MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102

MBU
MOHAN BABU
UNIVERSITY
DREAM. BELIEVE. ACHIEVE

SCHOOL OF LIBERAL ARTS AND SCIENCES

B.Sc. - Bioinformatics

(3 Years Degree)

B.Sc. (Hons.) - Bioinformatics

(4 Years Degree)

CURRICULUM AND SYLLABUS

(From 2025-26 Admitted Batches)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM (FFCBCS)

MOHAN BABU UNIVERSITY

Vision

To be a globally respected institution with an innovative and entrepreneurial culture that offers transformative education to advance sustainability and societal good.

Mission

- Develop industry-focused professionals with a global perspective.
- Offer academic programs that provide transformative learning experience founded on the spirit of curiosity, innovation, and integrity.
- Create confluence of research, innovation, and ideation to bring about sustainable and socially relevant enterprises.
- Uphold high standards of professional ethics leading to harmonious relationship with environment and society.

SCHOOL OF LIBERAL ARTS AND SCIENCES

Vision

To be the ideal culmination for the edification of liberal arts and sciences recognized for excellence, innovation, entrepreneurship, environment and social consciousness.

Mission

- Infuse the essential knowledge of liberal arts and sciences, skills and an inquisitive attitude to conceive creative and appropriate solutions to serve industry and community.
- Proffer a know-how par excellence with the state-of-the-art research, innovation, and incubation ecosