_2\text{ZnSnS}_4$  (CZTS) Made By SILAR Method, Gayatri Banerjee, Souvik Das, Subhankar Ghosh, Published in Materials Today, Proceedings 18 (2019) 494–500.
15. Optical Properties Of Nanorod Rich Copper Zinc Tin Sulphide Grown By Chemical Bath, Gayatri Banerjee, Swarup Chaudhuri, Subhankar Ghosh, Published in AIP Conference Proceedings Feb 2019

# STATISITCS

Semester	ONE
Paper Number	HSTCR1012T
Paper Title	Descriptive Statistics
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Modules	Single
Course description/objective	<p><i>At the end of this course a student should be able to understand</i></p> <ul style="list-style-type: none"> <li>○ Different types of data and the art of data handling.</li> <li>○ The techniques of summarization and identification of the salient features of the data through graphical displays.</li> <li>○ The concept of moment and quantiles</li> <li>○ The salient features of metric data related to a single variable.</li> <li>○ Different measures of association for bivariate data.</li> <li>○ Extension of concepts to trivariate data.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b>Statistical Methods:</b> Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement: nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, column diagram and step diagrams. Stem and Leaf display. [12L]</p> <p><b>UNIT 2:</b>  <b>Univariate data:</b> Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, Measures of skewness and kurtosis. Box Plot. Sheppard's corrections. [17L]</p> <p><b>UNIT 3:</b>  <b>Bivariate data:</b> Definition, scatter diagram, simple correlation, Simple linear regression, principle of least squares, Fitting of polynomials and exponential curves, Transformation to linearity: log-linear and power transformations , Rank correlation, Correlation ratio, Intra-class correlation. [15L]</p> <p><b>UNIT 4:</b>  <b>Trivariate data:</b> multiple linear regression, partial and multiple correlation. [8L]</p>
List of Practical	1. Graphical representation of data.

	<ol style="list-style-type: none"> <li>2. Problems based on measures of central tendency.</li> <li>3. Problems based on measures of dispersion.</li> <li>4. Problems based on combined mean and variance and coefficient of variation.</li> <li>5. Problems based on moments, skewness and kurtosis.</li> <li>6. Fitting of polynomials, exponential curves.</li> <li>7. Karl Pearson correlation coefficient.</li> <li>8. Correlation coefficient for a bivariate frequency distribution.</li> <li>9. Lines of regression, angle between lines and estimated values of variables.</li> <li>10. Spearman rank correlation with and without ties.</li> <li>11. Partial and multiple correlations.</li> <li>12. Planes of regression and variances of residuals for given simple correlations.</li> <li>13. Planes of regression and variances of residuals for raw data.</li> <li>14. Computation of correlation ratio.</li> <li>15. Computation of intra class correlation coefficient</li> </ol>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I, &amp; II, 8th Edn. The World Press, Kolkata.</li> <li>2. Yule G.U. and Kendall M.G (1994) : An Introduction to the theory of Statistics. 14<sup>th</sup> Edn. Universal Book stall, Delhi.</li> <li>3. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.</li> </ol>	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>ONE</b>
Paper Number	<b>HSTCR1022T</b>
Paper Title	<b>Probability &amp; Probability Distributions I</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Modules	Single
Course description/objective	<p><i>At the end of the course a student should</i></p> <ul style="list-style-type: none"> <li>○ Understand different definitions and meaning of Probability.</li> <li>○ Know different laws of probability and the theorems connecting them.</li> <li>○ Be able to apply the laws of probability.</li> <li>○ Know the notion of conditional probability.</li> <li>○ Understand what is a random variable and its probability distribution.</li> <li>○ Understand different aspects of univariate discrete probability distribution.</li> <li>○ Understand different aspects of bivariate discrete probability distribution.</li> </ul>
syllabus	<p><b>UNIT 1:</b>  <b>Probability:</b> Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical and axiomatic.  [10L]</p> <p><b>UNIT 2:</b>  <b>Theorems of Probability:</b> Theorem of compound probability, theorem of total probability, Bayes theorem and its applications, independent events.  [10L]</p> <p><b>UNIT 3:</b>  <b>Random variables:</b> discrete random variables, p.m.f. and c.d.f., statement of properties of c.d.f, illustrations and properties of random variables. Derivation of moments (discrete situation).  [8L]  <b>Standard discrete probability distributions:</b> Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform. [12L]</p> <p><b>UNIT 4:</b>  <b>Two dimensional random variables:</b> discrete type, joint, marginal and conditional, p.m.f and c.d.f., statement of properties of c.d.f, independence of variables, trinomial distribution. [12L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Numerical sums using classical definition.</li> <li>2. Numerical sums on conditional probability.</li> <li>3. Fitting of binomial distribution for given n and p.</li> </ol>

	<ol style="list-style-type: none"> <li>4. Fitting of binomial distribution after computing mean and variance</li> <li>5. Fitting of Poisson distribution for given value of <math>\lambda</math></li> <li>6. Fitting of Poisson distribution after computing mean.</li> <li>7. Fitting of negative binomial.</li> <li>8. Fitting of suitable distribution.</li> <li>9. Application problem based on binomial distribution</li> <li>10. Application problem based on Poisson distribution.</li> <li>11. Application problem based on negative binomial distribution.</li> </ol>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.</li> <li>2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.</li> <li>3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford &amp; IBH Publishing, New Delhi .</li> <li>4. S.M. Ross : A First Course in Probability.</li> <li>5. K.L. Chung : Elementary Probability Theory with Stochastic Process.</li> </ol>	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>TWO</b>
Paper Number	<b>HSTCR2032T</b>
Paper Title	<b>Probability &amp; Probability Distributions II</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Modules	Single
Course description/objective	<i>At the end of the course a student should</i> <ul style="list-style-type: none"> <li>○ Knowledge about different aspects of univariate continuous probability distributions.</li> <li>○ Knowledge about different aspects of bivariate continuous probability distributions.</li> <li>○ Knowledge about probability inequalities and their applications.</li> </ul>

	<ul style="list-style-type: none"> <li>○ Knowledge about different generating functions and their uses.</li> <li>○ Knowledge about univariate and bivariate transformations and their applications.</li> <li>○ Knowledge about proper application of continuous theoretical distribution.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b>Continuous random variables:</b> p.d.f. and c.d.f., illustrations and properties, univariate transformations with illustrations Derivation of moments (continuous situation). Probability Inequalities: Markov &amp; Chebyshev.  [12L]</p> <p><b>UNIT 2:</b>  <b>Two dimensional random variables:</b> continuous type, joint, marginal and conditional, p.d.f., and c.d.f.. Independence of two random variables, bivariate transformations with illustrations. Moments. Conditional expectation and variance. Correlation coefficient.  [14L]</p> <p><b>UNIT 3:</b>  <b>Generating functions:</b> Moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems (without proof) along with applications.  [10L]</p> <p><b>UNIT 4:</b>  <b>Standard continuous probability distributions:</b> uniform, normal, exponential, Cauchy, beta, gamma, lognormal, logistic, double exponential and Pareto along with their properties and limiting/approximation cases. Bivariate Normal Distribution and its properties. [16L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Problems based on the property of normal distribution.</li> <li>2. To find the ordinate for a given area for normal distribution.</li> <li>3. Application based problems using normal distribution.</li> <li>4. Fitting of normal distribution when parameters are given .</li> <li>5. Fitting of normal distribution when parameters are not given.</li> <li>6. Fitting of some other continuous distributions.</li> </ol>
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.</li> <li>2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.</li> <li>3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford &amp; IBH Publishing,</li> </ol>

	New Delhi . 4. S.M. Ross : A First Course in Probability. 5. K.L. Chung : Elementary Probability Theory with Stochastic Process.	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>TWO</b>
Paper Number	<b>HSTCR2041T</b>
Paper Title	<b>Algebra</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Theory</b>
No. of periods assigned	Th: 5 Tutorial: 1
Modules	<b>Module 1:</b> Units 1 & 2 ( 2 periods/week) <b>Module 2:</b> Units 3 & 4 ( 3 periods/week)
Course description/objective	<p><i>After completion of the course a student is expected to have an idea of</i></p> <ul style="list-style-type: none"> <li>○ Matrix algebra and determinants.</li> <li>○ Theory of equations.</li> <li>○ Vector spaces, subspaces, their dimensions and basis.</li> <li>○ Rank of a matrix and systems of linear equations.</li> <li>○ Characteristic roots and vectors along with the understanding of classification of quadratic forms.</li> <li>○ Linear transformation in connection to matrices.</li> </ul> <p><i>This course is expected to lay the foundations to the courses like Multivariate Analysis and Linear Model.</i></p>
Syllabus	<p><b>UNIT1:</b>  <b><i>Algebra of matrices</i></b> - A review, theorems related to triangular, symmetric and skew symmetric matrices, idempotent matrices, orthogonal matrices, singular and non-singular matrices and their properties. Trace of a matrix. Adjoint and inverse of a matrix and related properties, Partitioning of matrices and simple properties.</p> <p>[10L]</p> <p><b>UNIT 2:</b>  <b><i>Determinants of Matrices:</i></b> Definition, properties and applications of determinants for 3<sup>rd</sup> and higher orders, evaluation of determinants of order 3 and more using transformations. Symmetric and Skew symmetric determinants, Circulant determinants and Vandermonde determinants for nth order,</p>



	<p>Jacobi's Theorem. Product of determinants. Use of determinants in solution to the system of linear equations. [16L]</p> <p><b>UNIT 3:</b>  Vector spaces, Subspaces, sum of subspaces, Span of a set, Linear dependence and independence, dimension and basis, dimension theorem. Orthogonal vectors, Gram-Schmidt orthogonalization, ortho-complement space. Row space &amp; column space of a matrix, Null space and nullity. [20L]  Elementary matrices, row reduction and echelon forms, the matrix equations <math>Ax=b</math>, solution sets of linear equations.  Applications of linear equations, inverse of a matrix. Rank of a matrix, row-rank, column-rank, standard theorems on ranks, rank of the sum and the product of two matrices. Characteristic roots and Characteristic vector, Properties of characteristic roots, Cayley Hamilton theorem, Quadratic forms: Classification &amp; canonical reduction. Rank and Signature, Linear transformations. Applications of Linear Algebra in Statistics. [22L]</p> <p><b>UNIT 4:</b>  Theory of equations, statement of the fundamental theorem of algebra and its consequences. Relation between roots and coefficients of any polynomial equations. Solutions of cubic and biquadratic equations when some conditions on roots of equations are given. [10L]</p>	
List of Practical	<b>NIL</b>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Hadley G.( 2002): Linear Algebra. Narosa Publishing House (Reprint).</li> <li>2. Searle S.R.(1982): Matrix Algebra Useful for Statistics. John Wiley &amp; Sons.</li> <li>3. Narayan Shanti (2004): A Textbook of Matrices, S Chand &amp; Co Ltd.</li> <li>4. Hoffman Kenneth, Kunze Ray (1978): Linear Algebra. Phi Learning Pvt Ltd.</li> </ol>	
Evaluation	CIA: 20 End Sem Exam: 80 Total : 100 Module 1: 25 Module 2: 55	
Paper Structure for End Sem	Short questions ( 5 marks each)	Long questions (15 marks each)
Module 1	2 out of 3	1 out of 2
Module 2	5 out of 8	2 out of 3

Semester	<b>THREE</b>
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Paper Number	<b>HSTCR3052T &amp; HSTCR3052P</b>
Paper Title	<b>Sampling Distributions &amp; Statistical Inference 1</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	Single
Course description/objective	<p><i>At the end of the course a student should be able to understand</i></p> <ul style="list-style-type: none"> <li>○ The notion of sampling distribution of a statistic</li> <li>○ The importance of sampling distributions in Statistical Inference.</li> <li>○ The notion of standard error of a statistic.</li> <li>○ The basics of Testing of Hypotheses.</li> <li>○ The basic principle underlying tests of significance with application to different distributions.</li> <li>○ A preliminary idea of p-value and its use in testing of hypotheses.</li> </ul>
Syllabus	<p><b>UNIT1:</b>  <b>Introduction:</b> Definitions of random sample, parameter and statistic, sampling distribution of a statistic and its standard error. Distributions of functions of random variables. Illustration through simple transformation and generating function technique. [8L]</p> <p><b>UNIT 2:</b>  <b>Exact sampling distribution:</b> Definition and derivation of p.d.f. of <math>\chi^2</math> with n degrees of freedom (d.f.) using m.g.f., nature of p.d.f. curve for different degrees of freedom, mean, variance, m.g.f., mode, additive property and limiting form of <math>\chi^2</math> distribution. [6L]  Student's and Fishers t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t distribution. [6L]</p> <p>Snedecore's F-distribution, Derivation of p.d.f., nature of p.d.f. curve with different degrees of freedom, mean, variance and mode.  Distribution of <math>1/F(n_1, n_2)</math>. Relationship between t, F and <math>\chi^2</math> distributions. [5L]  Sampling distributions of sample mean and sample variance when parent population is normal. Null distribution of sample correlation coefficient (statement only). [3L]</p> <p><b>UNIT 3:</b>  <b>Testing and Confidence Intervals:</b> Null and alternative hypotheses, level of significance, Type I and Type II errors, their probabilities and</p>

	<p>critical region- Tests of significance and confidence intervals based on <math>\chi^2</math>, t and F distribution when samples are generated from Univariate and Bivariate normal population (s). [12L]</p> <p>Exact tests relating to Binomial proportion (s) and Poisson mean (s). [4L]</p> <p><b>UNIT 4:</b>  <b>Order Statistics:</b> Introduction, distribution of the rth order statistic, smallest and largest order statistics. Joint distribution of rth and sth order statistics, distribution of sample median and sample range. [8L]</p>	
List of Practical	<ol style="list-style-type: none"> <li>1. Testing of significance for single proportion and difference of two proportions.</li> <li>2. Testing of significance for single Poisson mean and difference of means of two independent Poisson distributions.</li> <li>3. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.</li> <li>4. Testing if the population variance has a specific value and its confidence intervals</li> <li>5. Testing of significance and confidence intervals of correlation coefficient.</li> <li>6. Testing of equality of population variances for two independent normal populations and related confidence intervals.</li> <li>7. Testing of ratio of variances for bivariate normal population and related confidence interval.</li> </ol>	
Reading Reference List	<ol style="list-style-type: none"> <li>1. Goon, A.M. Gupta, M.K. and Dasgupta, B. (2003): An outline of Statistical Theory, Vol. 1, 4<sup>th</sup> Edn. World Press, Kolkata.</li> <li>2. Rohatgi V.K. and Saleh, A. K. Md, E. (2009): An Introduction to Probability and Statistics, 2<sup>nd</sup> edition (Reprint), John Wiley and Sons.</li> <li>3. Hogg, R.V. and Tanis, E.A. (2009): A Brief Course in Mathematical Statistics. Pearson Education.</li> <li>4. Johnson, R.A. and Bhattacharya, G.K. (2001): Introduction to the theory of Statistics, 3<sup>rd</sup> edition (Reprint). Tata McGraw-Hill Pub. Co. Ltd.</li> </ol>	
Evaluation	<p style="text-align: center;"><b>Theory</b></p> <p>CIA: 10  End-Sem: 50  Total: 60</p>	<p style="text-align: center;"><b>Practical</b></p> <p>Continuous assessment: 40</p>
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>THREE</b>
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Paper Number	<b>HSTCR3062T &amp; HSTCR3062P</b>
Paper Title	<b>Survey Sampling and Indian Official Statistics</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	Single
Course description/objective	<p><i>At the end of the course a student should be able to understand</i></p> <ul style="list-style-type: none"> <li>○ The principles underlying sampling as a means of making inferences about the population.</li> <li>○ The need for probability sampling when we cannot assume any population distribution.</li> <li>○ The statistical aspects associated with the design and analysis of Sample surveys.</li> <li>○ Different sampling schemes and situations where these are applicable.</li> <li>○ The importance of introducing auxiliary variable in the improvement of estimation procedures under certain situations.</li> <li>○ The sources and mechanisms of collecting official statistics in India.</li> </ul>
Syllabus	<p><b>UNIT1:</b> Concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination. [16L]</p> <p><b>UNIT 2:</b> Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision, Systematic Sampling: Technique, estimates of population mean and total, variances of these estimates (<math>N=n \times k</math>). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections. [12L]</p> <p><b>UNIT 3:</b> Ratio &amp; Regression methods of estimation in simple random sampling . Hartley-Ross estimator. Cluster sampling (equal clusters only) estimation of population mean and its variance, Concept of sub sampling. Two-stage Sampling, Estimation of Population mean and variance of the estimate, comparison between two-stage, cluster and uni-stage sampling [17 L]</p>

	<b>UNIT 4:</b> Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO), and National Statistical Commission. Government of India's Principal publications containing data on the topics such as population, industry and finance. [7L]	
List of Practical	1. To select a SRS with and without replacement. 2. For a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by WR and WOR and establish all properties relative to SRS. 3. For SRSWOR, estimate mean, standard error, the sample size 4. Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods. Compare the efficiencies of above two methods relative to SRS. 5. Estimation of gain in precision in stratified sampling. 6. Comparison of systematic sampling with stratified sampling and SRS in the presence of a linear trend. 7. Ratio and Regression estimation: Calculate the population mean or total of the population. Calculate mean squares. Compare the efficiencies of ratio and regression estimators relative to SRS. 8. Cluster sampling: estimation of mean or total, variance of the estimate, estimate of intra-class correlation coefficient, efficiency as compared to SRS. 9. Two stage sampling.	
Reading/ Reference List	1. Cochran, W.G. (1984): Sampling Techniques (3rd Ed.), Wiley Eastern. 2. Sukhatme, P.V., Sukhatme, B.V. Sukhatme, S. Asok, C. (1984). Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics. 3. Murthy, M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta. 4. Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa Publishing House. 5. Goon A.M., Gupta M.K. and Dasgupta B. (2008): Fundamentals of Statistics, Vol-II, World Press. 6. Guide to current Indian Official Statistics, Central Statistical Office, GOI, and New Delhi. <a href="http://mospi.nic.in/">http://mospi.nic.in/</a>	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40

Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>THREE</b>
Paper Number	<b>HSTCR3071T</b>
Paper Title	<b>Mathematical Analysis</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Theory</b>
No. of periods assigned	Th: 5 Tutorial: 1
Module	Module 1: (Unit 1,2 & 3) : 3 periods/week Module 2: Unit 4 : 2 periods/week
Course description/objective	<p><i>At the end of the course, a student is expected to</i></p> <ul style="list-style-type: none"> <li>○ Identify sequences of real numbers and their properties.</li> <li>○ Identify series of real numbers and apply tests to study their convergence/divergence.</li> <li>○ Understand the properties of real valued functions.</li> <li>○ Understand and apply Mean Value theorems in various problems.</li> <li>○ Identify sequences and series of real functions (with special focus on power series), apply tests to identify their various modes of convergence.</li> <li>○ Learn numerical approximations to analytically intractable functions.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b><i>Sequence and Series of real numbers:</i></b> Sequence of real numbers and their convergence, limits of sequences, Cauchy's general principle of convergence, Cauchy's first theorem on limits, monotonic sequences, limit superior and limit inferior of a bounded sequence. [10L]</p> <p>Infinite series, positive termed series and their convergence, Comparison tests, D'Alembert's ratio test, Cauchy's <math>n^{\text{th}}</math> root test, Gauss test, Cauchy's condensation test and integral test (Statements and examples only). Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence. [6L]</p> <p><b>UNIT 2:</b>  <b><i>Properties of real valued functions:</i></b> Limit, Continuity, Differentiability, Uniform Continuity and Boundedness of functions, Indeterminate forms, L'Hospital's rule. Rolle's and Lagrange's mean value theorems. Taylor's theorem and Lagrange's and Cauchy's form of remainder (without proof). Taylor's and Maclaurin's series expansion. [14L]</p> <p>Reimann Integration of Real valued Functions. Convergence of Integrals, Simple tests. Multiple Integration. [10L]</p> <p><b>UNIT 3:</b></p>

	<p><b>Sequence and series of functions:</b> Pointwise &amp; Uniform convergence. Simple tests, Properties of Uniformly convergent functions. Power series. [12L]</p> <p><b>UNIT 4:</b>  <b>Numerical Analysis:</b> Finite differences and interpolation. Operators <math>\Delta</math> and <math>E</math>. Newton's forward and backward interpolation formulae. Lagrange's interpolation formulae. Numerical Integration, Gauss quadrature, Trapezoidal rule, Simpson's one-third rule with error terms. Stirling's approximation to factorial <math>n</math>. Solution of equations in a single variable- Bisection, Iteration and Newton Raphson method. [26L]</p>	
List of Practical	<b>NIL</b>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Bartle, R. G. and Sherbert, D. R. (2002): Introduction to Real Analysis (3rd Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore.</li> <li>2. Goldberg, R. (1976) : Methods of Real Analysis (2<sup>nd</sup> Edition), John Wiley and Sons.</li> <li>3. Apostol T.M. (1987) : Mathematical Analysis, Second Edition, Narosa Publishing House, New Delhi.</li> <li>4. Sastry, S.S. (2000): Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi.</li> </ol>	
Evaluation	CIA- 20 End Sem- 80 Total: 100 Module 1: 55 Module 2: 25	
Paper Structure	Short questions (5 marks each)	Long questions (15 marks each)
Module 1	5 out of 8	2 out of 3
Module 2	2 out of 3	1 out of 2

Semester	<b>FOUR</b>
Paper Number	<b>HSTCR4082T &amp; HSTCR4082P</b>
Paper Title	<b>Statistical Inference 2</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>



No. of periods assigned	Th: 4 Pr: 3
Module	Single
Course description/objective	<p><i>At the end of the course a student should</i></p> <ul style="list-style-type: none"> <li>○ Understand the basic notions of point estimation.</li> <li>○ Visualise the notion of MVUE.</li> <li>○ Know the different methods to generate point estimators.</li> <li>○ Understand the Neyman Pearson approach to tests of significance</li> <li>○ Understand the Likelihood approach to tests of significance and its general applicability.</li> <li>○ Understand the link between the Neyman Pearson and Likelihood approach.</li> <li>○ Understand the basic difference between a fixed sample approach and the sequential approach to testing of hypotheses.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b><i>Estimation:</i></b> Concepts of estimation, unbiasedness, mean square error, sufficiency, completeness and exponential family of distributions. [6L]  Factorization theorem. Minimum variance unbiased estimator (MVUE), Rao-Blackwell and Lehmann-Scheffe theorems and their applications. [10L]  Cramer-Rao inequality (statement and applications) and MVB estimators [4L]</p> <p><b>UNIT 2:</b>  <b><i>Methods of Estimation:</i></b> Method of moments, method of maximum likelihood estimation, method of minimum Chi-square [8L]</p> <p><b>UNIT 3:</b>  <b><i>Principles of test of significance:</i></b> Most powerful test, uniformly most powerful test, Neyman Pearson Lemma (statement and applications to construct most powerful test), Unbiased test. [10L]  Likelihood ratio test, properties of likelihood ratio tests (without proof) [3L]</p> <p><b>UNIT 4:</b>  <b><i>Sequential Analysis:</i></b> Sequential probability ratio test (SPRT) for simple vs simple hypotheses. [3L]  Fundamental relations among <math>\alpha</math>, <math>\beta</math>, A and B, determination of A and B in practice. [4L]  Wald's fundamental identity and the derivation of operating</p>

	characteristics (OC) and average sample number (ASN) functions. Examples based on Normal, Poisson, Binomial and Exponential distributions. [4L]	
List of Practical	<ol style="list-style-type: none"> <li>1. Unbiased estimators (including unbiased but absurd estimators)</li> <li>2. Cramer-Rao inequality and MVB estimators</li> <li>3. Sufficient Estimators – Factorization Theorem, Rao-Blackwell theorem, Complete Sufficient estimators</li> <li>4. Lehman-Scheffe theorem and UMVUE</li> <li>5. Maximum Likelihood Estimation</li> <li>6. Estimation by the method of moments, minimum Chi-square</li> <li>7. Most powerful critical region (NP Lemma)</li> <li>8. Uniformly most powerful critical region</li> <li>9. Unbiased critical region</li> <li>10. Power curves</li> <li>11. Likelihood ratio tests for simple null hypothesis against simple alternative hypothesis</li> <li>12. Likelihood ratio tests for simple null hypothesis against composite alternative hypothesis</li> <li>13. Asymptotic properties of LR tests</li> <li>14. SPRT procedure</li> <li>15. OC function and OC curve</li> <li>16. ASN function and ASN curve</li> </ol>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Goon A.M., Gupta M.K.: Das Gupta.B. (2005), Fundamentals of Statistics, Vol. I, World Press, Calcutta.</li> <li>2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2<sup>nd</sup>Edn. (Reprint) John Wiley and Sons.</li> <li>3. Miller, I. and Miller, M. (2002) : John E. Freund's Mathematical Statistics (6th addition, low price edition), Prentice Hall of India.</li> <li>4. Dudewicz, E. J., and Mishra, S. N. (1988): Modern Mathematical Statistics. John Wiley &amp; Sons.</li> <li>5. Mood A.M, Graybill F.A. and Boes D.C (2001) : Introduction to the Theory of Statistics, McGraw Hill, New Delhi.</li> <li>6. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997) Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.</li> <li>7. Snedecor G.W and Cochran W.G.(1967) Statistical Methods. Iowa State University Press.</li> </ol>	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>FOUR</b>
Paper Number	<b>HSTCR4092T &amp; HSTCR4092P</b>
Paper Title	<b>Linear Models</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	Single
Course description/objective	<p><i>At the end of the course, a student is expected to</i></p> <ul style="list-style-type: none"> <li>○ Extend the modelling of a response-predictor relationship to the case where there are more than 2 predictors. Also, to extend the concepts of multiple and partial correlations to the multivariate case.</li> <li>○ Identify a Gauss Markov Model and classify it based on the nature of the parameters and the design matrix.</li> <li>○ Define Estimability of Linear Parametric Functions, identify such functions and their BLUES. Estimation of the Error Variance in a Gauss Markov Model.</li> <li>○ Know the Fundamental Theorems of Least squares and their applications in analysing ANOVA, Regression and ANOCOVA Models.</li> <li>○ Test for presence of regression, structural form of regression in a bivariate setup, compare regression lines over two or more populations, presence of regression and significance of predictors in a multivariate setup.</li> <li>○ To learn to include a concomitant variable in order to increase the efficiency of tests of differential effects of factors- ANOCOVA Models.</li> </ul>

Syllabus	<p><b>UNIT 1:</b>  <b>Multivariate Data:</b> Multiple linear regression, multiple and partial correlation. [10L]</p> <p><b>UNIT 2:</b>  <b>Gauss-Markov set-up:</b> Theory of linear estimation, Estimability of linear parametric functions, Method of least squares, Gauss-Markov theorem, Estimation space and Error Space, Estimation of error variance. Tests of General Linear Hypotheses (statements only). Classification of Linear Models. [10L]</p> <p><b>UNIT 3:</b>  <b>Regression analysis:</b> Hypothesis testing in case of simple and multiple regression models. [10L]</p> <p><b>UNIT 4:</b>  <b>Analysis of variance:</b> Analysis of Variance in one-way and two-way classified data (with equal number of observations per cell) for fixed effect models. [12L]  <b>Analysis of covariance:</b> Analysis of covariance for one-way and two-way classified data with one concomitant variable. [10L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Estimability in Gauss Markov Model.</li> <li>2. Simple linear regression.</li> <li>3. Multiple regression.</li> <li>4. Tests for linear hypothesis.</li> <li>5. Analysis of variance of one way classified data.</li> <li>6. Analysis of variance of a two way classified data with one observation per cell.</li> <li>7. Analysis of variance of a two way classified data with equal number of observations per cell.</li> <li>8. Analysis of covariance of a one way classified data with one concomitant variable.</li> <li>9. Analysis of covariance of a two way classified data with one concomitant variable.</li> </ol>
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Goon, A.M., Gupta, M.K., and Dasgupta, B. (2002), Fundamental of Statistics, Volume 1, 8th Edn. The World Press, Kolkata.</li> <li>2. Goon, A.M., Gupta, M.K., and Dasgupta, B. (2002), Fundamental of Statistics, Volume 2, 8th Edn. The World Press, Kolkata.</li> <li>3. Scheffe, H, Linear Models</li> <li>4. Rao, C.R., Linear Statistical Inference.</li> <li>5. Mukhopadhyay, P. (2011): Applied Statistics, 2<sup>nd</sup> edition revised reprint, Books and Allied(P) Ltd.</li> <li>6. Weisburg, S (2005) Applied Linear Regression (Third edition), Wiley.</li> <li>7. Wu, C. F. J. and Hamada, M. (2009). Experiments, Analysis and Parameter Design Optimization (Second edition), John Wiley.</li> </ol>

	8. Renchner, A.C. and Schaalje, G.B. (2008). Linear Models in Statistics (Second edition), John Wiley and Sons.	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>FOUR</b>
Paper Number	<b>HSTCR4102T &amp; HSTCR4102P</b>
Paper Title	<b>Statistical Quality Control</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	single
Course description/objective	<p><i>At the end of the course, a student is expected to</i></p> <ul style="list-style-type: none"> <li>○ Have an exposure to the application of statistical theory in the industry.</li> <li>○ Distinguish the various phases of SQC and capturing the variation in quality of the manufactured items.</li> <li>○ Learn about Statistical Techniques used in various phases, namely Control Charts in Process Control and Sampling Inspection Techniques in Product Control.</li> <li>○ Learn to measure process capability.</li> <li>○ Identify and determine an optimum Sampling Inspection Plan when the quality of a product is an attribute.</li> <li>○ Learn about recent developments in SQC – Six Sigma Plans, Total Quality Management, VOC and Critical to Quality Concepts.</li> </ul>
Syllabus	<b>UNIT 1:</b> <b>Quality:</b> Definition, dimensions of quality, historical perspective of quality control and improvements starting from World War II, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards: Introduction to ISO quality standards, Quality registration. Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation. Statistical Control

	<p>Charts- Construction and Statistical basis of 3-<math>\sigma</math> Control charts, Rational Sub-grouping. [12L]</p> <p><b>UNIT2:</b>  <b>Control charts :</b> X-bar &amp; R-chart, X-bar &amp; s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes. Analysis of patterns on control chart. Estimation of process capability.  [16L]</p> <p><b>UNIT 3:</b>  <b>Acceptance sampling plan for attributes:</b> Principle of acceptance sampling plans. Single and Double sampling plan their OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables.  [12L]</p> <p><b>UNIT 4:</b>  <b>Introduction to Six-Sigma:</b> Overview of Six Sigma, Lean Manufacturing and Total Quality Management (TQM). Organizational Structure and Six Sigma training plans-Selection Criteria for Six-Sigma roles and training plans. Introduction to DMAIC using one case study: Define Phase, Measure Phase, Analyse Phase, Improve Phase and Control Phase.  [12L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Construction and Interpretation of statistical control charts  X-bar &amp; R chart  X-bar &amp; s-chart  np- chart  p-chart  c-chart  u- chart</li> <li>2. Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves.</li> <li>3. Calculation of process capability and comparison of 3-sigma control limits with specification limits.</li> <li>4. Use a case study to apply the concept of six sigma application in DMAIC: practical application.</li> </ol>
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Montgomery, D.C. (2009): Introduction to Statistical Quality control, 6<sup>th</sup> edition, Wiley India, Pvt Ltd</li> <li>2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol 2, 8<sup>th</sup> edition, The world Press, Kolkata</li> </ol>

	3. Mukhopadhyay, P. (2011): Applied Statistics, 2 <sup>nd</sup> edition revised reprint, Books and Allied(P) Ltd. 4. Montgomery, D.C. and Runger, G.C. (2008): Applied Statistics and Probability for Engineers, 3 <sup>rd</sup> edition reprint, Wiley India Pvt Ltd. 5. Ehrlich, B. Harris (2002): Transactional Six sigma and Lean Servicing, 2 <sup>nd</sup> edition, St Lucie Press 6. Hoyle, David (1995): ISO Quality systems Handbook, 2 <sup>nd</sup> edition, Butterworth Heinemann Publication.	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>FIVE</b>
Paper Number	<b>HSTCR5112T &amp; HSTCR5112P</b>
Paper Title	<b>Stochastic Process and Time Series</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	Single
Course description/objective	<i>At the end of the course a student should be able to</i> <ul style="list-style-type: none"> <li>○ Identify a time series as a sequence of correlated random variables.</li> <li>○ Understand the difference between time series and time series data.</li> <li>○ Cite some real life examples of time series arising from different fields.</li> <li>○ Decompose time series data into classical components.</li> <li>○ Analyse for stationarity for an actual insight into the probability model underlying the series.</li> <li>○ Use the basics of forecasting for a time series.</li> </ul>
Syllabus	<b>UNIT 1:</b> Stochastic Process: Introduction and Stationary Process. Markov Chains: Definition of Markov Chain, transition probability matrix, order of markov chain, Markov chain as graphs, higher transition probabilities. [8L]  <b>UNIT 2:</b> Time Series as a Stochastic Process. Time Series data. Application of time series from various fields. Components of a times series, Decomposition of time series. Estimation of trend by free hand curve method, method of semi averages, fitting

	<p>mathematical curves, and growth curves. Method of moving averages. [16L]</p> <p><b>UNIT 3:</b> Estimation of seasonal component by Method of simple averages, Ratio to Trend, Ratio to Moving Averages and Link Relative method. Harmonic Analysis. Variate component method. [12L]</p> <p><b>UNIT 4:</b> Stationary Time series: Weak stationarity, autocorrelation function and correlogram. Some Special Processes: Moving-average (MA) process and Autoregressive (AR) process of orders one and two, Estimation of the parameters of AR (1) and AR (2) – Yule-Walker equations. Simple Exponential smoothing. [16L]</p>	
List of Practical	<ol style="list-style-type: none"> <li>1. Determination of trend by curve fitting</li> <li>2. Determination of trend by moving averages</li> <li>3. Determination of seasonal indices by method of averages</li> <li>4. Harmonic Analysis</li> <li>5. Correlogram Analysis</li> <li>6. Fitting of AR 1 and AR 2 models</li> <li>7. Simple Exponential Smoothing</li> </ol>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol 2, 8<sup>th</sup> edition, The world Press, Kolkata</li> <li>2. Cooray, TMJA(2008) Applied Time Series, Analysis and forecasting, Narosa Publishing house</li> <li>3. Chatfield, C. (2004) Analysis of Time Series, Chapman &amp; Hall</li> </ol>	
Evaluation	<p><b>Theory</b></p> <p>CIA: 10</p> <p>End-Sem: 50</p> <p>Total: 60</p>	<p><b>Practical</b></p> <p>Continuous assessment: 40</p>
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>FIVE</b>
Paper Number	<b>HSTCR5122T &amp; HSTCR5122P</b>
Paper Title	<b>Economic Statistics and Demography</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	2 Module 1: Units 1 & 2 ( 2 periods) Module 2: Units 3 & 4 ( 2 periods)



Course description/objective	<p><i>At the end of the course a student should</i></p> <ul style="list-style-type: none"> <li>○ Have preliminary ideas of formulating statistical measures to account for inflation/deflation and economic growth of a country.</li> <li>○ Have knowledge on comparative social statistics.</li> <li>○ Have an idea about a population and population study.</li> <li>○ Know some of the basic as well as derived measures for the study of human population.</li> <li>○ Understand the concept of a life table and its significance in real life.</li> <li>○ Be familiar with the notion of growth of a population along with methods of estimating and forecasting the same.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b><i>Index Numbers:</i></b> price, quantity and value indices, choice of weights, Various formulae and their comparisons. Tests of index numbers. Fisher's ideal index number. Chain Index Number. [10L]  <b><i>Some important indices:</i></b> Consumer Price Index, Wholesale Price index &amp; Index of industrial Production- methods of construction and uses. [3L]  <b><i>National accounts:</i></b> Definition of national income. A brief account of product, expenditure and income approaches for estimation of National Income. [3L]</p> <p><b>UNIT 2:</b>  <b><i>Measurement of poverty and inequality:</i></b> Desirable properties and different descriptive measures including Gini's coefficient, Lorenz curve. Use of Pareto and Log Normal distributions. Measures of unemployment. [7L]  <b><i>Comparative Social Statistics:</i></b> Indices related to human development and gender disparity. [3L]</p> <p><b>UNIT 3:</b>  <b><i>Introduction:</i></b> Demographic events and processes. Sources of population data, Census and registration. Errors in census and registration data. Rates and ratios of vital events. [3L]  <b><i>Measurements of mortality:</i></b> Crude death rate (CDR), Specific death rate (SDR), Infant mortality rate (IMR) and Standardized death rates. Life (Mortality) tables: assumption, description and uses. Stable and Stationary population. [7L]</p> <p><b>UNIT 4:</b>  <b><i>Measurements of Fertility:</i></b> Crude Birth Rate (CBR), General Fertility rate (GFR), Specific Fertility rate (SFR) and total Fertility rate (TFR). [6L]  <b><i>Measurement of population growth:</i></b> Crude rates of natural increase, Pearl's Vital index, Gross Reproduction Rate (GRR) and Net reproduction rate (NRR). [4L]</p>

	<b>Population estimation, Projection and Forecasting:</b> Use of AP and GP methods for population estimates. Fitting of population curve for population forecasting using Rhode's method. [6L]	
List of Practical	<ol style="list-style-type: none"> <li>1. Calculate price and quantity index numbers using simple and weighted average of price relatives.</li> <li>2. To calculate the Chain Base index numbers.</li> <li>3. Problems on cost of living index numbers.</li> <li>4. Lorenz curve.</li> <li>5. Pareto and lognormal fitting.</li> <li>6. Measures of mortality</li> <li>7. Life Tables</li> <li>8. Measures of fertility and population growth</li> <li>9. Population Estimation and Projection</li> <li>10. Fitting of logistic equation by Rhode's method</li> </ol>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Mudgett Bruce D (1951): Index Numbers, N.Y : Wiley.</li> <li>2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. II, 8th Edn. The World Press, Kolkata.</li> <li>3. Nagar A.L, Das R.K (1997): Basic statistics, Oxford University Press.</li> <li>4. Ramakumar R (2002) Technical Demography, New Age.</li> </ol>	
Evaluation	<b>Theory</b> CIA- 10 End Sem (Module 1) - 25 End Sem ( Module 2)- 25 Total - 60	<b>Practical</b> Continuous assessment: 40
Paper structure for End Sem Theory	Short questions ( 5 marks each)	Long questions(15 marks each)
Module 1	2 out of 3	1 out of 2
Module 2	2 out of 3	1 out of 2

Semester	<b>SIX</b>
Paper Number	<b>HSTCR6132T &amp; HSTCR6132P</b>
Paper Title	<b>Design of Experiments</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	single

Course description/objective	<p><i>At the end of the course, a student should be able to</i></p> <ul style="list-style-type: none"> <li>○ Understand Randomization and Replication as essential principles and Local Control as a desirable principle in statistical designing of experiments.</li> <li>○ Construct standard designs – CRD, RBD and LSD and apply ANOVA techniques to analyse these designs.</li> <li>○ Compare relative efficiency of one design with respect to the other.</li> <li>○ Analyse the standard designs if one observation is missing in the layout.</li> <li>○ Understand Incomplete Block Designs.</li> <li>○ Construct and analyse un-confounded and confounded Factorial Designs.</li> <li>○ Construct Fractional Factorials by creating aliases.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b>Experimental designs:</b> Role, historical perspective. Terminologies: Experimental error, Basic principles, Uniformity trials, Fertility contour maps, Choice of size and shape of plots and blocks. [5L]  <b>Basic designs:</b> Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – Layout, Model and Analysis, Relative Efficiencies, Analysis with one missing observation. [10L]</p> <p><b>UNIT 2:</b>  <b>Incomplete Block Designs:</b> Balanced Incomplete Block Design (BIBD) – parameters, relationships among its parameters, incidence matrix and its properties. [8L]</p> <p><b>UNIT 3:</b>  <b>Factorial experiments:</b> Advantages, Notations and Concepts of <math>2^n</math> factorial experiments- their design and analysis. Total and Partial confounding for <math>2^n</math> (<math>n \leq 5</math>), factorial experiments. [19L]</p> <p><b>UNIT 4:</b>  <b>Fractional factorial experiments:</b> Construction of one-half and one-quarter fractions of <math>2^n</math> (<math>n \leq 5</math>) factorial experiments, Alias structure, Resolution of a design. [10L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Analysis of CRD</li> <li>2. Analysis of an RBD</li> <li>3. Analysis of an LSD</li> <li>4. Analysis of an RBD with one missing observation</li> <li>5. Analysis of an LSD with one missing observation</li> <li>6. Analysis of <math>2^2</math> and <math>2^3</math> factorial in CRD and RBD</li> <li>7. Analysis of <math>2^2</math> and <math>2^3</math> factorial in LSD</li> <li>8. Analysis of a completely confounded two level factorial design in 2 blocks</li> <li>9. Analysis of a completely confounded two level factorial design in 4 blocks</li> </ol>

	10. Analysis of a partially confounded two level factorial design 11. Analysis of a single replicate of a 2 <sup>n</sup> design 12. Analysis of a fraction of 2 <sup>n</sup> factorial design	
Reading/Reference Lists	1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8thEdn. World Press, Kolkata. 2. Mukhopadhyay, P. : Applied Statistics. 3. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House. 4. Dey, A. (1986) : Theory of Block Designs, Wiley Eastern Limited. 5. Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley. 6. Das, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments. Wiley Eastern Ltd. 7. Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>SIX</b>
Paper Number	<b>HSTCR6142T &amp; HSTCR6142P</b>
Paper Title	<b>Multivariate Analysis and Non Parametric Methods</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	single
Course description/objective	<i>At the end of the course students should know</i> <ul style="list-style-type: none"> <li>○ About Multivariate Probability Distribution.</li> <li>○ Multinomial and Multivariate Normal distributions along with their properties.</li> <li>○ Sampling distributions of some statistics drawn from Multivariate Normal distribution.</li> <li>○ Application of multivariate techniques in Principal Component Analysis</li> <li>○ Application of multivariate techniques in Principal Component Analysis</li> <li>○ Discriminant Analysis.</li> <li>○ Different nonparametric tests for location, scale and randomness.</li> </ul>

Syllabus	<p><b>UNIT I:</b>  <b>Random Vector:</b> Probability mass/density functions, Distribution function, Mean vector &amp; Dispersion matrix, Marginal &amp; Conditional distributions. [6L]</p> <p><b>UNIT 2:</b>  Multinomial Distribution, Multivariate Normal distribution and its properties [12L].  Sampling distribution for mean vector and variance- covariance matrix (Statement only) [5L]  Multiple and partial correlation coefficient and their properties.[5L]</p> <p><b>UNIT 3:</b>  <b>Applications of Multivariate Analysis:</b> Discriminant Analysis, Principal Components Analysis. [12L]</p> <p><b>UNIT 4:</b>  <b>Nonparametric Tests:</b> Introduction and Concept, Test for randomness based on total number of runs, Empirical distribution function, Kolmogrov Smirnov test for one sample, Sign tests- one sample and two samples, Wilcoxon-Mann-Whitney test, Kruskal-Wallis test. [12L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Multiple Correlation</li> <li>2. Partial Correlation</li> <li>3. Multivariate Normal Distribution</li> <li>4. Multinomial Distribution</li> <li>5. Discriminant Analysis</li> <li>6. Principal Components Analysis</li> <li>7. Test for randomness based on total number of runs,</li> <li>8. Kolmogrov Smirnov test for one sample.</li> <li>9. Sign test: one sample, two samples, large samples.</li> <li>10. Wilcoxon-Mann-Whitney U-test</li> <li>11. Kruskal-Wallis test</li> </ol>
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Anderson, T.W. (2003): An Introduction to Multivariate Statistical Analysis, 3<sup>rd</sup> Edn., John Wiley</li> <li>2. Muirhead, R.J. (1982): Aspects of Multivariate Statistical Theory, John Wiley.</li> <li>3. Kshirsagar, A.M. (1972) :Multivariate Analysis, 1<sup>st</sup>Edn. Marcel Dekker.</li> <li>4. Johnson, R.A. and Wichern, D.W. (2007): Applied Multivariate Analysis, 6<sup>th</sup>Edn., Pearson &amp; Prentice Hall</li> <li>5. Mukhopadhyay, P. (2006) : Mathematical Statistics. 3<sup>rd</sup> Edn, Books and Allied limited, Kolkata.</li> <li>6. Gibbons, J. D. and Chakraborty, S (2003): Nonparametric Statistical Inference. 4<sup>th</sup> Edition. Marcel Dekker, CRC.</li> </ol>

Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

	<b>FIVE</b>
Paper Number	<b>HSTDS5012T &amp; HSTDS5012P</b>
Paper Title	<b>Categorical Data Analysis</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	single
Course description/objective	<p><i>At the end of the course a student should know</i></p> <ul style="list-style-type: none"> <li>○ The difference between ordinal and nominal scales of measurement.</li> <li>○ Concept of contingency tables.</li> <li>○ Different measures of association for a kx1 contingency table.</li> <li>○ Different measures of association in three way tables.</li> <li>○ How to model cell frequencies in a contingency table.</li> <li>○ Logit and Probit regression models with reference to binary data</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b><i>Association in two way tables:</i></b> Introduction to Categorical Data, 2x2 contingency table, types of observational studies, notion of independence &amp; association, ideas of complete and absolute association. Yules measures of association and colligation, Cramer's measure of association, Extension to kx1 contingency table: Pearson's chi-square, Kendall's <math>\tau</math> &amp; <math>\tau_b</math>, Goodman-Kruskal's <math>\gamma</math>. Difference of proportions, relative risk, odds ratio, log odds ratio. [20L]</p> <p><b>UNIT 2:</b>  <b><i>Association in three way tables:</i></b> Partial tables, marginal tables, conditional associations, conditional versus marginal association, Simpson's paradox. Conditional and marginal odds ratio, Conditional independence versus marginal independence. Homogeneous association. [10L]</p> <p><b>UNIT 3:</b></p>

	<p><b>Generalized linear Model:</b> Components of a generalized linear model, Random component, systematic component, Link function</p> <p>[6L]</p> <p><b>Generalized linear model for binary data:</b> Logistic and probit regression model, Multiple logistic regression. Model fitting by using score function. [8L]</p> <p><b>UNIT 4:</b></p> <p><b>Model for contingency table:</b> Log linear model of independence for two way table, Interpretation of the parameters in independence model, saturated model for two way table. The log-linear and logistic connection. [8L]</p>	
List of Practical	<ol style="list-style-type: none"> <li>Measures of association for 2x2 contingency table.</li> <li>Relative risk, odds ratio</li> <li>Measures of association for kx1 contingency table.</li> <li>Fitting a logit model</li> <li>Fitting a probit model</li> <li>Fitting of multiple logistic regression.</li> </ol>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>Goon A.M., Gupta M.K., Dasgupta, B. (2005), Fundamentals of Statistics, Vol II, World Press, Calcutta.</li> <li>McCullagh, P &amp; Nelder, J.A.(1995), Generalized Linear Models. Chapman and Hall.</li> <li>Simonoff, J.F.(2010): Analyzing Categorical Data. Springer</li> <li>Fienberg, S.E. (2007): The Analysis of Cross Classified data, 2<sup>nd</sup> Edn, Springer</li> <li>Michael S. Lewis Beck (1993): Basic Statistics. Sage Publication.</li> <li>Agresti, A. (2007): An Introduction to Categorical data analysis. Wiley.</li> </ol>	
Evaluation	<p style="text-align: center;"><b>Theory</b></p> <p>CIA: 10</p> <p>End-Sem: 50</p> <p>Total: 60</p>	<p style="text-align: center;"><b>Practical</b></p> <p>Continuous assessment: 40</p>
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

r	<b>FIVE</b>
Paper Number	<b>HSTDS5022T &amp; HSTDS5022P</b>
Paper Title	<b>Large Sample Theory</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3

Module	Single
Course description/objective	<p><i>At the end of the course students should</i></p> <ul style="list-style-type: none"> <li>○ Understand different modes of convergence of statistics and inter-relationship among them.</li> <li>○ Know about Central Limit Theorem and its applications.</li> <li>○ Understand the large sample behaviour of different statistics (based on both moments and quantiles) relating to estimation and tests of hypothesis.</li> <li>○ Know about various transformations on statistics and their use in inferential problems.</li> <li>○ Know about Pearsonian Chi-Square statistic and its uses.</li> <li>○ Know about different asymptotic properties of estimators.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b>Limit Theorems:</b> Convergence in Probability, Weak Laws of Large Numbers and their applications, Convergence in Distribution, relation between two kind of convergence, Slutsky's Theorem, De-Moivre-Laplace Limit Theorem. Normal approximation to Poisson distribution, Statement of Central Limit Theorem (iid case) and its use in test and confidence interval for binomial proportions and Poisson means.  [10L]</p> <p><b>UNIT 2:</b>  <b>Standard Errors of Statistics:</b> Derivation and uses of large sample standard error of sample moments, Standard deviation, Coefficient of variation, <math>b_1</math> &amp; <math>b_2</math> measures, Correlation coefficient. Asymptotic distribution of sample quantiles.  [14L]</p> <p><b>Variance Stabilization:</b> Transformation of Statistics, Derivation and use of <math>\sin^{-1}</math>, square root, logarithmic &amp; Fisher's Z transformations.  [10L]</p> <p><b>UNIT 3:</b>  <b>Asymptotic Property of Estimators:</b> Consistency, Asymptotic efficiency, ARE, CAN and BAN estimators. Properties of MLE (statement only) and their uses in testing and confidence interval.  [8L]</p> <p><b>UNIT 4:</b>  <b>Pearsonian <math>\chi^2</math>:</b> Large Sample distribution of Pearsonian <math>\chi^2</math> statistic &amp; its uses (goodness of fit, independence, homogeneity). Yates' correction in a 2x2 contingency table.  [10L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Testing of significance and confidence intervals for single proportion and difference of two proportions using CLT.</li> </ol>



	<ol style="list-style-type: none"> <li>Testing of significance and confidence intervals for single Poisson mean and difference of two Poisson means using CLT.</li> <li>Testing of significance and confidence intervals concerning sample standard deviation, coefficient of variation and correlation coefficient (both single sample and two sample cases).</li> <li>Testing of significance and confidence intervals using variance stabilizing transformations.</li> <li>Determination of the minimum sample size required to achieve normality by sample proportion, mean and standard deviation.</li> <li>Tests for goodness of fit, independence and homogeneity using Pearsonian chi-square statistic.</li> </ol>	
Reading/Reference Lists	<ol style="list-style-type: none"> <li>A.M.Gun, M.K. Gupta &amp; B.Dasgupta (2003): An Outline of Statistical Theory, Vol 1 , 4<sup>th</sup> Edn World Press.</li> <li>A.M.Gun, M.K. Gupta &amp; B.Dasgupta (2005): An Outline of Statistical Theory Vol. 2 , 3<sup>rd</sup> Edn World Press.</li> <li>P. Mukhopadhyay (2006): Mathematical Statistics. 3<sup>rd</sup> Edn, Books and Allied Limited</li> <li>V.K. Rohatgi &amp; A.K.M.E. Saleh (2003): An Introduction to Probability and Statistics, 2<sup>nd</sup> Edn, Wiley.</li> <li>C.R. Rao (1983): Linear Statistical Inference and its Application. 3<sup>rd</sup> Edn, Wiley Eastern Limited.</li> <li>R.V. Hogg and A.T. Craig (2002): Introduction to Mathematical statistics. 5<sup>th</sup> Edn, Pearson Education.</li> </ol>	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>SIX</b>
Paper Number	<b>HSTDS6032T &amp; HSTDS6032P</b>
Paper Title	<b>Econometrics</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 3
Module	Single

Course description/objective	<p><i>At the end of the course students should</i></p> <ul style="list-style-type: none"> <li>○ Knowledge of the concept of Economic Modelling.</li> <li>○ Knowledge of the difference between an economic and an econometric model.</li> <li>○ Knowledge about the Gauss-Markov linear model elaborately and the corresponding inferential problems.</li> <li>○ Elaborate knowledge about the phenomena - Heteroscedasticity, Autocorrelation and Multicollinearity.</li> <li>○ Knowledge of the tools for detection of Heteroscedasticity, Autocorrelation and Multicollinearity of the above model, some of their effects.</li> <li>○ Knowledge of the remedial measures.</li> <li>○ Knowledge of validating economic model through the econometric tools.</li> </ul>
Syllabus	<p><b>UNIT1:</b>  <b><i>What is Econometrics:</i></b> Comparing mathematical and econometric model with illustrative examples – consumption and production function, Stages of econometric methodology, Review of simple linear regression model.  <b>Regression Diagnostics:</b> Residual plots, outliers, leverage and influential data points, Cook’s distance.  [10L]</p> <p><b>UNIT 2:</b>  <b><i>Heteroscedasticity:</i></b> Nature of heteroscedasticity – illustrative examples, OLS method under heteroscedasticity and its consequences, detecting heteroscedasticity – residual plot, Glejser test, Goldfeld-Quandt test, remedial measure through variable transformation and generalized least squares (GLS).  [15L]</p> <p><b>UNIT 3:</b>  <b><i>Autocorrelation:</i></b> Nature of autocorrelation – illustrative examples, OLS method under autocorrelation – AR(1) model, detecting autocorrelation – residual plot, Runs test, Durbin-Watson test, GLS method for correcting autocorrelation.  [12L]</p> <p><b>UNIT 4:</b>  <b><i>Multicollinearity:</i></b> Nature of multicollinearity – illustrative examples, OLS method under perfect multicollinearity and its consequences, detecting multicollinearity – thumb rules based on <math>R^2</math>, pair-wise and partial correlations, remedial measures via more data, dropping and transformation of variables. [15L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Fitting of ordinary linear regression equations with diagnostics.</li> <li>2. Tests of heteroscedasticity.</li> <li>3. Fitting of regression equation after making adjustments for heteroscedasticity.</li> </ol>

	4. Tests of autocorrelation. 5. Fitting of regression equation after making adjustments for autocorrelation. 6. Tests of multicollinearity. 7. Fitting of regression equation after making adjustments for multicollinearity.	
Reading/Reference Lists	1. G.S. Maddala (1977): Introduction to Econometrics, Mac Graw Hill. 2. D.N. Gujarati (1995) : Basic Econometrics , Mac Graw Hill International editions. 3. J. Johnston and J. Dinardo (1997) : Econometric Methods , 4 <sup>th</sup> Edn, Mac Graw Hill.	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> Continuous assessment: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

#### General Elective Statistics

Semester	<b>THREE</b>
Paper Number	<b>HSTGE3032T &amp; HSTGE3032P</b>
Paper Title	<b>Introductory Probability</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 2
Module	Single
Course description/objective	<p><i>At the end of the course a student should</i></p> <ul style="list-style-type: none"> <li>○ Have the basic concepts of objective probability.</li> <li>○ Know different laws of probability and the theorems connecting them.</li> <li>○ Know the notion of conditional probability.</li> <li>○ Have a clear idea of a random variable.</li> <li>○ Understand different aspects of univariate discrete and continuous probability distribution.</li> <li>○ Have an idea of convergence in probability and in law.</li> </ul>
Syllabus	<b>UNIT 1:</b> Random experiments, sample space, events and algebra of events. Classical definition of probability, theorems regarding union and intersections of events (no derivation required). Conditional probability, theorem on conditional probability. Independence of events. Frequency definition of probability. [15L]  <b>UNIT 2:</b>

	<p>Random Variable and its probability distribution, cumulative distribution function, probability mass function, probability density function, moment and quantile measure of central tendency, dispersion, skewness, kurtosis (concepts only). [12L]</p> <p><b>UNIT 3:</b>  <b>Univariate Distributions:</b> Binomial, Poisson, Hypergeometric, Geometric, Rectangular, Normal, Exponential, Gamma, Beta.</p> <p>[17L]</p> <p><b>UNIT 4:</b>  Convergence in Probability, Almost sure convergence, Chebyshev's inequality, weak law of large numbers, De-Moivre Laplace and Lindeberg Levy Central Limit Theorem (Statement and application). [8L]</p>	
List of Practical	<ol style="list-style-type: none"> <li>1. Fitting of Binomial distribution.</li> <li>2. Fitting of Poisson distribution.</li> <li>3. Fitting of Normal distribution.</li> <li>4. Problems based on Binomial distribution.</li> <li>5. Problems based on Poisson distribution.</li> <li>6. Problems based on Normal distribution.</li> </ol>	
Reading/ Reference list	<ol style="list-style-type: none"> <li>1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I, 8th Edn. The World Press, Kolkata.</li> <li>2. Hogg and Craig: Introduction to Mathematical Statistics.</li> <li>3. S.M. Ross : A First Course in Probability.</li> </ol>	
Evaluation	<p style="text-align: center;"><b>Theory</b></p> <p>CIA: 10  End-Sem: 50  Total: 60</p>	<p style="text-align: center;"><b>Practical</b></p> <p>CIA: 10  End Sem: 30  Total: 40</p>
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

Semester	<b>FOUR</b>
Paper Number	<b>HSTGE4042T &amp; HSTGE4042P</b>
Paper Title	<b>Sampling Distributions and Statistical Inference</b>
No. of Credits	<b>6</b>
Theory/Composite	<b>Composite</b>
No. of periods assigned	Th: 4 Pr: 2
Module	single
Course description/objective	<p><i>At the end of the course a student should</i></p> <ul style="list-style-type: none"> <li>○ Have a clear idea of sampling distribution of a statistic and statistical inference.</li> </ul>

	<ul style="list-style-type: none"> <li>○ Be able to distinguish among the different categories of statistical inference.</li> <li>○ Have knowledge of some basic estimators.</li> <li>○ Have a basic idea on interval estimation.</li> <li>○ Have knowledge of basic statistical tests.</li> <li>○ Be able to appreciate the need for ANOVA and its basic underlying idea.</li> </ul>
Syllabus	<p><b>UNIT 1:</b> Population and Sample, Random Sample, Parameter &amp; Statistic, Sampling Fluctuation &amp; Sampling Distribution, Standard Error. Sampling Distributions arising out of Normal Population – <math>\chi^2</math>, t, F (definition &amp; statement of important properties). Joint Distribution of sample mean &amp; sample variance in case of normal population (statement only). [12L]</p> <p><b>UNIT 2:</b> <b>Point Estimation:</b> Estimator, Bias &amp; Mean Square Error. Unbiasedness &amp; Minimum Variance. Consistency- Sufficient conditions (statement only). Methods of Estimation – Method of Moments &amp; Method of Maximum Likelihood. [16L]</p> <p><b>UNIT 3:</b> <b>Testing of Hypotheses:</b> Null &amp; Alternative Hypotheses. Simple &amp; Composite Hypotheses. Test Statistic &amp; Critical Region. Type I &amp; Type II errors. Level of significance. Power &amp; Size. Tests for mean &amp; variance of a normal population. Tests for difference of means &amp; ratio of variances of two independent normal populations. Anova for one way and two way classified data with fixed effects model. [18L]</p> <p><b>UNIT 4:</b> <b>Interval Estimation:</b> Confidence Interval &amp; Confidence Coefficient. Confidence Interval for mean &amp; variance of a normal population and difference of means &amp; ratio of variances of two independent normal populations. [6L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Problems on Estimation.</li> <li>2. Confidence interval for the parameters of a normal distribution (one sample and two sample problems).</li> <li>3. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).</li> <li>4. Analysis of Variance of a one way classified data.</li> <li>5. Analysis of Variance of a two way classified data.</li> </ol>
Reading/ Reference list	<ol style="list-style-type: none"> <li>1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I, &amp; II, 8th Edn. The World Press, Kolkata.</li> <li>2. Goon, A.M. Gupta, M.K. and Dasgupta, B. (2003): An outline of Statistical Theory, Vol. 1, 4<sup>th</sup> Edn. World Press, Kolkata.</li> </ol>

	3. Rohatgi V.K. and Saleh, A. K. Md , E. (2009): An Introduction to Probability and Statistics, 2 <sup>nd</sup> edition (Reprint), John Wiley and Sons.	
Evaluation	<b>Theory</b> CIA: 10 End-Sem: 50 Total: 60	<b>Practical</b> CIA: 10 End Sem: 30 Total: 40
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	4 out of 6	2 out of 3

### PROGRAM SPECIFIC OUTCOMES:

1. Provide the foundations to apply the fundamental concepts of exploratory data analysis.
2. Knowledge of the basic concepts of analysis, algebra and probability theory.
3. Knowledge of the basic theoretical and applied principles of statistics.
4. Knowledge of software and programming logic.
5. Analyzing data arising out of different fields using statistical packages to draw statistically valid conclusions.
6. The knowledge acquired in the course helps a student to pursue Masters in Statistics or get placement as an applied statistician as well.
7. Contribution to the advancement of research and development at large by encouraging independent statistical thinking through project dissertation.

### Skill Enhancement Statistics

Semester	<b>THREE</b>
Paper Number	<b>HSTSE3011P</b>
Paper Title	<b>Introduction to C Programming</b>
No. of Credits	<b>2</b>
Theory/Composite	<b>Practical</b>
No. of periods assigned	<b>2+2</b>
Module	<b>Single</b>
Course description/objective	<p><i>At the end of the course, a student is expected to</i></p> <ol style="list-style-type: none"> <li>1. Understand the importance and uniqueness of C programming language.</li> <li>2. Understand the loop structures and their uses.</li> <li>3. Understand the conditional statements and their uses.</li> <li>4. Create user defined functions and use them appropriately.</li> <li>5. Know the basic ways of handling file in C.</li> <li>6. Know the usage of C programming in some selected fields of Statistics and Mathematics.</li> </ol>
Syllabus	<b>UNIT 1:</b> <b>Introduction:</b> Constants, Variables and Key Words. Relational and logical operators. Conditional Statements – <i>If, If-Else</i> . Loop Structures – <i>For</i> loop. Control statements: <i>Break, Exit</i> and <i>Continue</i> functions. Single Dimensional Array. [14L]

	<p><b>UNIT2:</b>  <b>Loop Structures:</b> While, Do-While. Two Dimensional Arrays. [8L]</p> <p><b>UNIT 3:</b>  <b>User-defined functions:</b> A multi-function program using user-defined functions, definition of functions, return values and their types, function prototypes and calls. Category of Functions : no arguments and no return values, arguments but no return values, arguments with return values, no arguments but returns a value, functions that return multiple values. Recursion function. [20L]</p> <p><b>UNIT 4:</b>  <b>Files and Pointers:</b> Declaration and initialization of pointer variables, accessing the address of a variable, accessing a variable through its pointer, pointer expressions. Pointers and arrays, arrays of pointers, pointers as function arguments, functions returning pointers. Basic file handling. [10L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Moment Measures of Central Tendency, Dispersion, Skewness and Kurtosis.</li> <li>2. Quantile Measures of Central Tendency, Dispersion, Skewness and Kurtosis.</li> <li>3. Construction of a Frequency Distribution – Discrete and Continuous.</li> <li>4. Computation of Simple Correlation Coefficient and Regression Lines.</li> <li>5. Spearman's Rank Correlation Coefficient.</li> <li>6. Addition, Multiplication and Transpose of Matrices.</li> <li>7. Determinant of a matrix.</li> <li>8. Inverse of a non-singular matrix.</li> <li>9. Interpolation by Lagrange's Formula.</li> <li>10. Solution of Equations by Bisection and Iteration Methods.</li> <li>11. Numerical Integration – Trapezoidal and Simpson's One Third Rules.</li> <li>12. Value of n! using recursion.</li> <li>13. Random number generation from Uniform, Normal, Chi-square, t and F distributions.</li> <li>14. Storage of output in a file.</li> </ol>
Reading/Reference Lists	<ol style="list-style-type: none"> <li>1. Kernighan, B.W. and Ritchie, D. (1988): C Programming Language, 2<sup>nd</sup> Edition, Prentice Hall.</li> <li>2. Balagurusamy, E. (2011): Programming in ANSI C, 6<sup>th</sup> Edition, Tata McGraw Hill.</li> <li>3. Gottfried, B.S. (1998): Schaum's Outlines: Programming with C, 2<sup>nd</sup> Edition, Tata McGraw Hill.</li> <li>4. Kanetkar Y. (2016): Let Us C, 15<sup>th</sup> Edition, BPB Publication.</li> </ol>
Evaluation	<p>CIA: 20  End Sem: 80  Total: 100</p>

Semester	<b>FOUR</b>
Paper Number	<b>HSTSE4021P</b>
Paper Title	<b>Statistical Data Analysis Using R</b>
No. of Credits	<b>2</b>
Theory/Composite	<b>Practical</b>
No. of periods assigned	<b>2+2</b>
Module	Single
Course description/objective	<p><i>At the end of the course, a student is expected to:</i></p> <ul style="list-style-type: none"> <li>○ Create, Access and Save Files, access help pages and load/install new packages.</li> <li>○ Use R as a calculator to compute basic mathematical functions.</li> <li>○ Draw diagrams and add titles and legends to them.</li> <li>○ Compute statistical measures using in-built functions.</li> <li>○ Learn programme structures and implement them to write one's own code.</li> <li>○ Read and Write Data from external file sources.</li> </ul>
Syllabus	<p><b>UNIT 1:</b>  <b>Introduction :</b> History and Overview of R, the CRAN, Installing the R Software, The R-Console and the R-Script. Saving and Accessing Files. Libraries in R. Loading and Installing Packages in R. The <i>quit()</i> and the <i>history()</i> commands. [2L]</p> <p><b>R as a calculator :</b> Basic Mathematical Functions. The Base Library. Defining variables, calling variables, Unary and Binary Operators on Variables. [3L]</p> <p><b>Modes of Data Storage :</b> Vectors, Matrices, Data Frames, Lists. The <i>c()</i>, <i>edit()</i> and <i>scan()</i> commands. Defining Attributes. Creating Patterned Data – the <i>rep()</i> and <i>seq()</i> commands. Extracting rows and columns in data frames and lists. Assigning names to columns of data frames and matrices and rows of lists. The \$ operator. The <i>attach()/detach()</i> command. Conditional selections and subsetting of objects. The <i>length()</i> command. Merging multiple vectors or columns of different data frames into one - The <i>cbind()</i>, <i>rbind()</i> and <i>merge()</i> commands. Inter-Conversions of the various modes of storages. [6L]</p> <p><b>UNIT 2:</b>  <b>Diagrammatic representations of Non-Frequency Data :</b> the <i>plot()</i> command. Line Diagram, Bar (Horizontal and Vertical) diagrams, Multiple Bar diagrams, Multiple Line diagrams, Pie and Subdivided Charts. Adding legends, Title, labels, limits on the axis. The 'graphics' package and the 'ggplot2' package. The <i>par()</i> parameter and its arguments. [6L]</p> <p><b>Diagrammatic representations of Frequency Data :</b> Frequency Distributions, the <i>table()</i> command. Column Diagrams and Histograms. Box Plots - the <i>summary()</i> command. Cumulative</p>



	<p>Frequency Diagrams. Juxtaposing frequency curves over histograms. [8L]</p> <p><b>UNIT 3:</b></p> <p><b>Univariate Statistics:</b> Descriptive Measures of Central Tendency, Dispersion, Skewness and Kurtosis. The '<i>moments</i>' package and its functions. [4L]</p> <p><b>Bivariate Statistics:</b> Scatterplot, Various forms of correlations. Regression Theory – the <i>lm()</i> command, polynomial regression. Residual Plots. [2L]</p> <p><b>Linear Algebra:</b> Algebra of Matrices. The '<i>Matrix</i>' package. Obtaining Determinants, Trace, Rank and Inverse of a Matrix. Obtaining row reduced forms of matrices, obtaining an orthonormal basis. Eigen Values and Eigen Vectors. Solving a system of equations. Diagonalisation of Matrices. [2L]</p> <p><b>UNIT 4:</b></p> <p><b>Programming in R:</b> Control Statements: if, if else. Loop Structures: for, while, repeat. User defined functions – Passing arguments, calling functions and returning values. [7L]</p> <p><b>Statistical Simulations:</b> Drawing Random Samples from different finite and infinite probability distributions – the <i>set.seed()</i> command. Illustrations through statistical problems (probability estimates by long-run relative frequencies, Bias and MSE's of estimates, coverage of Confidence Intervals, calculating empirical level and power of tests). Optimisation of Functions – the <i>optim()</i> function and its various arguments. [8L]</p> <p><b>File Handling:</b> Importing and Exporting Data from/to other softwares. [4L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Computing Basic Mathematical Functions using R as a calculator.</li> <li>2. Storing Data in various modes - vectors, matrices, data frames and lists.</li> <li>3. Representing Non-Frequency Data by diagrams.</li> <li>4. Obtain Frequency distributions from raw discrete and continuous data.</li> <li>5. Representing Frequency Data by diagrams.</li> <li>6. Univariate Statistical Measures in R.</li> <li>7. Bivariate Statistical Measures in R.</li> <li>8. Arithmetical Operations on Matrices and computing determinants, rank, inverse, characteristic roots and vectors of matrices.</li> <li>9. Control Structures and Loops in R.</li> <li>10. Applications of control structures and loops to write programme codes of various statistical problems.</li> <li>11. Export and Import Data from/to other software</li> <li>12. Install and load new packages and libraries in R.</li> </ol>

Reading/ Reference list	<ol style="list-style-type: none"> <li>1. Dalgaard, P : Introductory Statistics with R, Springer Publications, 2<sup>nd</sup> edition, 2008.</li> <li>2. Maindonald, J. &amp; Braun, J. : Data Analysis and Graphics Using R , Cambridge University Press, Cambridge, 2<sup>nd</sup> edition, 2007.</li> <li>3. Faraway, J. J. : Linear Models with R ,Chapman&amp; Hall/CRC Texts in Statistical Science.</li> </ol>
Evaluation	CIA: 20 End Sem: 80 Total: 100

	<b>FOUR</b>
Paper Number	<b>HSTSE452</b>
Paper Title	<b>Monte Carlo Method</b>
No. of Credits	<b>2</b>
Theory/Composite	<b>Practical</b>
No. of periods assigned	<b>2+2</b>
Module	<b>Single</b>
Course description/objective	<p><i>At the end of this course a student is expected to understand</i></p> <ul style="list-style-type: none"> <li>○ Random number generation through some popular approaches using computer.</li> <li>○ Simulation using CDF inversion and Box-Muller method and its various applications.</li> <li>○ Monte Carlo integration and basic idea of importance sampling</li> </ul>
Syllabus	<p><b>UNIT 1:</b></p> <p>Using the computer for random number generation (treated as a black box). A brief look at some popular approaches (no mathematical justification needed). Simulating a coin toss, a die roll and a card shuffle. [12L]</p> <p><b>UNIT 2:</b></p> <p>CDF inversion method. Simulation from standard distributions. Finding probabilities and moments using simulation. [10L]</p> <p><b>UNIT 3:</b></p> <p>Monte Carlo integration. Basic idea of importance sampling. (MCMC not included) [12L]</p> <p><b>UNIT 4:</b></p> <p>Generating from Binomial and Poisson distributions, and comparing the histograms to the PMFs.</p>

	<p>Generating from Uniform(0,1) distribution and applying inverse CDF transforms.</p> <p>Simulating Gaussian distribution using Box-Muller method.</p> <p>Approximating the expectation of a given function of a random variable using simulation.</p> <p>Graphical demonstration of the Law of Large Numbers.</p> <p>Approximating the value of pi by simulating dart throwing.</p> <p>[18L]</p>
List of Practical	<ol style="list-style-type: none"> <li>1. Using the computer for random number generation.</li> <li>2. Simulating a coin toss, a die roll and a card shuffle.</li> <li>3. Simulation from standard distributions using CDF inversion method.</li> <li>4. Finding probabilities and moments using simulation.</li> <li>5. Monte Carlo integration.</li> <li>6. Importance sampling.</li> <li>7. Generating from Binomial and Poisson distributions, and comparing the histograms to the PMFs.</li> <li>8. Generating from Uniform(0,1) distribution, and applying inverse CDF transforms.</li> <li>9. Simulating Gaussian distribution using Box-Muller method.</li> <li>10. Approximating the expectation of a given function of a random variable using simulation.</li> <li>11. Graphical demonstration of the Law of Large Numbers.</li> <li>12. Approximating the value of pi by simulating dart throwing.</li> </ol>
Reading/ Reference list	<ol style="list-style-type: none"> <li>1. Shonkwiler, Ronald W. and Mendivil, Franklin (2009): Explorations in Monte Carlo Methods (Undergraduate Texts in Mathematics)</li> <li>2. Carsey, Thomas M. and Harden, Jeffrey J. (2014): Monte Carlo Simulation and Resampling Methods for Social Science.</li> </ol>
Evaluation	50 marks: Continuous Internal assessment

	<b>FOUR</b>
Paper Number	<b>HSTSE453</b>
Paper Title	<b>Research Methodology</b>
No. of Credits	<b>2</b>
Theory/Composite	<b>Theory</b>
No. of periods assigned	<b>2</b>
Module	<b>Single</b>

Course description/objective	<p><i>At the end of the course a student is expected to understand</i></p> <ul style="list-style-type: none"> <li>• Different roles and types of research.</li> <li>• Survey methodology.</li> <li>• Various techniques for data analysis and interpretations.</li> <li>• Methods of Collecting survey data pertaining to a research problem.</li> <li>• Formats and presentations of Reports.</li> </ul>	
Syllabus	<p><b>UNIT 1:</b> What is Research? Role of Research in important areas. Characteristics of Scientific Method. Process of research: Stating Hypothesis or Research question, Concepts &amp; Constructs, Units of analysis &amp; characteristics of interest, Independent and Dependent variables, Extraneous or Confounding variables. Measurements and scales of Measurements. Types of research: Qualitative &amp; Quantitative Research, Longitudinal Research, Survey &amp; Experimental Research. [8L]</p> <p><b>UNIT 2:</b> Survey Methodology and Data Collection, sampling frames and coverage error, non-response. [5L]</p> <p><b>UNIT3:</b> Review of various techniques for data analysis covered in core statistics papers, techniques of interpretation, precaution in interpretation. [5L]</p> <p><b>UNIT 4:</b> Develop a questionnaire, collect survey data pertaining to a research problem (such as gender discriminations in private v/s government sector, unemployment rates, removal of subsidy, impact on service class v/s unorganized sectors), questions and answers in surveys, Internal &amp; External validity, , interpret the results and draw inferences. Formats and presentations of Reports – an overview. [8L]</p>	
List of Practical	NIL	
Reading/ Reference list	<ol style="list-style-type: none"> <li>1. Kothari, C.R. (2009): Research Methodology: Methods and Techniques, 2nd Revised Edition reprint, New Age International Publishers.</li> <li>2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners, SAGE publications.</li> </ol>	
Evaluation	<p>End Sem Exam : 40 Marks</p> <p>Continuous assessment: 10 marks</p> <p>Total: 50 marks</p>	
Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	2 out of 4	2 out of 3



# COMMERCE

## IT

### SEMESTER 3 – ECOMMERCE

#### COURSE OBJECTIVES

1. To learn about the working of various online business organizations; their business structures and how they generate revenue and the various security issues.
2. To enhance knowledge in the various cyber-crimes being committed and how to keep our data safe.
3. To learn how to create web pages and design them with the help of hyper texts and Java Script language – to impart the students a basic knowledge of scripting language.

#### Course Outcome

1. To be capable to implement the various strategies required in a business organization.
2. To associate with the peer groups for knowledge sharing sessions to further strengthen the decision making process.
3. To implement techniques to keep the data secured in the organizations
4. To develop websites for a business organizations

### SEMESTER 4 – COMPUTER APPLICATIONS IN BUSINESS

#### COURSE OBJECTIVES

1. To help students know about the concepts and terminology used in the operations of business computer applications.
2. To give hand-on experience in various application software to enhance knowledge in business activities
3. To enlighten the students in emerging issues on data science.

#### Course Outcome

1. Applying various techniques in business using different mathematical functions; carrying out analysis, creating simple and advanced graphical representations to minimize time and effort in real life.
2. To create database, manage data storage and retrieve data effectively.

### SEMESTER 6 – COMPUTERIZED ACCOUNTING SYSTEM

#### COURSE OBJECTIVES

1. To impart accounting knowledge to students through accounting and other computer application softwares.
2. To keep the students up-to-date regarding the various accounting software used in the market and make them ready to enter the field of job.
3. To help the students realize that the advantages of computerized accounting software over the traditional method of manual accounting software.

#### Course Outcome

1. To equip the students with application of query language, the most commonly used language in software system
2. To develop an understanding about the accounting information system
3. To equip students to develop computerized accounting system for small business.

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# BUSINESS LAW

Semester	1
Paper code	BCHCR120
Full marks	100
Paper name	BUSINESS LAW
Course objective	<ol style="list-style-type: none"> <li>1) describe methods of applying principles and the provisions of law</li> <li>2) assess the correctness of the actions taken in legal area in the light of the legal principles</li> <li>3) understand and identify the relevance of laws</li> <li>4) appreciate and understand the fundamental principles behind the laws</li> <li>5) demonstrate the competency in the use of the statutory materials to the practical life situations</li> <li>6) identify the legal obligations, remedies, rights and duties</li> <li>7) describe legal rules and concepts</li> </ol>
Course outcome	<ol style="list-style-type: none"> <li>1) compose simple contracts</li> <li>2) appreciate and understand the fundamental principles behind the laws</li> <li>3) be careful in the pursuits of law and legal principles</li> <li>4) develop awareness of the socio legal dimension of the law and its applicability</li> <li>5) demonstrate the competency in the use of the statutory materials to the practical life situations</li> </ol>

# CORPORATE LAW

Semester	2
Paper code	BCHCR220
Paper name	CORPORATE LAW



Full marks	100
Couse objective	<ol style="list-style-type: none"> <li>1) describe methods of applying principles and the provisions of law</li> <li>2) assess the correctness of the actions taken in legal area in the light of the legal principles</li> <li>3) understand and identify the relevance of laws</li> <li>4) understand and identify the relevance of laws</li> <li>5) appreciate and understand eth fundamental principles behind the laws</li> <li>6) be careful in eth pursuits of law and legal principles</li> <li>7) develop awareness of the socio legal dimension of the law and the applicability</li> </ol>
Course outcome	<ol style="list-style-type: none"> <li>8) identify and asses the need of the reformation of the l aw and its importance</li> <li>9) encourage students to develop a critical appreciation of the role of the corporate sector</li> <li>10) to understand the development and the changes of the law in eth corporate sector</li> <li>11) to help in the formation and the registration of the company</li> <li>12) to understand the government regulatory bodies like the SEBI and the MCA and their rules</li> <li>13) identify the legal obligations, remedies, rights and duties</li> </ol>

# ECONOMICS

- **Programme Outcome (PO)**

The CBCS curriculum as prescribed by UGC for B.COM(Honours) program is an interdisciplinary programme. The overall programme outcomes can be identified as :

- (i) Shift in focus from the teacher-centric to student-centric education.
- (ii) Student may undertake as many credits as they can cope with (without repeating all courses in a given semester if they fail in one/more courses).
- (iii) CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers(even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.
- (iv). CBCS makes education broad-based and at par with global standards. One can take credits by combining unique combinations. For example, Physics with Economics, Microbiology with Chemistry or Environment Science etc.
- (v).CBCS offers flexibility for students to study at different times and at different institutions to complete one course (ease mobility of students). Credits earned at one institution can be transferred to another institution.

- **Programme Specific Outcome (PSO)**

The programme specific outcome of B.Com (Honours) curriculum portrays an array of papers comprising of core papers, generic elective, ability enhancement courses. The B.Com (Honours) programme looks into an holistic development of a student . This is an interdisciplinary program, where a student will be exposed to the insights on Accounting & Finance, Marketing, Environmental Studies, Business Law, IT, Economics, Mathematics & Statistics and Language Group respectively. The specific outcomes of Economics program can be identified as :

- (i).. To able to understand basic concepts of economics.
- (ii). To able to analyze economic behavior in practice.
- (iii). Understand the economic way of thinking.
- (iv). The ability to analyze historical and current events from an economic perspective.
- (v). The ability to write clearly expressing an economic point of view.
- (vi). Be exposed to alternative approaches to economic problems through exposure to coursework in allied fields.
- (vii). To create students ability to suggest of the various economic problems.

- **Course Outcome (CO)**

The course outcome underlines the placing of three papers on Economics in B.Com (Honours) curriculum. Semester-I offers Micro-Economics , Semester-II offers Macro-Economics and Semester-IV offers Indian Economy respectively.

The outcome of the course on Micro-Economics in Semester-I is to acquaint the students with the concepts of microeconomics dealing with consumer behavior. The course also makes the student understand the supply side of the market through the production and cost behavior of firms.

The outcome of the course on Macro-Economics in Semester-II aims at providing the student with knowledge of basic concepts of the macro economics. The modern tools of macro-economic analysis are discussed and the policy framework is elaborated, including the open economy.

The outcome of the course on Indian Economy in Semester-IV seeks to enable the student to grasp the major economic problems in India and their solution. A student is expected to comprehend the basic fundamentals of the economy.

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# BENGALI

## BACHELOR OF ARTS (BA-BENGALI)

Learning Outcome Based Curriculum Framework

Paper Code-- GBNCR1031T

Paper Title- History of Literature, Novel, Drama

Semester- 1

No. Of Credits- 6

Theory/ Composite-- Theory

Number of period assigned-- 5 Theory+1 tutorial

### Program outcome

1. Basic information about History of Bengali literature of Medieval period.
2. Poets and their lives during their time related to socio-economic-cultural-political situations of Bengal.
3. Importance of 'Charyapada' and 'Shrikrishnakirtana' and other Medieval literature of Bengal.
4. A literary interpretation on Mati Nandi and his 'Koni'.
5. Description and perception on Manoj Mitra and his drama 'Narak Guljar'.
6. Relation between Modern time and modern Bengali literature.

### Programme Specific Outcome

1. Critical studies on Ancient and Mediaeval Bengali literature.
2. Information about the time period of Medieval Bengali literature.
3. Process of perception of a Bengali novel and a Bengali Drama.
4. Acquiring knowledge on criticism of Bengali Novel and Drama.
5. Knowledge on the new movement of Bengali Drama and its impact.
6. Humanity, religion and God in the Bengali literature.

### Course Outcome

1. Process of Criticism.
2. Interest on literature.
3. Increase of reading and writing habits of literature.
4. Thinking and learning mind.

St. Xavier's College (Autonomous), Kolkata

Department of Bengali

Learning Outcome Based Curriculum Framework

Semester--2

Paper Code--GBNCR2061T

Paper Title-Literary Genre, Medieval literature and story stories

Number of credits--6

Theory/Composite-- Theory

Number of period assigned--5 Theory+1 Tutorial

#### Programme Outcome

1. Vaishnava Sahitya of Medieval Bengali literature.
2. Different 'Parjaya' of Vaishnava Padaboli, likely Purbaraga, Anuraga, Avisara, Mathura, Prarthana.
3. Poets of Vaishnava Padaboli, likely Vidyapati, Chandidasa, Gyanadasa, Gobindadasa.
4. Different literary genres, likely Poetry, Novel, Short story, Drama - definition and characteristics.
5. Bengali short stories of Rabindranath.
6. Bengali short stories of Prabhatkumar Mukhopadhyaya, Saratchandra Chattopadhyay, Parashuram, Banaphul and Manik Bandyopadhyay.

#### Program Specific Outcome

1. Knowledge on differences between various types of literary genres.
2. Ability to criticize the short stories.
3. Enhancement of ability to know the quality of literature.
4. Knowledge of sources and roots of Bengali words used in medieval Vaishnava Padaboli.

#### Course Outcome

1. Literary and lyrical sense of Medieval Bengali Padaboli literature.
2. Critical studies and finding of significance of literary genres.
3. Introduction of Bengali short stories and Rabindranath's contribution on it.
4. Humour, tragical significance and reality in Bengali short stories.
5. Acquiring knowledge on significance of short stories.
6. Findings on Influence of life in Short story.

St. Xavier's College (Autonomous), Kolkata  
Department of Bangla

TLEARNING OUTCOME BASED CURRICULUM FRAMEWORK

### **GBNCR3091: Folk Literature; Essays, Poems of Rabindranath**

## **Programme Outcome**

1. To provide an idea about the poems of Rabindranath.
2. To introduce the rich tradition of belles letters in Bangla literature
3. To let them know about the different stages of Rabindranath's poetry and how the new dictions and ideas are emerging through the different stages of his life.

## **Programme Specific Outcome**

1. Students are knowing about Tagore's poetry as well as his life.
2. Students are being aware of biographical criticism, as they are being habituated to read a literature parallel with its author's biography.
3. There is a reach tradition of belles letter of Bangla literature, students are being familiarized with it and they are able to understand that how it has changed from time to time

## **Course Outcome**

By the end of the term the students

1. Will be familiar with Tagore's poetry as well as his biography
2. Will be able to understand the tradition of belles letters of bangla literature.

St. Xavier's College (Autonomous), Kolkata  
Department of Bangla

TLEARNING OUTCOME BASED CURRICULUM FRAMEWORK

**GBNCR4121T : Meter, Figure of speech, Novel**

## **Programme Outcome**

1. To provide an idea about rhetoric and prosody.
2. To provide an idea about Bangla novel and narratology.

## **Programme Specific Outcome**

1. Students are being able to scan a poem by its meter.
2. As well as they are being aware to read a poetry.

3. Students are having knowledge about novel and narratology.

### **Course Outcome**

By the end of the term the students

1. Will be able to scan a poem by it's metre.
2. Will be able to recite a poem better
3. Will be enriched by the theory of narratology and by the expatriation to judge a novel critically.

St. Xavier's College(Autonomous),Kolkata

Department of Bangla

## **LEARNING OUTCOME BASED CURRICULUM FRAMEWORK**

### **GBNCR5151T Linguistic and ability teaching**

#### **Programme Outcome**

The course designed for the BA General students aims to providing the fundamental concept of Linguistic and enhance some skills like translation, proof correction, letter writing, advertisement writing.

#### **Programme Specific Outcome**

The first section deals with the basic of sound changes, semantics and the change of meaning.

The second part offers proof correction, translation ( from English to Bengali ) some part of a prose of advertisement are to be given to translate. Or impersonal letter, dialogue of cinema are to be given to translate.

The final section offers letter writing, interview writing and advertisement writing.

### **Course Outcome**

The participants, students of BA General streams are expected to

acquire a basic knowledge of linguistic

achieve necessary skills to ready a by proof correction

develop their skills to write formal letter, advertisement, interview, dialogue which help them to be a professional reporter, translator, script writer etc.

### **GBNCR6181T Modern Literature and Technical Skill Enhancement**

#### **Programme Outcome**

The course designed for the BA General students aims to providing the fundamental history and the mode of formation of Bengali prose, story writing and Bengali poetry ( from Rabindranath Tagore to the first half of twentieth century)

#### **Programme Specific Outcome**

The first section deals with Sreerampore Mission to before Rabindranath Tagore period

The second section offers story writing

The final section offers Bengali poetry from Rabindranath to the first half of twentieth century.

### **Course Outcome**



The history of Bengali prose help the students to understand the mode of formation and changes of Bengali prose

Story writing increase their imagination power and their writing skill.

Receive the socio cultural perspective of Bengali poetry.

Understand the advancement of modern poetry from nineteenth century.

### **HBNGE301T : Bangla Fiction and its Adaptations**

#### **Programme Outcome**

The course, designed as an extra-departmental ancillary programme, aims at providing a cursory orientation to the fictional genre and its adaptation in different media. The course also includes the Dramatic Mode in its purview.

#### **Programme Specific Outcome**

- The programme deals with an array of fictional forms.
- The first section is dedicated to the genre of Novel.
- The second part offers close readings of Short Stories and their adaptation in Films.
- The final section is dedicated to Drama, where a select play is minutely studied.

#### **Course Outcome**

The participants, students of different Core streams, are expected to

- acquire a basic knowledge of literary fiction and modes of reading,
- learn the relations between literary and non-literary forms of expression,
- achieve necessary skills for contextualizing a literary text in its socio-cultural perspective,
- receive a basic idea of modalities of reception and inter-generic transactions.

## **HBNGE401T Bangla Lyric: Medieval period to Twentieth century**

### **Programme Outcome**

As one of the oldest literary genres, understanding of lyric is fundamental to any literary or linguistic exercise. The course is designed to address the nuances of the Lyric mode.

### **Programme Specific Outcome**

- The course addresses, in the beginning, the lyrics of the medieval period, in the forms of *padavali* – *Vaishnava* as well as *Shakta*.
- The programme moves on to the lyrics of nineteenth century and studies Iswar Gupta, Michael Madhusudan Dutt and Rabindranath Thakur.
- The final section of the programme is dedicated to the lyrics of the twentieth century and focuses on the works of the poets like Kazi Nazrul Islam, Jibanananda Dash, Sudhindranath Datta, Subhas Mukhopadhyay, Sankha Ghosh, Kavita Singha and Joy Goswamy.

### **Course Outcome**

The participants are expected to

- study and understand the emergence and development of Lyric as a Genre;
- learn the generic significance of the lyric form;
- study the relationship between religious practices in medieval Bengal and their relation to *padavali*;
- understand the advent of modernity in Bangla lyric; grasp the nuances of the poetic diction in the contemporary literary scenario.

# MASTER OF ARTS (MA-BENGALI)

## MBNG4101: Linguistics and Bangla Language

### Programme Outcome

- To have a fundamental understanding of the basic nature, branches and history of Linguistic enquiry;
- To understand and use methods of logical analysis and data from a wide variety of Languages and dialects;
- To distinguish, evaluate and interpret the methodologies and the results in the context of understanding the nature of language;
- To provide a broad interdisciplinary perspective on linguistics to emphasise the relevance of work in other fields.

### Programme Specific Outcome

- To familiarise with a philological and historical approach to the evolution of languages;
- Introduction to the fundamentals of Phonology;
- Introduction to the fundamentals of Morphology;
- Introduction to the fundamentals of Syntax;
- Introduction to the contemporary approaches in Psycho-linguistics, Socio-linguistics and Stylistics
- Standards of transcription: IPA and Roman script (with diacritical marks)

### Course Outcome

By the end of the term the students

- will have a basic idea of Synchronic and Diachronic models of linguistic analysis;
- will have the basic knowledge of Sound systems in spoken languages;
- will be able to distinguish between phonological elements of language;
- will learn the functional significance of morphological elements;
- transcribe speech from a variety of languages into IPA and Roman;
- will have an introduction to TG grammar.

## **MBNG4102: Ancient and Medieval Bangla Literature**

### **Programme Outcome**

The course aims at familiarising the students with

- the history of Ancient and Medieval Bengal;
- existing scholarship in religious philosophy;
- fundamentals of Manuscriptology;
- history of art and architecture of Ancient and Medieval Bengal;
- the pre-print culture and oral traditions.

### **Programme Specific Outcome**

The course will introduce the following seminal texts from Ancient and Medieval periods:

- *Charyapada* as the only extant text from the ancient period;
- *Srikrishnakirtan* as the extant text of the transitional phase from ancient to medieval;
- *Sriram Panchali* of Krtitibas as an example of Literary Translation;
- *Srichaitanyacharitamrita* as an example of Hagiography;
- *Sunyapuran*;
- *Annadamangal* as the epitome of the literature of the 'Second Transitional Phase'.

### **Course Outcome**

The students will be able to understand

- the transformations in the religious life of Bengal in a historical manner;
- the feudal system of medieval Bengal;
- the fundamentals of Proto-Bangla language and script;
- the fundamentals of Tantric-Sahajiya cult;
- the literary transactions between Bengal and its south;
- the dynamics of orality and literate culture in medieval Bengal.

## **MBNG4103: Bangla Poetry I**

### **Programme Outcome**

The course aims at understanding the cultural dynamics of the late eighteenth and nineteenth centuries. The course will try to analyse the nature and development of the following areas:

- advent of the new musical modes and their relation to literature;
- changes in lyricism and the poetry of the early colonial period;
- the experiments in narrative poetry and emergence of literary epic;
- lyric-practices of the contemporaries of Rabindranath Thakur.

### **Programme Specific Outcome**

The course will try to look deeply into some of the cultural practices and the seminal texts of the late eighteenth and nineteenth centuries such as:

- the emergence of the practices of *Kavigan*, *Panchali*, *Tappa*, *Akhrai*, *Brahmasangeet*, as urban performative forms;
- advent of Dwijendralal, Rajanikanta and Atulprasad;
- print culture and musicology;
- emergence of literary epic and *Meghnadbadh Kavya*;
- emergence of a new form of Narrative poetry in nineteenth century;
- development of lyric poetry in the nineteenth century;

### **Course Outcome**

The participants are expected to get a grasp of the following:

- a history and a historiography of Bangla lyric in nineteenth century;
- the lyric mode in the nineteenth century Bengal;
- relationship between lyric poetry and music;
- emergence of literary epic and newer forms of narrative poetry;
- popularization of technologies of mechanical reproducibility and its implications on Bangla lyric.

## **MBNG4014: Bangla Fiction I**

### **Programme Outcome**

The principal objective of the course is to introduce the advent and development of the fictional forms of the modern era. The course tries to study

- the emergence and development of the Novel in Bangla literature;
- the emergence and development of modern Short Story in Bangla;
- the intricate of narrative structures.

### **Programme Specific Outcome**

The course aims at addressing a literary historiography of the modern narrative forms in Bangla literature through an in-depth study of selected texts. It attempts at

- a detailed study of the emergence of a novelistic discourse in nineteenth century Bengal;
- Colonial modernity, print and emergence of a reading public and the emergence of Novel;
- Novel and its relation to other speech genres;
- Emergence of Short Story as a modern literary form.

### **Course Outcome**

The participants are expected to understand the nuances of the development of Bangla Novel through close readings of the novels from nineteenth and twentieth centuries by Pearychand Mitra or Bankimchandra Chattopadhyay or Trailokyanath Mukhopadhyay, and Tarashankar Bandyopadhyay or Manik Bandyopadhyay or Satinath Bhaduri. They should be able to

- understand the intricates of narratological tropes;
- study the thematological impetus for the fictional utterances;
- imbibe the historiographic significance of novelistic practices;
- understand the relations between modernity and form.

## **MBNG4201: Dramaturgy, Theatre and Bangla Play**

### **Programme Outcome**

The course will try to demonstrate fundamental aspects and production skill related to theatrical performance. The course will try to study

- socio-economic, political and cultural background of Bangla Theatre;
- various theatre movements in Bengal;
- East-West literary relations and Dramaturgy;
- dramatic theories and bangla theatre.

### **Programme Specific Outcome**

The course will try to portray the relevance of dramatic theory and its application through some major texts of nineteenth and twentieth centuries such as:

- *Krishnakumari* as a historical drama;
- *Sadhabar Ekadashi* as a drama creating dialogue among the social classes;
- *Debigarjan* as portrayal of the social turmoil;
- *Chand Baniker Pala* as reception of traditional *pala* in a proscenium theatre;
- the significance of one act play, its specific mode of circulation and reception.

### **Course Outcome**

The participants will be able to

- study of drama as a genre;
- read and analyse a dramatic work in terms of production and performance;
- obtain the knowledge of the collaborative relationships between the actor, character, text, event and audience in a range of social contexts;
- reach at a social history of theatre in the nineteenth and twentieth centuries;
- situate Bangla theatre in an international context.

## **MBNG4202: Rabindranath**

### **Programme Outcome**

Rabindranath Thakur revolutionised Bangla literature and culture. He contributed to virtually every imaginable field of Bangla literature and the paper attempts at an understanding of his life and time and his work through a selection of texts and readings.

### Programme Specific Outcome

- The first part of the course will address the poetic genius of Rabindranath through a selection of texts;
- The course will also include a number of his songs and try to evaluate his contribution to the rich heritage of Bangla songs.
- The second part of the course includes his prose works including his autobiographies;
- The course will try to evaluate Rabindranath as a novelist through his works like *Gora* or *Chaturanga*.
- The course offers a detailed study of his dramatic works in two different segments. The first tries to read one of his iconic plays like *Phalguni*, *Muktadhara*, or *Raktakarabi*. The second part tries to trace the evolution of one his text cycles like *Rajarshi-Bisarjan* or *Raja-Arupratan*.
- The final part of the course will try to address ten of Rabindranath's essays spanning his life and locate them in their contexts.

### Course Outcome

The course aspires to contemplate on the life and works of Rabindranath not only as a pioneering figure in Bangla literature, but also a monumental presence at the turn of the century. It is expected that the students will carefully examine

- the social, cultural and political perspective of eighteenth and nineteenth centuries;
- the role of the Tagore family in Bengal renaissance;
- the nature of the relationship between Rabindranath's works and his time;
- the evolution of the genius of Rabindranath as portrayed through a myriad form of expressions including, but not limited to literature;
- the contributions of Rabindranath as one of the foremost critics and philosophers of language and literature.



## **MBNG4203: Ethnography and Folklore**

### **Programme Outcome**

Bengal has several rich indigenous performative traditions as well as an equally rich heritage of scholarship on such traditions. The course will try to acquaint the students with some selected traditions and existing scholarship on such traditions. Additionally, the course will also offer a theoretical background on various schools of scholarship in ethnography and folkloristics.

### **Programme Specific Outcome**

- First module of the course will attempt a brief introduction to the history of genesis and development of folkloristics in Bengal through the works of William Kerry, Rabindranath Thakur, Dakshinaranjan Mitra Majumder; George Grierson, Edgar Thurston, Arnold Bake; Verrier Elwin and D D Kosambi
- The module will also try to introduce various international schools of folkloristics and ethnography such as Anthropology, Psychoanalysis, Formalism and Ethnomusicology through the works of J. Bronowski, Sigmund Freud, Emil Durkheim, Claude Levi-Strauss, Antonio Gramsci, Mikhail Bakhtin and John Blacking.
- The second module will try to introduce a number of indigenous folklore of Bengal such as Rhymes, Idioms, Riddles, Tells and Fables; various indigenous performative traditions like *Gambhira*, *Gajan*, *Alkap*, *Kach*, *Domni*, *Khan* etc.

### **Course Outcome**

This course aims to

- familiarise students with the nature and history of folklore of Bengal;
- provide the basic knowledge of oral narratives and their relation to society;
- discuss the tools, technics and methods of folklore studies;
- imparting the basic idea about applying the theoretical knowledge to the study of indigenous traditions;
- a preliminary training in associating with the preservation of intangible cultural heritage.

## **MBNG4204: Literary Theory and Aesthetics**

### **Programme Outcome**

This course will introduce the Literary Theory and Aesthetics and its application in Bangla literature. The course will try to study

- the relation between literary theory and aesthetics
- historiography of Indian literary theory
- Eastern influence on Bangla literary theory
- continental aesthetics and its impact on literary criticism in Bengal

### **Programme Specific Outcome**

- First part of the first module of this course deals with four seminal texts in Sanskrit Poetics from the medieval period, viz., *Sringaraprakasa* of Bhoja, *Kavyamimamsa* of Rajasekhara, *Sahityadarpana* of Visvanatha Kaviraja and *Ujjvalanilamani* of Rupa Gosvami (selections).

- Second part of the module deals with the literary transaction between Bengal and the 'Near East' and its aesthetic outcomes. Through a preliminary reading of Al-Hallaj, Rumi, Attar and Omar Khayyam the course will try to look into the origin of Sufi traditions and how, in the context of Bengal, it influences a syncretic practice of the Sahajia cults.
- First part of the second module discusses Textuality and Literary Hermeneutics with a reference to Biblical Studies. It also addresses the notions of Manuscriptology, Textual variants and Variorum; Editorial practices and Editions etc.
- Second part of the module focuses on continental aesthetics of twentieth century and tries to give an overview of various literary movements and cultural theories like Modernism, Structuralism, Psycho-analysis, Phenomenology, Post-Structuralism, Post-Modernism and their interrelations.

### **Course Outcome**

The participants are expected to

- understand the interrelation between Sanskrit literary theory and Bangla literature;
- acquire knowledge of continental aesthetics and its relation with Bangla literary criticism;
- grasp the nuances of cross-cultural literary transactions and its implication for Bangla literature;
- develop skills in textual criticism and editorial practices.

# COMPUTER SCIENCE

## **B.Sc. Computer Science (Honours) - PROGRAM SPECIFIC OUTCOME**

The Program specific outcomes of Computer Science Curriculum are as follows:

Each student should be able to demonstrate the following competencies upon graduating with a Bachelor of Science in Computer Science:

Ability to apply knowledge of computing appropriate to the discipline.

Ability to analyze a problem and identify and define the computing requirements to solution.

Ability to design, implement and evaluate a computer-based system, process, component or program to meet desired needs.

Ability to function effectively on teams to accomplish a common goal.

Understanding of professional, ethical, security, and social issues and responsibilities.

Ability to analyze the local and global impact of computing on individuals, organizations and society.

Ability to use current techniques, skills, and tools necessary for computing practice.

Ability to apply design and development principles in the construction of software systems of varying complexity.

**ST. XAVIER'S COLLEGE**

**(AUTONOMOUS)**

**KOLKATA**

**COMPUTER SCIENCE HONOURS**

**SYLLABUS UNDER CBCS SCHEME**

**W.E.F. 2018-19**

**Course Structure for B. Sc (Computer Science)**

Semester	Paper Code	Paper Name	Remarks	Course Offered By	Credits
1	AEC-1	Ability Enhancement (Compulsory) – Paper 1	English/MIL/Communication Skill/Environmental Science	Other Department	2
	C11	Programming Fundamentals using C/C++	COMPOSITE	Computer Science	6
	C12	Computer System Architecture	COMPOSITE	Computer Science	6
	GE1	General Elective 1	Ancillary Paper (Physics/Maths/etc.)	Other Department	6
2	AEC-1	Ability Enhancement (Compulsory) – Paper 2	English/MIL/Communication Skill/Environmental Science	Other Department	2
	C21	Programming in JAVA	COMPOSITE	Computer Science	6
	C22	Discrete Structures	THEORY	Computer Science	6
	GE2	General Elective 2	Ancillary Paper (Physics/Maths/etc.)	Other Department	6
3	C31	Data Structures	COMPOSITE	Computer Science	6
	C32	Operating Systems	COMPOSITE	Computer Science	6
	C33	Computer Networks	THEORY	Computer Science	6
	SEC31	Skill Enhancement course Paper 1 (Elective)	COMPOSITE	Computer Science	2
	GE3	General Elective 3		Other Department	6
4	C41	Design and Analysis of Algorithms	COMPOSITE	Computer Science	2
	C42	Software Engineering	COMPOSITE		6
	C43	Database Management Systems	COMPOSITE		6

	SEC41	Skill Enhancement course Paper 2 (Elective)	COMPOSITE	Computer Science	2
	GE4	General Elective 4		Other Department	6
5	C51	Internet Technologies	COMPOSITE	Computer Science	6
	C52	Theory of Computation	THEORY	Computer Science	6
	DSE51	Discipline Specific Elective Paper 1		Computer Science	6
	DSE52	Discipline Specific Elective Paper 2		Computer Science	6
6	C61	Artificial Intelligence	COMPOSITE	Computer Science	6
	C62	Computer Graphics	COMPOSITE	Computer Science	6
	DSE61	Discipline Specific Elective Paper 3		Computer Science	6
	DSE62	Discipline Specific Elective Paper 4		Computer Science	6
<b>Total</b>					140

**B. Sc (Comp. Sc.) Syllabus – As per UGC Guidelines following CBCS norm**

**PART I - 14 core papers (same as UGC stipulation)**

SEMESTER NO.	PAPER CODE	PAPER NAME	TYPE	MARKS				CLASSES PER WEEK (13 WEEKS)		
				THEORY		PRACT	TOTAL	THEORY	PRACT	TUTORIAL
				GR-A	GR-B					
1	C11	Programming Fundamentals using C/C++	COMPOSITE	30	30	40	100	4	4	X
	C12	Computer System Architecture	COMPOSITE	30	30	40	100	4	4	X
2	C21	Programming in JAVA	COMPOSITE	60		40	100	4	4	X
	C22	Discrete Structures	THEORY	40	60	--	100	5	X	1
3	C31	Data Structures	COMPOSITE	30	30	40	100	4	4	X
	C32	Operating Systems	COMPOSITE	40	20	40	100	4	4	X
	C33	Computer Networks	THEORY	50	50	--	100	5	X	1
4	C41	Design and Analysis of Algorithms	COMPOSITE	30	30	40	100	4	4	1
	C42	Software Engineering	COMPOSITE	30	30	40	100	4	4	X
	C43	Database Management Systems	COMPOSITE	30	30	40	100	4	4	X
5	C51	Internet Technologies	COMPOSITE	30	30	40	100	4	4	X
	C52	Theory of Computation	THEORY	50	50	--	100	5	X	1
6	C61	Artificial Intelligence	COMPOSITE	30	30	40	100	4	4	1
	C62	Computer Graphics	COMPOSITE	30	30	40	100	4	4	X

**PART II - Discipline Specific Electives (DSE) - To select 1 from each group**

SEMESTER NO.	PAPER CODE		PAPER NAME	TYPE	MARKS				CLASSES PER WEEK (13 WEEKS)		
					THEORY		PRACT	TOTAL			
					GR-A	GR-B			THEORY	PRACT	TUTORIAL
5	DSE51	DSE51A	Microprocessor	COMPOSITE	100		40	100	4	4	X
		DES51B	System Software	THEORY	30	70	--	100	5	X	1
	DSE52	DSE52A	Computational Mathematics	COMPOSITE	30	30	40	100	4	4	X
		DSE52B	Operations Research	COMPOSITE	30	30	40	100	4	4	X
6	DSE61	DSE61A	Data Security	THEORY	50	50	--	100	5	1	X
		DSE61B	Data Mining & Data Warehousing	THEORY	40	60	--	100	5	1	X
	DSE62	DSE62	Project/Dissertation work		--	--	--	100	X	X	X

**PART III - Skill Enhancement Course - To select 1 from each group**

SEMESTER NO.	SNO	PAPER CODE	PAPER NAME	MARKS	CLASSES PER WEEK (13 WEEKS)		
					THEORY	LAB	TUTORIAL
3	SEC31	SEC31A	HTML	50	1	2	-
		SEC31B	Android	50	1	2	-
		SEC31C	R Programming	50	1	2	-
4	SEC41	SEC41A	ORACLE (SQL/PL-SQL)	50	1	2	-
		SEC41B	Programming in Python	50	1	2	-
		SEC41C	PHP Programming	50	1	2	-





## Detailed Syllabus

### Part I Core Papers

<b>Paper Code: C11T</b>	<b>Programming Fundamentals using C/C++ (Theory)</b>	<b>Marks: 60</b>
<b>Serial Number</b>	<b>Topic</b>	<b>Number of Periods</b>
<b>Group A (26 periods)</b>		
1	History of C and C++, Overview of Procedural Programming and Object-Orientated Programming. Using main() function, Compiling and Executing Simple Programs in C++.	4
2	Declaring data types, defining and initializing variables, scope of variables, using named constants, keywords, data types, casting of data types, operators, using comments in programs, character I/O, formatted and console I/O, using basic header files	5
3	Simple expressions in C/C++, understanding operators precedence in expressions, conditional statements (if construct, switch-case construct), understanding syntax and utility of iterative statements (while, do-while, and for loops), use of break and continue in loops, using nested Statements	5
4	Utility of functions, call-by-value, call-by-address, call-by-reference, functions returning value, void functions, inline functions, return data type of functions, functions parameters, differentiating between declaration and definition of functions, command line arguments / parameters in functions, functions with variable number of arguments	4
5	Creating and using one dimensional arrays, declaring and defining an array, initializing an array, accessing individual elements in an array, manipulating array elements using loops, two-dimensional arrays, declaring, defining and initializing two-dimensional array, working with rows and columns, introduction to multi-dimensional arrays	4
6	Understanding utility of structures and unions, declaring, initializing and using simple structures and unions, manipulating individual members of structures and unions, array of structures, individual data members as structures, passing and returning structures from functions Structure with union as member, Union with structures as members	4
<b>Group B (26 periods)</b>		
7	Understanding a pointer variable, simple use of pointers, declaring and dereferencing pointers to simple variables, pointers to pointers, pointers to structures, problems with pointers, passing pointers as function arguments, returning a pointer from a function, using arrays as pointers, Passing arrays to functions, pointers versus references, declaring and initializing references, using references as function arguments and function return values	6

8	Memory Allocation in C++ :Differentiating between static and dynamic memory allocation, use of malloc, calloc and free functions, use of new and delete operators, storage of variables in static and dynamic memory allocation	4
9	File I/O, Preprocessor Directives - Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros	4
10	Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors,Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors,Overview of Template classes and their use.	4
11	Need of Overloading functions and operators, Overloading functions by number and type of arguments, Looking at an operator as a function call, Overloading Operators (including assignment operators, unary operators)	4
12	Introduction to Inheritance (Multi-Level Inheritance, Multiple Inheritance), Polymorphism(Virtual Functions, Pure Virtual Functions), Basics Exceptional Handling (using catch and throw, multiple catch statements), Catching all exceptions, Restricting exceptions, Rethrowing exceptions.	4
	<b>Total</b>	<b>52</b>
Reference Books	1. HerbtzSchildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.2003 2. BjarneStroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013. 3. BjarneStroustrup, "Programming -- Principles and Practice using C++", 2nd Edition, Addison-Wesley 2014. 4. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008. 5. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011. 5. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000. 6. Andrew Koeni, Barbara, E. Moo, "Accelerated C++", Published by Addison-Wesley, 2000. 7. Scott Meyers, "Effective C++", 3rd Edition, Published by Addison-Wesley, 2005. 8. Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.2014 9. Walter Savitch, "Problem Solving with C++", Pearson Education, 2007. 10. Stanley B. Lippman, JoseeLajoie, Barbara E. Moo, "C++ Primer", Published by AddisonWesley, 5th Edition, 2012	

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<b>Paper Code: C11P</b>	<b>Problem Solving Using C/C++ (Practical)</b>	<b>Marks: 40</b>
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Course Outcome....

To make students understand the basic concepts of procedural paradigm

To guide the students build an interactive and modular approach to programs

To make the students understand the different file handling modes used in procedural approach

To make students understand the object oriented paradigm with C++

To make students understand the merits and application areas of an object oriented programming tool in solving real life problems

To make students understand the idea behind a generic programming



<b>Paper Code:</b> <b>C12T</b>	<b>Computer System Architecture</b> <b>(Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
<b>Group A (26 periods)</b>		
1	<b>Data Representation and Basic Computer Arithmetic</b>  Number systems, complements: 1's complement and 2's complement, fixed and floating point representation, character representation, addition, subtraction, multiplication and division algorithms for integers	6
2	<b>Digital System Design</b>  Logic Gates and circuits, Truth Tables, Boolean Algebra, Boolean Function, Simplification, Combinational circuits – multiplexers, decoders, de-multiplexers, encoders, comparators, Sequential Circuits – Flip-flops – RS, D, JK, Master Slave, T; Registers – Shift, Parallel; Counters – Excitation Tables, Synchronous, Asynchronous	20
<b>Group B (26 periods)</b>		
1	<b>Introduction to Computer</b>  Functional Units, Basic I/O devices, Storage devices, Bus Structure	2
2	<b>Basic Computer Organization and Design</b>  Organization of a model computer: CPU registers, Bus Interconnection design of basic computer, machine language, assembly language, Instruction Execution Cycle, Instruction formats, Addressing mode, instruction codes, concept of instruction pipelining, RISC, CISC	8
3	<b>Central Processing Unit</b>  Micro-Programmed Control Unit, Combinational ALU Design: Adders, Subtractors, 2's complement adder-subtractor	8
4	<b>Memory Organization</b>  Design of the RAM, Associative memory, Cache memory: Mapping techniques, Introduction to Virtual Memory.	8
<b>Total</b>		<b>52</b>

**Books and References:**

1. Digital Computer Electronics, Malvino and Brown, Tata McGraw-Hill
2. Digital Logic and Computer Design, M Morris Mano, Pearson education India
3. M. Mano, Computer System Architecture, Pearson Education 1992
4. W. Stallings, Computer Organization and Architecture Designing for Performance, 8th Edition, Prentice Hall of India, 2009
5. Carl Hamacher, Computer Organization, Fifth edition, McGrawHill, 2012.
6. Computer Architecture and Organization, Hayes, McGraw-Hill
7. Computer Organization and Design, P. Pal Chaudhuri, Prentice-Hall of India Pvt.Ltd

<b>Paper Code: C12P</b>	<b>Computer System Architecture (Practical H/W)</b>	<b>Marks: 40</b>
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Course Outcome....

The student is expected to learn about the different components such as memory, control unit, ALU; that are present in a computer and how they interface and interact with each other.

The student is expected to learn about the circuits that are present within the components of a computer.

The student will acquire knowledge about the roles and functions of the components.

The student will perform various logical and mathematical operations in different number systems.

The student will design and implement sequential and combinational circuits

The student will design and implement multiple bit synchronous and asynchronous circuits

<b>Paper Code: C21T</b>	<b>Programming in JAVA (Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
	<b>Introduction to Java</b> - Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions,	5

1	Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods).	
2	<b>Arrays, Strings and I/O</b> - Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.	8
3	<b>Object-Oriented Programming Overview</b> - Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection. 3. Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata (14 lectures) Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.	5
4	<b>Exception Handling, Threading</b> - Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads.	11
5	<b>File Handling in Java</b> - Opening a sequential file, Writing data on a file, reading data from a file, Use of classes to open file in input mode or in write mode, To open file in Random Access mode, To move file identifier from one byte position to another byte position in dynamic fashion, To read and write data in basic data type mode such as int, float, double, etc.	6
6	<b>Applets and Event Handling</b> - Java Applets: Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms, Listener Interfaces, Adapter and Inner Classes.	11
7	<b>Advanced Topics</b> - Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of JSP and servlets.	6
<b>Total</b>		<b>52</b>
<b>Books and References:</b>  "Head First Java", Orielly Media Inc. 2nd Edition, 2005.  E. Balaguruswamy, "Programming with Java", 4th Edition, McGraw Hill, 2009.  Paul Deitel, Harvey Deitel, "Java: How to Program", 10th Edition, Prentice Hall, 2011.  Herbert Schildt, "Java The Complete Reference", Oracle Press, Seventh Edition, 2017.		

<b>Paper Code:</b> <b>C21P</b>	<b>Problem Solving Using JAVA</b>  <b>(Practical)</b>	<b>Marks: 40</b>
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Course Outcome....

To make students understand the object oriented paradigm with Java

To make students understand the ideas behind platform independence in executing an application

To give a fundamental idea of multithreaded programming environment

To impart the concepts of exception handling while dealing real life problems

To make students understand the applicability of accessing different modules from different packages

To make students realize the effectiveness of Java in the development of web applications

<b>Paper Code: C22T</b>	<b>Discrete Structures</b> (Theory)	<b>Marks: 100</b>
<b>Sl. No.</b>	<b>Group A</b>	<b>No. of Periods</b>
1.	<b>Counting Theory</b> Sets - finite and Infinite sets, uncountable Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.	16
2.	<b>Recurrences</b> Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem, Generating Functions	16
	<b>Total</b>	32
<b>Sl. No.</b>	<b>Group B</b>	<b>No. of Periods</b>
3.	<b>Propositional Logic</b> Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory	5
4..	<b>Introduction to Probability Theory</b> Introduction to discrete probability, sample space, Finite probability space, Conditional probability, Independence, Independent repeated trials, Bernoulli Trials and Binomial distribution, probability distribution of Random variable, Expectation of random variable, Variance	9
5.	<b>Graph Theory</b> Definition of Graph, Graph Terminology, Finite and Infinite graphs. Directed and undirected graphs, Degree, Isolated vertex, Pendant vertex. Null graphs. Walks: Paths and circuits. Connected and disconnected graphs, Euler's graphs, Hamiltonian paths and circuits. Planer Graph, Isomorphic graph, coloring graphs	10
6.	<b>Graph Algorithms</b> Adjacency Matrix, Floyd's shortest Path algorithm, Trees, Shortest spanning tree using Kruskal Algorithm and Prim's Algorithm, Dijkstra's Algorithm to find shortest path from a given vertex, Breadth First Search Algorithm (BFS), Depth First Search Algorithm Problems(DFS).	9
	<b>Total</b>	33
<b>Recommended Books:</b>		
1. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition , Tata McGraw Hill, 1985		
2. Kenneth Rosen, Discrete Mathematics and Its Applications, Sixth Edition ,McGraw Hill 2006		

3. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms , John wiley Publication, 1988
4. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
5. D.J. Hunter, Essentials of Discrete Mathematics, Jones and Bartlett Publishers

Course Outcome ....

Students are expected to use mathematical reasoning in order to read, comprehend, and construct mathematical arguments.

Students will count or enumerate objects and perform combinatorial analysis and are expected to learn about theories such as the principle of inclusion and exclusion, etc. which will help them solve several problems in the field of Computer Science..

Students will learn the basic concepts of sets, permutations, relations, graphs, trees and are expected to learn about recurrence relations which is one of the most important tools needed to analyse algorithms.

Students will represent discrete objects and relationships using abstract mathematical structures

Students will learn to implement and simulate counting principles using recurrence relations.

Students will formulate and model problems with the concepts and techniques of discrete mathematics in various applications and students will be aware of key topic in the field of Discrete Mathematics such as Relations, Functions, Partial Orderings.

<b>Paper Code: C31T</b>	<b>Data Structures (Theory)</b>	<b>Marks: 60</b>
<b>Serial Number</b>	<b>Topic</b>	<b>Number of Periods</b>
	<b>Group A</b>	<b>26</b>
1	Concept of different data structures, ADT	3

2	Basic ideas on complexity analysis, Big-Oh, Small-Oh, Big-Omega, Small Omega, Big-Theta notations	4
3	Ideas about recursion, comparative study with iteration	2
4	Different representation and applications of array, address translation	3
5	Representation of linked lists, different types, different operations on each of the types	6
6	Definition of stack, array and linked list representations, applications on reverse polish notations	4
7	Definition of queue, array and linked list representations, different types	4
	<b>Group B</b>	<b>26</b>
8	Definition of binary tree, quantitative properties, types, array and linked representation, different traversals, definition of threaded binary tree, advantages	6
9	Definition of binary search tree, properties, different operations, definition and properties of AVL Tree	5
10	Linear and binary searches, advantages and disadvantages	2
11	Internal and external sorting, in-place sorting, stable sorting, different sorting algorithms – Bubble, Selection, Insertion, Shell, Merge, Quick and Heap	9
12	Definition of hashing, advantages, different hash functions, collision resolution techniques, applications	4
	<b>Total</b>	<b>52</b>

**Reference Books:**

Horowitz and Sahni – Fundamentals of Data Structures in C – Orient Longman Pvt. Ltd.

Reema Thareja – Data Structures using C – Oxford Publications

Srivastava and Srivastava – Data Structures Through C in Depth – BPB Publications

Data Structure in C, Horowitz & Sahni, Silicon Press

Data Structures & Program Design in C, R. Kruse, Pearson Education

Data Structures using C, A. M. Tenenbaum, Pearson Education

Data Structures with C, Lipschutz, TMH

<b>Paper Code: C31P</b>	<b>Data Structures  (Practical)</b>	<b>Marks: 60</b>
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Course Outcome....

To impart the concepts of different kinds of data structures and their real life applications and make students understand different sorting and searching algorithms

To convey the approach of solving unknown problems with the help of fundamental data structures and to understand basic concepts about stacks, queues ,lists, trees and graphs.

To impart the basic concepts application of data structures and algorithms and to understand concepts about searching and sorting techniques and its usability in real life.

Ability to summarize searching and sorting techniques.

Ability to analyze algorithms and its correctness, complexity analysis in different stages.

To understand about writing algorithms which is a finite step by step approach in solving problems with the help of fundamental data structures.

<b>Paper Code: C32T</b>	<b>Operating Systems</b> <b>(Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
<b>Group – A (31 Periods)</b>		
1	Introduction: Basic OS functions, resource abstraction, types of operating systems, interrupt driven program, concurrent processing, multiprogramming, batch processing, time sharing.	4
2	Operating systems for personal computers & workstations, process control & real time systems.	2
3	Operating System Organization - Processor and user modes, kernels, system calls and system programs.	5
4	Process System - view of the process and resources, process abstraction, process hierarchy, threads, threading issues, thread libraries;	5
5	Process Scheduling, non-pre-emptive and pre-emptive scheduling algorithms.	5
6	Concurrent processes, critical section, semaphores.	5
7	Methods for inter-process communication; deadlocks.	5
<b>Group – B (21 periods)</b>		
8	Memory Management Physical and virtual address space; memory allocation strategies –fixed and variable partitions	5
9	Paging, segmentation, virtual memory	4
10	File and I/O Management Directory structure, file operations, file allocation methods,	5
11	Device management, disk scheduling algorithms	5
12	Protection and Security - Authentication, Internal access Authorization	2
<b>Total</b>		<b>52</b>
<b>Books and References:</b>  A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.  A.S. Tanenbaum, Modern Operating Systems, 3rd Edition, Pearson Education 2007.  G. Nutt, Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.  W. Stallings, Operating Systems, Internals & Design Principles , 5th Edition, Prentice Hall of India. 2008.  Operating Systems : Principles And Design, Choudhury, Pabitra Pal, Prentice Hall of India		

<b>Paper Code: C32P</b>	<b>Operating Systems (Practical)</b>	<b>Marks: 40</b>
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Course Outcome ....

To understand the services provided by and the design of an operating system along with the structure and organization of the file system.

To understand a processes and their synchronization and scheduling.

To understand different approaches to memory management.

Students should be able to use system calls for managing processes, memory and the file system.

Students should understand the data structures and algorithms used to implement an OS.

At the end of this course the students will demonstrate a knowledge of process control, threads, concurrency, memory management scheduling, I/O and files, distributed systems, security

<b>Paper Code: C33T</b>	<b>Computer Networks (Theory)</b>	<b>Marks: 100</b>
<b>Serial</b>	<b>Topic</b>	<b>No. of Periods</b>
<b>GROUP-A</b>		<b>32</b>
	<b>Introduction to Computer Networks</b>  Network definition; network topologies; network classifications; network protocol; layered network architecture; overview of OSI reference model; overview of TCP/IP protocol suite.	10
2.	<b>Physical Layer Functionalities</b>  Transmission Media. Multiplexing: FDM, TDM and Applications. Switching Techniques: Circuit, Message and Packet Switching. Encoding Techniques.	13
3.	<b>Data Link Layer Functions and Protocol</b>  <b>Error</b> detection and error correction techniques; data-link control- framing and flow control; error recovery protocols: Stop and wait ARQ, Go-back-n ARQ, Selective repeat ARQ.	10
<b>GROUP-B</b>		<b>33</b>
4.	<b>Multiple Access Protocol and Networks</b>  Carrier and non carrier sense protocols; IEEE 802.X – Introduction, architecture, protocol and management of Ethernet and token ring.	11
5.	<b>Networks Layer Functions and Protocols</b>  Datagram and Virtual circuit switching techniques; IP addressing: Concepts, classification, subnetting in IPv4.	11
6.	<b>Transport Layer Functions and Protocols</b>  Transport services- error and flow control, Connection establishment and release- three way handshake.	6
7.	<b>Overview of Application layer protocol</b>  Overview of WWW & HTTP protocol.	5
	<b>Total</b>	<b>65</b>
	<b>Reference Books :</b>  1. B. A. Forouzan: Data Communications and Networking, Fifth edition, THM , 2012.  2. A. S. Tanenbaum: Computer Networks, Fifth edition, PHI , 2010.	



Course Outcome....

Describe the general principles of data communication.

Describe how computer networks are organized with the concept of layered approach.

Describe how signals are used to transfer data between nodes.

Describe protocols for Implement of a simple LAN

Analyze the functions of Data Link layer.

Describe the various forms of addressing techniques.

<b>Paper Code: C41T</b>	<b>Design and Analysis of Algorithms (Theory)</b>	<b>Marks: 60</b>
<b>Serial No.</b>	<b>Group A</b>	<b>No. of Periods</b>
	<b>Introduction</b> Basic Design and Analysis techniques, Growth of functions, Summations, Induction, Recurrences.	5
2.	<b>Algorithm Design Techniques</b> Divide and conquer - Strassen's Method; Dynamic programming – Bellman-Ford algorithm; Greedy concepts; Back tracking – 8 Queens problem.	11
3.	<b>Sorting and Order Statistics</b> Heap sort, Merge Sort, Quick sort, sorting in linear time, Median and order statistics.	10
	<b>Total</b>	26
<b>Serial No.</b>	<b>Group B</b>	<b>No. of Periods</b>
4.	<b>Generalized Tree Algorithms</b> Threaded Binary Tree, Binary Search Tree, AVL Tree and B Tree.	10
5.	<b>Graphs</b> Graph Representation, Breadth First Search, Depth First Search, Minimal spanning Tree using Prim's and Kruskal's algorithms	8
6.	<b>String Processing</b> String Matching, Brute Force Technique, KMP Technique	4
7.	<b>Computational Geometry Algorithms</b> Convex Hulls, Closest pair of points	2
8.	<b>Notion of NP-completeness</b> P class, NP-hard class, NPcomplete class, Circuit Satisfiability problem.	2
	<b>Total</b>	26
1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, PHI. 2. E. Horowitz , S. Sahani, R Sanguthevar, Fundamentals of Computer Algorithms, Galgotia. 3. Sarabasse & A.V. Gelder Computer Algorithm – Introduction to Design and Analysis, Pearson		

<b>Paper Code: C41P</b>	<b>Design and Analysis of Algorithms (Practical)</b>	<b>Marks: 40</b>
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Course Outcome....

Analyze the asymptotic performance of algorithms.

Write rigorous correctness proofs for algorithms.

Demonstrate a familiarity with major algorithms and data structures.

Apply important algorithmic design paradigms and methods of analysis.

Synthesize efficient algorithms in common scientific design situations.

Implement the algorithms using suitable programming language.

<b>Paper code:</b> <b>C42T</b>	<b>Software Engineering</b> <b>(Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Periods</b>
	<b>Group A</b>	<b>26</b>
1.	<b>Introduction:</b> The Evolving Role of Software, Software Characteristics, Changing Nature of Software, Software Engineering as a Layered Technology, Software Process Framework, Framework and Umbrella Activities, Process Models, Capability Maturity Model Integration (CMMI).	8
2.	<b>Requirement Analysis:</b> Software Requirement Analysis, Initiating Requirement Engineering Process, Requirement Analysis and Modeling Techniques, Flow Oriented Modeling, Need for SRS, Characteristics and Components of SRS, SRS Validation.	9
3.	<b>Software Design:</b> Design principles, Architectural Design Elements, Software Architecture, Module level concepts, Coupling, Cohesion, Structured design methodology, Data Design at the Architectural Level and Component Level, Mapping of Data Flow into Software Architecture, Modeling Component Level Design.	9
	<b>Group B</b>	<b>26</b>
4.	<b>Software Project Management:</b> Phases in Software Project Management: Estimation in Project Planning Process, Project Scheduling, Phases in Software Project Management, Function Point Method, Cost Estimation – COCOMO.	8
5.	<b>Risk Management:</b> Software Risks, Risk Identification, Risk Projection and Risk Refinement, RMMM Plan.	5
	<b>Quality Management:</b> Quality Concepts, Software Quality Assurance, Software Reviews, Metrics for Process and Projects.	5
6.	<b>Software Testing :</b> Software Testing Fundamentals, Levels of Testing, Types of testing, Strategic Approach to Software Testing, Test Strategies for Conventional Software, Validation Testing, System Testing, Black-Box Testing, White-Box Testing and their type, Basis Path Testing.	8
<p>Reference Books:</p> <p><b>Software Engineering: A Practitioner's Approach, by Roger S Pressman, McGraw Hills</b></p> <p>Software Engineering, Ian Sommerville - Pearson Education</p> <p>An Integrated Approach to Software Engineering, Pankaj Jalote – NAROSA</p> <p>Object-Oriented Analysis and Design with Applications, Grady Booch, Robert A. Maksimchuk, Addison Wesley</p> <p>Fundamentals of Software Engineering, Rajib Mall, PHI</p>		

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<b>Paper code: C42P</b>	<b>Software Engineering (Practical)</b>	<b>Marks: 40</b>
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Course Outcome....

Acquire the skills on how to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, implementation, and deployment

An ability to work in one or more significant application domains using software engineering principles and approaches

Work as an individual and as part of a multidisciplinary team to develop and deliver quality software

Demonstrate an ability to identify, formulate, and solve software development problems by applying principles of software engineering

Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle

Demonstrate an ability to use the techniques and tools necessary for software engineering practice

<b>Paper Code:</b> <b>C43T</b>	<b>Database Management Systems</b> <b>(Theory)</b>	<b>Marks: 60</b>
<b>S NO</b>	<b>Topic</b>	<b>No. of Periods</b>
	<b>Group A</b>	<b>27</b>
1.	Fundamental concepts of DBMS; Purpose of Database Systems; Data Abstraction: Physical, Conceptual and External Levels; Data Models; Database Languages; Database Users; Database Manager; Database Administrator; DBMS Structure.	9
2.	<b>Entity Relationship Model:</b> Entity Sets; Relationship Sets; Mapping Constraints; Keys; E R Diagrams; Strong and Weak Entity Sets; Extended ER Features: Specialization/Generalization, Aggregation.	9
3.	<b>Relational Model:</b> Structure of Relational Databases; Database Schema; Query Languages: Relational Algebra: Fundamental Operations, Additional Operations; Tuple and Domain Relational Calculus; Structured Query Languages	9
	<b>Group B</b>	<b>25</b>
4.	<b>Database design:</b> Constraints: Domain Constraints; Referential Integrity; Functional Dependencies, Normalization: 1NF, 2NF, 3NF and BCNF	5
5.	<b>File Organization:</b> Operations on files, Records: Fixed length, Variable Length, Sequential File Organization, Indexing structures for files (Primary index, secondary index, clustering index), Multilevel indexing using B and B+ trees. Hashing: Hash functions; Static and Dynamic Hashing.	7
6.	<b>Transaction Processing:</b> ACID properties, concurrency control	5
7.	<b>Introduction to Distributed Databases:</b> Introduction; Comparison with traditional databases; DDBMS Components; Fragmentation, Replication, Allocation.	8
<b>Total</b>		<b>52</b>
<b>Books and References:</b>		
1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.		
2. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.		
3. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.		
4. Distributed Databases: Principles and Systems; Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill		

<b>Paper Code: C43P</b>	<b>Database Management Systems (Practical)</b>	<b>Marks: 40</b>
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Course Outcome ....

Learn the fundamentals of DBMS

Model and design real life problems using ER diagrams

Learn Procedural and non-procedural languages

Improve database design through normalization

Understand the fundamentals of advanced database concepts

Learn Structured Query Language

<b>Paper Code: C51T</b>	<b>Internet Technologies (Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
<b>Group – A (26 Periods)</b>		
1	<b>Java :</b> Use of Objects, Array and ArrayList class	5
2	<b>JSP :</b>  Introduction to JavaServer Pages, HTTP and Servlet Basics,  The Problem with Servlets,  The Anatomy of a JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, Implicit JSP Objects, Conditional Processing, Displaying Values, Using an expression to Set an Attribute, Declaring Variables and Methods, Error Handling and Debugging, Sharing Data Between JSP Pages, Requests, and Users, Database Access	17

3	<b>Java Beans:</b> Java Beans Fundamentals, JAR files, Introspection, Developing a simple Bean.	4
<b>Group – B (26 Periods)</b>		
1	<b>JavaScript:</b> Data types, operators, functions, control structures, events and event handling, validation through HTML forms, methods.	16
2	<b>JDBC:</b> JDBC Fundamentals, Establishing Connectivity and working with connection interface, Working with statements, Creating and Executing SQL Statements.	10
<b>Total</b>		<b>52</b>
<b>Books and References:</b>  Ivan Bayross, Web Enabled Commercial Application Development Using Html, Dhtml,javascript, Perl Cgi , BPB Publications, 2009.  Cay Horstmann, BIG Java, Wiley Publication , 3rd Edition., 2009  Herbert Schildt , Java 7, The Complete Reference, , 8th Edition, 2009.  Jim Keogh ,The Complete Reference J2EE, TMH, , 2002.  O'Reilly , Java Server Pages, Hans Bergsten, Third Edition, 2003.		

<b>Paper Code: C51P</b>	<b>Internet Technologies (Practical)</b>	<b>Marks: 40</b>
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Course Outcome....

Make the students acquainted with the concepts of Java

Give the students idea on JavaScript and guide them through the database connectivity with Java

Give the knowledge of Advanced Java Concepts

Make the students understand the difference between Servlets and JSP

Make the students understand about the relations in Model View Controller architecture used in Internet Technologies



Give the students an idea on N-Tier architecture

<b>Paper Code:</b> C52T	<b>Theory of Computation</b>  (Theory)	<b>Marks: 100</b>
<b>Week</b>	<b>Topic</b>	<b>No. of Periods</b>
<b>Group A (30 periods)</b>		
1	<b>Introduction to Theory of Automata</b>  Mathematical Preliminaries and notation, Basic concepts of Languages, Grammars and Automata, Some Applications	2
1	<b>Languages</b>  Alphabets, string, language, Basic Operations on language, Concatenation, Kleene's Star, Kleene's theorem.	8
2	<b>Finite Automata and Regular Languages</b>  Regular Expressions, Transition Graphs, Deterministic Finite automata(DFA)and non-deterministic finite automata(NDFA), NFA to DFA Conversion, Regular languages and their relationship with finite automata, Pumping lemma and closure properties of regular languages.	20
<b>Group B (35 Periods)</b>		
1	<b>Context free languages</b>  Context free grammars, parse trees, ambiguities in grammars and languages, Pushdown automata (Deterministic and Non-deterministic), Pumping Lemma, Properties of context free languages, Chomsky Normal Form(CNF), Greibach Normal Form(GNF).	16
2	<b>Turing Macines and Models of Computations</b>  Turing Machine as a model of computation, Designing Turing machine (i) To add two positive integers, (ii) To subtract one integer from another integer, (iii) To take product of 2 integers, Non deterministic Turing machine, halting problem.	11
3	<b>Computability Theory</b>  Chomsky hierarchy of languages, linear bounded automata and context sensitive language, Universal Turing Machine.	8
<b>Total</b>		<b>65</b>
<b>Books and References:</b>  1. Daniel I.A.Cohen, Introduction to computer theory, John Wiley,1996  2. Lewis & Papadimitriou, Elements of the theory of computation , PHI 1997.  3. Hopcroft, Aho, Ullman, Introduction to Automata theory, Language & Computation –3rd Edition, Pearson Education. 2006		

4. P. Linz, An Introduction to Formal Language and Automata 4th edition Publication Jones Bartlett, 2006

5.Theory of Computer Science – Automata languages and computation -Mishra and Chandrashekar, 2nd edition, PHI.

Course Outcome....

To give an overview of the theoretical foundations of computer science from the perspective of formal languages.

To illustrate finite state machines to solve problems in computing.

To familiarize Regular grammars, context free grammar.

To use basic concepts of formal languages of finite automata techniques.

To solve various problems of applying normal form techniques, push down automata and Turing Machines.

After the completion of this course the students should find themselves favourably positioned to learn the design of a compiler

<b>Paper code: C61T</b>	<b>Artificial Intelligence (Theory)</b>	<b>Marks: 60</b>
<b>Serial</b>	<b>Group A</b>	<b>No. of Periods</b>
1	<b>Introduction:</b> Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Intelligent Agents, their structure, behavior and environment	08
2.	<b>Knowledge Representation:</b> Introduction to First Order Predicate Logic, Resolution Principle, Unification, Semantic Nets, Conceptual Dependencies, Frames, Production Rules, Conceptual Graphs.	10
3.	<b>Dealing with Uncertainty and Inconsistencies:</b> Truth Maintenance System, Default Reasoning, Probabilistic Reasoning, Bayesian Probabilistic inference, Possible World Representations.	08
	<b>Total</b>	26
<b>Serial</b>	<b>Group B</b>	<b>No. of Periods</b>
4	<b>Problem Solving and Searching Techniques:</b> Problem Characteristics, Production Systems, Control Strategies, Breadth First Search, Depth First Search, Hill climbing, Heuristics Search Techniques: Best First Search, Constraint Satisfaction Problem, Means-End Analysis.	20
5	<b>Understanding Natural Languages:</b> Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.	6
	<b>Total</b>	26
<b>Books and References:</b>		
1. DAN.W. Patterson, Introduction to A.I and Expert Systems – PHI, 2007.		
2. Russell & Norvig, Artificial Intelligence-A Modern Approach, LPE, Pearson Prentice Hall, 2nd edition, 2005.		
3. Rich & Knight, Artificial Intelligence – Tata McGraw Hill, 2nd edition, 1991.		
4. W.F. Clocksin and Mellish, Programming in PROLOG, Narosa Publishing House, 3rd edition, 2001.		
5. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley, Pearson Education, 3rd edition, 2000.		

<b>Paper code: C61P</b>	<b>Artificial Intelligence (Practical)</b>	<b>Marks: 40</b>
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Course Outcome.....

To present an overview of artificial intelligence (AI) principles and approaches.

Develop a basic understanding of the building blocks of AI: Search, Knowledge representation, inference, logic, and learning.

3. To implement typical problems in AI using a suitable programming language.
4. Understand and implement the role of various games in simulating various case studies in AI.
5. To be aware of the latest developments in AI along with its application area.
6. To be aware of the intelligent heuristics in AI along with its application area.

<b>Paper Code:</b> <b>C62T</b>	<b>Computer Graphics</b> <b>(Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
<b>Group - A (26 periods)</b>		
1	<b>Introduction</b> - Basic elements of Computer graphics, Applications of Computer Graphics.	2
2	<b>Graphics Hardware</b> - Architecture of Raster and Random scan display devices, input and output devices.	5
3	<b>Two Dimensional Transformations</b> - Homogeneous coordinate system, Translation, Rotation, reflection along x-axis, reflection along y-axis, reflection along $y=x$ axis, reflection along $y=-x$ , scaling along x-axis, scaling along y-axis, composite transformations, reflection along a general axis.	5
4	<b>Three Dimensional Transformations</b> - Translation along x, y, z axes, Rotation along x-axis, y-axis and z-axis, reflection along xy-plane, reflection along yz-plane, reflection along zx-plane, scaling along x-axis, scaling along y-axis, scaling along z-axis, composite transformations, rotation along a general line.	5
5	<b>Fundamental Techniques in Graphics</b> - Line drawing algorithms, Circle drawing algorithm, Ellipse drawing algorithm, line and polygon clipping algorithms.	9
<b>Group - A (26 periods)</b>		
5	<b>Advanced Techniques in Graphics</b> - Polygon filling, Seed Fill algorithm, 2D and 3D Viewing Transformations (Projections- Parallel and Perspective), and Vanishing points.	4
6	<b>Geometric Modeling</b> - Parametric Functions, Bezier methods, Bezier curves, Bezier surfaces. B-Spline curve.	7
7	<b>Visible Surface determination</b> - Hidden surface elimination, Back-face detection, Depth-buffer method (Z-Buffer method), Depth-Sort method, Binary face partition method.	7
8	<b>Surface rendering</b> - Illumination and shading models. Basic color models and Computer Animation. Morphing.	8
<b>Total</b>		<b>52</b>
<b>Books and References:</b>  J.D.Foley, A.Van Dan, Feiner, Hughes Computer Graphics Principles & Practice 2nd edition Publication Addison Wesley 1990  D.Hearn, Baker: Computer Graphics, Prentice Hall of India 2008  D.F.Rogers Procedural Elements for Computer Graphics, McGraw Hill 1997.		

<b>Paper Code:</b> <b>C62P</b>	<b>Computer Graphics</b> <b>(Practical))</b>	<b>Marks: 40</b>
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**Course Outcome....**

To make the students understand the difference between Raster and Vector Graphics

To guide the students with the mathematical deductions of Basic and Composite transformations in Graphics

To make the students understand how the clipping is done for points, lines and polygons

Give the students an idea about the different fill algorithms

Give the students an idea of the Bezier and B-Spline curves

To make the students understand the applications of the Computer Graphics along with the different color models

**Part II - Discipline Specific Elective**

<b>Paper Code: DSE51AT</b>	<b>Microprocessor (Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
1	Microprocessor architecture: Internal architecture,	8
2	System bus architecture, memory and I/O interfaces.	7
3	Microprocessor programming: Register Organization	5
4	Instruction formats, assembly language programming.	10
5	Interfacing: Memory address decoding, cache memory and cache controllers, I/O interface, keyboard, display, timer,	12
6	Interrupt controller, DMA controller, video controllers, communication interfaces.	10
<b>Total</b>		<b>52</b>
<b>Books and References:</b>  Barry B. Brey : The Intel Microprocessors : Architecture, Programming and Interfacing. Pearson Education, Sixth Edition, 2009.  Walter A Triebel, Avtar Singh; The 8088 and 8086 Microprocessors Programming, Interfacing, Software, Hardware, and Applications. PHI, Fourth Edition 2005.  Microprocessor Architecture, programming and application with the 8085 – Ramesh S. Gaonkar, 4 <sup>th</sup> Edition, Penram International Publishing.		



<b>Paper Code: DSE51AP</b>	<b>Microprocessor (Practical)</b>	<b>Marks: 40</b>
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Course Outcome ....

To understand basic architecture of 8, 16 and 32 bit microprocessors.

To introduce 8085 architecture and programming in assembly language.

To introduce basic concepts of interfacing memory and peripheral devices to a microprocessor.

To understand interfacing of 8 bit microprocessor with memory and peripheral chips involving system design.

To understand techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.

To introduce various advanced processor architectures such as 80X86, Pentium and Multi-core Processors.

<b>Paper Code: DSE51BT</b>	<b>System Software (Theory)</b>	<b>Marks: 100</b>
<b>Week</b>	<b>Topic</b>	<b>No. of Periods</b>
<b>Group A (24 Periods)</b>		
1	Introduction: Concepts and Types of Translators: Assembler, Cross-Assembler, Pre-Processor, Interpreter, Simulator, Compiler, Cross-Compiler; Loader; Linker; Operating System	4
2	Assembler: One pass assembler, two pass assembler, macro assembler, conditional assembly	10
3	Loader: Absolute Loader, Relocatable Loader, Translate-and-go scheme	5
4	Linker: Direct Linking scheme, Linkage editors	5
<b>Group B (41 Periods)</b>		
1	Compiler: Different phases of compilation, Table management with reference to Symbol Table, Error Handling.	5

2	Lexical analyzer concepts.	4
3	Parser: Top down (Recursive descent and Predictive Parsing), Bottom up (Shift Reduce and Operator Precedence)	16
4	Intermediate Code Generation: Three Address Code and representation using quadruples, Triples and Indirect Triples	5
5	Code Optimization	5
6	Storage management	3
7	Code generation	3
<b>Total</b>		<b>65</b>
<b>Books and References:</b>  1. Systems Programming and Operating System, D. M. Dhamdhare, Tata McGraw Hills 2. Systems Programming, John J Donovan, Tata McGraw Hills 3. Alfred V. Aho and Jeffrey D. Ullman, Principles of Compiler Design, Narossa Publication 4. Aho, Sethi and Ullman, Compilers – Principles, Techniques and Tools, Narossa Publication 5. System Software-An Introduction to System Programming, Leland L Beck, Pearson Education		

Course Outcome ....

To give an overview of different types of System Software and their needs.

To learn about the operations needed by an Assembler.

To discuss about the different types of loaders and their functions.

To know how the linker functions.

To learn about the different phases of a compiler.

To learn the process of generating objects code from source code.

<b>Paper Code:</b> <b>DSE52AT</b>	<b>Computational Mathematics</b> <b>(Theory)</b>	<b>Marks: 60</b>
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Sl. No.	Group A	No. of Periods
1	Solution of Linear Simultaneous Equations : Gauss Elimination method, Gauss Seidal method, Gauss Jacobi Matrix Inversion method.	6
2	Solution of Non-linear Equations: Bisection method, Newton Raphson method	5
3	Integration methods: Trapezoidal Rule, Simpson's $1/3^{\text{rd}}$ rule, Romberg Integration method	6
4	Interpolation methods: Forward Interpolation method, Lagrange Interpolation method.	5
5	Least Square fit method.	4
	<b>Total</b>	<b>26</b>
Sl. No.	Group B	No. of Periods
6	Solution of Ordinary Differential Equations : Euler's method, Modified Euler's method, $2^{\text{nd}}$ Runge Kutta method, 4-th order Runge Kutta Method.	6
7	Network Scheduling by PERT/CPM : Rules for Network Construction, Construction of Network, Time analysis, Forward & Backward pass Computations, calculation of Floats and Slack Times, Critical Path Method(CPM), Programme Evaluation and Review Technique(PERT), PERT Procedure, Cost Consideration in PERT/CPM, Project Cost, Cost Slope, Time-Cost Optimization Algorithm.	10
8	Queueing Theory: The Input(Arrival Pattern), The Service Mechanism, The Queue Discipline, Customer's Behavior, Kendall's Notation for Representing Queueing Models, M/M/I( $\infty$ /FCFS), M/M/I(N/FCFS), M/M/S( $\infty$ /FCFS).	10
<b>Total</b>		<b>26</b>
<b>Books and References:</b>  1.Numerical Methods: Sen and Krishnamurthy, Tata Mcgraw Hill Book Company  2. Numerical Methods : Dr. S.A. Mollah  3. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley India  4. Higher Engineering Mathematics by BS Grewal, Khanna Publication		

<b>Paper Code:</b> <b>DSE52AP</b>	<b>Computational Mathematics</b>	<b>Marks: 40</b>
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	(Practical)	
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Course Outcome....

Understand the basic methods of solving linear simultaneous equations.

Learn to perform numerical integration.

Understand that basic methods of interpolating data.

Learn the various methods of solving ordinary differential equations.

Apply the basic methods of scheduling like PERT and CPM.

Learn various queuing models and apply then to real life scenario.

<b>Paper Code: DSE52BT</b>	<b>Operations Research (Theory)</b>	<b>Marks: 60</b>
<b>Sl. No.</b>	<b>Group A</b>	<b>No. of Periods</b>
1	<b>Introduction:</b> Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods. Examples	4
2	<b>Linear Programming:</b> Definition, formulation, solution- graphical, simplex methods, Objective function, Slack & surplus variables, Artificial Variable, Big-M method.	14
4	<b>Advanced Topic Of LP:</b> Duality, PRIMAL-DUAL relations-its solution, dual-simplex, post-optimality & sensitivity analysis, problems.	10
	<b>Total</b>	<b>26</b>
<b>Sl. No.</b>	<b>Group B</b>	<b>No. of Periods</b>
	<b>Deterministic Model:</b> Transportation model-balanced & unbalanced, North West Corner method, Matrix Minima Method, Vogel's Method, Maximization and Minimization of total cost, Optimal solution using Stepping stone method, MODI methods, removal of degeneracy, Assignment problems.	15
5.	<b>Introduction to Dynamic Programming:</b> Decision Tree and Bell Man's Principle of Optimality, Characteristics of Dynamic programming problem, Solution of Linear programming Problem by Dynamic Programming.	6
6.	<b>Game Theory:</b> Definition, Payoff, Types of Games, The Maxmin-Minimax principle, Games without Saddle Point(mixed Strategies), 2x2 Games without saddle point, Graphical method for 2xn or mx2 Games, Introduction to Discrete Dynamical System	5
<b>Total</b>		<b>26</b>
<b>Books and References:</b>  1. Operations Research: An Introduction (9th Edition), 2010, Hamdy A. Taha, Prentice Hall 2. Numerical Methods : Dr. S.A. Mollah 3. Operations Research : Harvey M. Warner, PHI. 4. Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi. 5. Operations Research : Kanti Swarup, P.K.Gupta, Man Mohan, Sultan Chand and Sons		

<b>Paper Code: DSE52BP</b>	<b>Operations Research (Practical)</b>	<b>Marks: 40</b>
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Course Outcome ....

Understand the basic methods of solving linear simultaneous equations.

Learn to perform numerical integration.

Understand that basic methods of interpolating data.

Learn the various methods of solving ordinary differential equations.

Apply the basic methods of scheduling like PERT and CPM.

Learn various queuing models and apply then to real life scenario.

<b>Paper Code: DSE61AT</b>	<b>Data Security (Theory)</b>	<b>Marks: 100</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
	<b>Group A</b>	<b>32</b>
1	Security, Attacks, Computer Criminals, Security Services, Security Mechanisms	5
2	Objectives, Block Ciphers and Stream Ciphers, Private Key and Public Key Cryptography: Diffie-Hellman, RSA Algorithms, Cryptanalysis	12
3	Secure programs, Non malicious Program errors, Malicious codes Virus, Worms and Trojan Horses, Trap doors, Salami attacks, Covert channels, Control against program	12
4	Introduction to Digital Watermarking and Steganography	3
	<b>Group B</b>	<b>33</b>
5	Database Security, Requirements, Reliability, Integrity	5
6	Threats in security of networks, security controls, firewalls, intrusion detection systems, secure e-mails	10
7	Definition of entity authentication, password technique, challenge response technique and biometric authentication process, digital certificate	9
8	Definition of entity authentication, password technique, challenge response technique and biometric authentication process, digital certificate, Introduction to Cyber Security	9
<b>Total</b>		<b>65</b>
<b>Books and References:</b>  Cryptography and Network Security by B.A.Forouzan, McGraw-Hill Publication  Cryptography and Network Security – Principles and Practice by William Stallings, PHI Publication  Computer Security and Cryptography by Alan G. Konheim, John Wiley and Sons Publications  Cryptography and Network Security by Atul Kahate, McGraw-Hill Publication		

Course Outcome....

To make students understand the concepts of security threat in any network communications and in data storage

To impart the knowledge of the fundamental algorithms on encryption and decryption

To give an overview on different security policies

To learn cryptographic techniques

To learn symmetric key and asymmetric key cryptosystems

To understand the importance of key distribution in network protocol



<b>Paper Code:</b> <b>DSE61BT</b>	<b>Data Mining and Data Warehousing</b>  <b>(Theory)</b>	<b>Marks: 100</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
	<b>Group A</b>	<b>26</b>
1	<b>Data Warehousing:</b> Introduction- Definition and description, need for data ware housing, need for strategic information, failures of past decision support systems, OLTP vs OLAP, OLAP requirements, Trends in DWH, Application of DWH.	13
2	<b>Data Warehousing Architecture:</b> Reference architecture- Components of reference architecture - Data warehouse building blocks, implementation, physical design process and DWH deployment process. A Multidimensional Data, Model Data Warehouse Architecture.	13
	<b>Group B</b>	<b>39</b>
3	<b>Data Mining:</b> Data mining tasks-Data mining vs KDD- Issues in data mining, Data Mining metrics, Data mining architecture - Data cleaning- Data transformation- Data reduction - Data mining primitives.	13
4	<b>Association Rule Mining:</b> Introduction - Mining single dimensional Boolean association rules from transactional databases - Mining multi-dimensional association rules.	10
5	<b>Classification and Prediction:</b> Classification Techniques - Issues regarding classification and prediction - decision tree - Bayesian classification –Classifier accuracy – Clustering – Clustering Methods - Outlier analysis.	13
6	<b>Applications and Other Data Mining Methods:</b> Text mining, Web mining.	3
<b>Total</b>		<b>65</b>
<b>Books and Reference:</b>		
Data Mining: Concepts and Techniques, 3 <sup>rd</sup> Edition, Han and Kamber, The Morgan Kaufmann Series in Data Management Systems		
Top 10 algorithms in Data Mining, CRC Press		
Data Warehousing, Data Mining & OLAP, Alex Berson and Stephen Smith, McGraw-Hill		
Data Mining and Data Warehousing, S.K.Mourya and Shalu Gupta, Alpha Science International		

<b>Paper Code: DSE62</b>	<b>PROJECT</b>	<b>Marks: 100</b>
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Course Outcome....

Understand and implement classical models and algorithms in data warehouses and data mining and be familiar with mathematical foundations of data mining tools.

Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

Master data mining techniques in various applications like social, scientific and environmental context.

Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

To make students understand data warehousing fundamentals and understand the concepts of building data warehouses with different modeling paradigms

To make students understand the implementation processes of OLAP operations on a data warehousing environment

### Part III – Skill Enhancement Courses

**\*\*NOTE:** There will be 2 practical classes per week for each of the SEC papers, based on the topics covered in the theory classes

<b>Paper Code: SEC31A</b>	<b>Paper Name: HTML Programming</b>	<b>Marks: 50</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
1	Basics of HTML  What is HTML?  Using an HTML Editor  HTML Tags and Attributes	2

	Parts of HTML Document Opening HTML using a browser	
2	<u>Text Formatting</u>  Basic Formatting Tags  Unordered Lists, Order List, List Items  Paragraph attributes, BGcolor, font, size	3
3	<u>Image and Hyperlinks</u>  Insert Image, Image size, Alternate Text  Hypertext, Hyperlinks, Named Anchors, Email Links, Alternate Text	2
4	<u>Forms and Tables</u>  Forms  Inputs  Edit Box, Radio Buttons, CheckBox, DropDownList, Buttons  Tables  TR, TD, TH, Colspan, Rowspan, Border	3
5	<u>Introduction to CSS</u>  What is CSS?  Why Cascading Style Sheets?  How to implement CSS?  CSS Id Selector  Css Class Selector  Different ways to use CSS  Inline CSS  Internal CSS  External CSS	3
<b>Total</b>		<b>13</b>
<b>Books and References:</b>  1. Introduction to <b>HTML</b> and CSS -- O'Reilly  2. Jon Duckett, HTML and CSS, John Wiley		

Course Outcome....

Use knowledge of HTML and CSS code and an HTML editor to create personal and/or business websites following current professional and/or industry standards.

Use critical thinking skills to design and create websites.

Use a stand-alone FTP program to upload files to a web server.

Implement interactive web page(s) using HTML, CSS and JavaScript.

Design a responsive web site using HTML5 and CSS3.

Demonstrate Rich Internet Application

<b>Paper Code: SEC31B</b>	<b>Paper Name: Android Programming</b>	<b>Marks: 50</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
1	<b>Introduction</b>  History of Android, Introduction to Android Operating Systems, Android Development Tools, Android Architecture.	2
2	<b>Overview of object oriented programming using Java</b>  OOPs Concepts: Inheritance, Polymorphism, Interfaces, Abstract class, Threads, Overloading and Overriding, Java Virtual Machine.	

3	<b>Development Tools</b> Installing and using Eclipse with ADT plug-in, Installing Virtual machine for Android sandwich/Jelly bean (Emulator), configuring the installed tools, creating a android project – Hello Word, run on emulator, Deploy it on USB-connected Android device.	3
4	<b>User Interface Architecture</b> Application context, intents, Activity life cycle, multiple screen sizes.	2
5	<b>User Interface Design</b> Form widgets, Text Fields, Layouts, Button control, toggle buttons, Spinners (Combo boxes), Images, Menu, and Dialog.	2
6	<b>Database</b> Understanding of SQLite database, connecting with the database.	2
<b>Total</b>		<b>13</b>
<b>Books and References:</b>  Android application development for java programmers. By James C. Sheusi. Publisher: Cengage Learning Learning Android. By Marko Gargenta -- O'Reilly		

Course Outcome ....

Experiment on Integrated Development Environment for Android Application Development.

Design and Implement User Interfaces and Layouts of Android App.

Use Intents for activity and broadcasting data in Android App.

Design and Implement Database Application and Content Providers.

Experiment with Camera and Location Based service.

Develop Android App with Security features.

<b>Paper Code: SEC31C</b>	<b>Paper Name: R Programming</b>	<b>Marks: 50</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
1.	Introduction: Overview and History of R, Getting Help, Data Types, Subsetting, Vectorized Operations, Reading and Writing Data.	4
2.	Control Structures, Functions, lapply, tapply, split, mapply, apply, Coding Standards.	5
3.	Scoping Rules, Debugging Tools, Simulation, R Profiler.	4
	<b>Total</b>	13
<b>Book and Reference</b>  1. William N. Venables and David M. Smith, An Introduction to R. 2nd Edition. Network Theory Limited.2009  2. Norman Matloff, The Art of R Programming - A Tour of Statistical Software Design, No Starch Press.2011		

Course Outcome ....

Install and use R for simple programming tasks.

Extend the functionality of R by using add-on packages.

Extract data from files and other sources and perform various data manipulation tasks on them.

Code statistical functions in R.

Use R Graphics and Tables to visualize results of various statistical operations on data.

Apply the knowledge of R gained to data Analytics for real life applications.

<b>Paper Code: SEC41A</b>	<b>Paper Name: Oracle</b>	<b>Marks: 50</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
1.	<b>SQL Vs. SQL * Plus:</b> SQL Commands and Data types, Operators and Expressions, Introduction to SQL * Plus.	2
2.	<b>Managing Tables and Data:</b> Creating and Altering Tables (Including constraints) • Data Manipulation Command like Insert, update, delete • SELECT statement with WHERE, GROUP BY and HAVING, ORDER BY, DISTINCT, Special operator like IN, ANY, ALL BETWEEN, EXISTS, LIKE • Join, Built in functions	3
3.	<b>Other Database Objects:</b> View • Synonyms, Index	2
4.	<b>Transaction Control Statements:</b> Commit, Rollback, Savepoint	2
5.	<b>Introduction to PL/SQL:</b> SQL v/s PL/SQL • PL/SQL Block Structure • Language construct of PL/SQL (Variables, Basic and Composite Data type, Conditions looping etc.) • % TYPE and % ROWTYPE • Using Cursor (Implicit, Explicit)	4
	<b>Total</b>	13

**Book and References:**

1. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle Paperback", BPB Publications, 2010.
2. Steven Feuerstein, Bill Pribyl, "Oracle PL/SQL Programming", 6th Edition, O'Reilly Media, 2014.



3. Rajeeb C. Chatterjee, "Learning Oracle SQL and PL/SQL: A simplified Guide", PHI, 2012.

Course Outcome....

Understand the Oracle database architecture

Understand the use the Relational model and how it is supported by SQL and PL/SQL

Acquire the knowledge of the processes of Database Development and Administration using SQL

Use Query and Sub query to Solve a Problem in Database Update

Perform transactions using Oracle PL/SQL

Enhance Database Programming skills and techniques using SQL and PL/SQL

<b>Paper Code: SEC41B</b>	<b>Paper Name: Python Programming</b>	<b>Marks: 50</b>
<b>Sl. No.</b>	<b>Topic</b>	<b>No. of Periods</b>
1	PYTHON PROGRAMMING OVERVIEW AND BASICS  Computer Basics and Fundamentals; Algorithms & Flowcharts; History & Features of Python; Difference between Python 2.7 and 3.6	1
2	VARIABLES, EXPRESSIONS AND BASIC INPUT OUTPUT  Identifiers, Keywords, Literals; Variables; Naming Convention; Operators; Follow Copy	1
3	A BRIEF LOOK AT DATA TYPES  List; Tuple; Dictionary; More On Data Types	2
4	CONTROL STATEMENTS  If Statement; Nested if-elif; Looping; Break; Continue; Pass	2
5	SYSTEM AND USERDEFINED FUNCTIONS  Defining a Function; Calling a Function; Anonymous Functions; Global and Local Functions	2
6	MODULES  Importing a Module; Math Module; Random Module; Packages	2
7	FILE HANDLING  Reading and Closing Module; Reading from XML file; Creating Log file; More on File Concept	1
8	OOP CONCEPT  OOP feature and brief description; Class Design; Constructor and Destructor; Use of self; Inheritance; Exception Handling Mechanism  Abstraction Mechanism; Multi-Threading; Database access with Python; GUI Application; Regular Expression	2
<b>Total</b>		<b>13</b>
<b>Books and References:</b>  1. P. K. Sinha & Priti Sinha , “Computer Fundamentals”, BPB Publications, 2007. 2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010. 3. T. Budd, Exploring Python, TMH, 1st Ed, 2011		

4. Allen Downey, Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python , Freely available online.2012
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Course Outcome ....

Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python

Express different Decision Making statements and Functions

Interpret Object oriented programming in Python

Understand and summarize different File handling operations

Explain how to design GUI Applications in Python and evaluate different database operations

Design and develop Client Server network applications using Python

<b>Paper Code:</b> SEC41C	<b>Paper Name: PHP Programming</b>	<b>Marks: 50</b>
<b>SL.No.</b>	<b>Topic</b>	<b>No. of Periods</b>
1	<b>Introduction to PHP :</b>  PHP introduction, inventions and versions, important tools and software requirements (like Web Server, Database, and Editors). PHP with other technologies, scope of PHP → Basic Syntax, PHP variables and constants. Types of data in PHP, Expressions, scopes of a variable (local, global)	1
2	<b>PHP Operators:</b>  Arithmetic, Assignment, Relational, Logical operators, Bitwise, ternary and MOD operator. PHP operator Precedence and associatively	1
3	<b>Handling HTML form with PHP HTML:</b>  Capturing Form Data, GET and POST form methods, Dealing with multi value fields. Redirecting a form after submission PHP conditional events and Loops, PHP IF Else conditional statements (Nested IF and Else), Switch case, while ,For and Do While Loop  Break ,Continue and exit PHP Functions	2
4	<b>PHP Functions:</b>  Function, Need of Function , declaration and calling of a function  PHP Function with arguments, Default Arguments in Function  Function argument with call by value, call by reference  Scope of Function Global and Local	2
5	<b>String Manipulation and Regular Expression:</b>  Creating and accessing String , Searching & Replacing String  Formatting, joining and splitting String, String Related Library functions. Use of different string functions like strlen(), strcmp(), strpos() etc. Use and advantage of regular expression over inbuilt function	3
6	<b>Arrays:</b>  Anatomy of an Array, Creating index based and Associative array, Accessing array. Looping with Index based array, with associative array using each () and foreach(), Sorting Arrays. Some useful Library function	2
7	<b>Advanced Topics:</b>  PHP Date and Time, File Handling(Open/Read/Create/Write)	2

	PHP Form Handling, Validation	
<b>Total</b>		<b>13</b>
<b>Books and References:</b>  Beginning PHP5, Merser, Kent et al, Wrox Publications  SAMS Teach Yourself PHP in 24 Hours, Matt Zandsta,Techmedia  Head First PHP & MySQL, Lynn Beighley and Michael Morrison,OREilly Publications  PHP: The Complete Reference, Steven Holzner, McGraw Hill Education		

Course Outcome....

Make the students understand the concepts of Server and Client programming

Make the students expert in HTML and JavaScript

Guide the students in practical sessions of PHP

Give the students an idea of connecting HTML forms with PHP

Guide the students in practical sessions of connecting PHP with other pages of HTML or PHP and understand the basics of String manipulation in PHP.

Make the students acquainted with the database connectivity of PHP and MySQL

## Course: Discipline Specific Core

Semester	1
Paper Number	
Paper Title	Programming Fundamentals using C/C++
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	Students are expected to achieve the following abilities:

	<p>To understand fundamentals of programming and different categories of the same</p> <p>To understand different components of a programming language</p> <p>To develop logical ability</p> <p>To be aware of the important topics and principles of software development</p> <p>To understand and to write a computer program to solve specified problems</p> <p>To be conversant with different programming platforms</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: Th – 10, Pr - 40</p> <p>End-Sem: Th – 50</p>

Semester	1
Paper Number	
Paper Title	Computer System Architecture
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>The following are the objectives of this course:</p> <p>The course gives an overview of the organisational structure of a computer.</p> <p>The student is expected to become capable of designing various arithmetic and logical circuits.</p> <p>The students would also learn about the modes of interaction between the different components and the organisational issues that may arise.</p> <p>The student is expected to learn about the functioning of the CPU and the various circuits present inside it.</p> <p>This course should serve as a stepping stone for learning about parallel architecture.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: Th – 10, Pr - 40</p> <p>End-Sem: Th – 50</p>

Semester	2
Paper Number	
Paper Title	Programming in JAVA
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>Students are expected to achieve the following abilities:</p> <p>To understand the fundamentals of object-oriented programming in Java</p> <p>To gain knowledge about basic Java language syntax and semantics</p> <p>To understand classes, objects, invoking methods etc.</p> <p>To understand the principles of inheritance, packages and interfaces</p> <p>To understand exception handling mechanisms</p> <p>To understand the applications of data structures in Java using Collection Framework</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: Th – 10, Pr - 40</p> <p>End-Sem: Th – 50</p>



Semester	2
Paper Number	
Paper Title	Discrete Structures
No. of Credits	6
Theory/Composite	Theory
No. of periods assigned	Th:5+1
Name of Faculty member(s)	
Course description/objective	<p>Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:</p> <p>Use mathematically correct terminology and notation.</p> <p>Learn correct direct and indirect proofs.</p> <p>Use proper examples to illustrate the basic concepts.</p> <p>Use counterexamples.</p> <p>Apply logical reasoning to solve problems wherever required.</p> <p>Understand its utility in solving computer science problems.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: 20</p> <p>End-Sem: 80</p>

Semester	3
Paper Number	
Paper Title	Data Structures
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>Students are expected to achieve the following abilities:</p> <p>To learn efficient storage mechanisms of data for an easy access.</p> <p>To choose appropriate data structure as applied to specified problem definition</p> <p>To handle operations like searching, insertion, deletion, traversing mechanism various data structures</p> <p>To teach the concept of protection and management of data</p> <p>To apply concepts learnt here in various domains like DBMS and compiler construction etc.</p> <p>To introduce various techniques for representation of the data in the real world.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50

Semester	3
Paper Number	
Paper Title	Operating Systems
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>To understand the services provided by and the design of an operating system.</p> <p>To understand the structure and organization of the file system.</p> <p>To understand what a process is and how processes are synchronized and scheduled.</p> <p>To understand different approaches to memory management.</p> <p>Students should be able to use system calls for managing processes, memory and the file system.</p> <p>Students should understand the data structures and algorithms used to implement an OS.</p> <p>End of this course students will demonstrate a knowledge of process control, threads, concurrency, memory management scheduling, I/O and files, distributed systems, security</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50

Semester	3
Paper Number	
Paper Title	Computer Networks
No. of Credits	6
Theory/Composite	Theory
No. of periods assigned	Th:5+1
Name of Faculty member(s)	
Course description/objective	<p>Upon completion of this course, the students will be able to:</p> <p>Understand the fundamental concepts of computer networking.</p> <p>Familiarize with the basic taxonomy and terminology of computer networking.</p> <p>Understand the need of layered architecture</p> <p>Gain expertise in some specific areas of networking such as design and maintenance of networks.</p> <p>Understand the basic concepts of internetworking.</p> <p>Introduce advanced networking concepts, for advanced courses in computer networking.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: 20</p> <p>End-Sem: 80</p>

Semester	4
Paper Number	
Paper Title	Design and Analysis of Algorithms
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>Upon completion of this course, students will be able to do the following:</p> <p>Analyze the asymptotic performance of algorithms.</p> <p>Compute time complexity expression of standard algorithms.</p> <p>Demonstrate a familiarity with major algorithms and data structures.</p> <p>Apply important algorithmic design paradigms and methods of analysis.</p> <p>Synthesize efficient algorithms in common scientific design situations.</p> <p>To apply concepts learnt here in various domains like DBMS and compiler construction etc.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: Th – 10, Pr - 40</p> <p>End-Sem: Th – 50</p>

Semester	4
Paper Number	
Paper Title	Software Engineering
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>Knowledge of basic SW engineering methods and practices, and their appropriate application.</p> <p>A general understanding of software process models.</p> <p>Understanding of software requirements and the SRS documents.</p> <p>Understanding of the role of project management.</p> <p>Describe data models, object models, context models and behavioural models.</p> <p>Understanding of design and implementation issues.</p> <p>Understanding of software testing approaches.</p> <p>Describe software measurement and software risks.</p> <p>Understanding on quality control and how to ensure good quality software.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: Th – 10, Pr - 40</p> <p>End-Sem: Th – 50</p>

Semester	4
Paper Number	
Paper Title	Database Management Systems
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	To gain a broad understanding of the discipline of database management systems and its application to the formulation, design, implementation and management of databases systems. It will enable the students to acquire the knowledge of various data models and their functioning, query processing, design issues, storage and efficient retrieval techniques.
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50

Semester	5
Paper Number	
Paper Title	Internet Technologies
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>At the end of the course the student will have</p> <p>The conceptual and technological developments in the field of Internet and web designing.</p> <p>Understanding the emphasis on comprehensive knowledge of Internet, its applications and the TCP/IP protocols widely deployed to provide Internet connective worldwide.</p> <p>Idea on World Wide Web with its widespread usefulness which has become an integral part of the Internet.</p> <p>Understanding of putting emphasis on basic concepts of web design.</p> <p>Comprehension of the technologies for Hypertext Mark-up Language (HTML).</p> <p>Concepts on specifying design rules in constructing web pages and sites.</p> <p>Effective dealing with programming issues relating to VB Script, JavaScript, Java, etc.</p> <p>Idea on figuring out the various security hazards on the Internet and need of security measures.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50



Semester	5
Paper Number	
Paper Title	Theory of Computation
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:5+1
Name of Faculty member(s)	
Course description/objective	<p>The following are the course objectives:</p> <p>Introduce students to the mathematical foundations of computation including automata theory</p> <p>To enable the students understand the theory of formal languages and grammars</p> <p>To give an idea of the notions of algorithm, decidability, complexity, and computability</p> <p>To explain to the students the concept of an abstract machine and how it can be theoretically modelled</p> <p>After the completion of this course the students should find themselves favourably positioned to learn the design of a compiler</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: 20</p> <p>End-Sem: 80</p>

Semester	6
Paper Number	
Paper Title	Artificial Intelligence
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>Upon completion of this course, students will be able to do the following:</p> <p>To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.</p> <p>To have an appreciation for the scientific issues underlying the design of AI systems.</p> <p>To have a basic proficiency in a traditional AI language including an ability to write programs and an ability to understand code written in that language.</p> <p>To have an understanding of the basic issues of knowledge representation and heuristic search, as well as an understanding of other topics like minimax, resolution, etc. that play an important role in AI programs.</p> <p>To understand the synergistic effects of AI algorithms and data representation methods.</p> <p>To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50

Semester	6
Paper Number	
Paper Title	Computer Graphics
No. of Credits	6
Theory/Composite	Composite
No. of periods assigned	Th:4 Pr:4
Name of Faculty member(s)	
Course description/objective	<p>At the end of the course the student will have</p> <p>Awareness of the concepts underlying modern Computer Graphics and Machine Vision.</p> <p>Understanding of the generic skills to design algorithms for digital image synthesis for a broad-based set of computing problems in various domains.</p> <p>Understanding of 2D geometric transformations.</p> <p>Concepts of the Algorithms for Clipping.</p> <p>Idea on 3D geometric and modelling transformations.</p> <p>Understanding of Illumination models and surface rendering methods.</p> <p>Idea in the fields of Multimedia Technology such as image editing, photo-retouching, web design, etc</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	<p>CIA: Th – 10, Pr - 40</p> <p>End-Sem: Th – 50</p>

## Course: Discipline Specific Elective

### Option 1

Semester	5
Paper Number	Elective 1
Paper Title	Microprocessor
No. of Credits	
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 4
Name of Faculty member(s)	
Course description/objective	<p>To understand basic architecture of 8, 16 and 32 bit microprocessors.</p> <p>To introduce 8085 architecture and programming in assembly language.</p> <p>To introduce basic concepts of interfacing memory and peripheral devices to a microprocessor.</p> <p>To understand interfacing of 8 bit microprocessor with memory and peripheral chips involving system design.</p> <p>To understand techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.</p> <p>To introduce various advanced processor architectures such as 80X86, Pentium and Multi-core Processors.</p>
Syllabus	Please see Annexure

Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50

**Option 2**

Semester	5
Paper Number	Elective 1
Paper Title	System Software
No. of Credits	
Theory/Composite	Theory
No. of periods assigned	Th: 5+1
Name of Faculty member(s)	
Course description/objective	<p>The objective of the course is as follows:</p> <p>To give the learners a detailed overview of the different kinds of System Software that are used in a computer.</p> <p>The course gives a detailed insight into the design and working of translators</p> <p>The student would be able to learn and design both a two-pass and a one-pass assembler by themselves</p> <p>The course gives an overview of different kinds of loaders and linkers as well as an idea of the design principles of the same.</p> <p>The course gives stress on the design of a compiler, given its importance in the programming world.</p> <p>The course highlights on the different phases of a compiler and the working and design of each of them.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: 20 End-Sem: 80

**Option 3**

Semester	5
Paper Number	Elective 2
Paper Title	Computational Mathematics
No. of Credits	
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 4
Name of Faculty member(s)	
Course description/objective	Upon completion of this course, students will be able to do the following: Understand the basic methods of solving linear simultaneous equations. Learn to perform numerical integration. Understand that basic methods of interpolating data. Learn the various methods of solving ordinary differential equations. Apply the basic methods of scheduling like PERT and CPM. Learn various queuing models and apply then to real life scenario.
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50

**Option 4**

Semester	5
Paper Number	Elective 2
Paper Title	Operations Research
No. of Credits	
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 4
Name of Faculty member(s)	
Course description/objective	Upon completion of this course, students will be able to do the following: Understand the basic methods of solving linear simultaneous equations. Learn to perform numerical integration. Understand that basic methods of interpolating data. Learn the various methods of solving ordinary differential equations. Apply the basic methods of scheduling like PERT and CPM. Learn various queuing models and apply them to real life scenario.
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: Th – 10, Pr - 40 End-Sem: Th – 50



**Option 5**

Semester	6
Paper Number	Elective 3
Paper Title	Data Security
No. of Credits	
Theory/Composite	Theory
No. of periods assigned	Th: 5+1
Name of Faculty member(s)	
Course description/objective	<p>Students are expected to achieve the following abilities:</p> <p>To identify computer and network security threats, classify the threats and develop a security model to prevent, detect and recover from the attacks.</p> <p>To encrypt and decrypt messages using block ciphers and stream ciphers</p> <p>To sign and to verify messages using well known signature generation and verification algorithms</p> <p>To analyze existing authentication and key agreement protocols, identify the weaknesses of these protocols</p> <p>To understand e-mail and file security software, PGP</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: 20 End-Sem: 80

**Option 6**

Semester	6
Paper Number	Elective 3
Paper Title	Data Mining and Data Warehousing
No. of Credits	
Theory/Composite	Theory
No. of periods assigned	Th: 5+1
Name of Faculty member(s)	
Course description/objective	<p>Upon completion of this course, students will be able to do the following:</p> <p>Understand the basic steps of data pre-processing.</p> <p>Develop ability to understand various data mining algorithms like association, classification, clustering etc.</p> <p>Understand the various architectures and components of a data warehouse.</p> <p>Compare and contrast OLAP and data mining as techniques for extracting knowledge from a data warehouse.</p> <p>Understand the role of data analytics in solving real life applications.</p> <p>Develop further interest in research and design of new Data Mining and warehousing techniques.</p>
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: 20 End-Sem: 80

**Course: Skill enhancement (Semester 3 and 4)**

Semester ____	3
Paper Number	
Paper Title	HTML
No. of Credits	
Theory/Composite	
No. of periods assigned	Th: 1 Pr: 2
Name of Faculty member(s)	
Course description/objective	
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: End-Sem:

Semester ____	3
Paper Number	
Paper Title	Android
No. of Credits	
Theory/Composite	
No. of periods assigned	Th: 1 Pr: 2
Name of Faculty member(s)	
Course description/objective	
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: End-Sem:

Semester ____	3
Paper Number	
Paper Title	R Programming
No. of Credits	
Theory/Composite	
No. of periods assigned	Th: 1 Pr: 2
Name of Faculty member(s)	
Course description/objective	
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: End-Sem:

Semester ____	4
Paper Number	
Paper Title	Oracle (SQL/PL-SQL)
No. of Credits	
Theory/Composite	
No. of periods assigned	Th: 1 Pr: 2
Name of Faculty member(s)	
Course description/objective	
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: End-Sem:

Semester ____	4
Paper Number	
Paper Title	Programming in Python
No. of Credits	
Theory/Composite	
No. of periods assigned	Th: 1 Pr: 2
Name of Faculty member(s)	
Course description/objective	
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: End-Sem:

Semester ____	4
Paper Number	
Paper Title	PHP Programming
No. of Credits	
Theory/Composite	
No. of periods assigned	Th: 1 Pr: 2
Name of Faculty member(s)	
Course description/objective	
Syllabus	Please see Annexure
Texts	
Reading/Reference Lists	Please see Annexure
Evaluation	CIA: End-Sem: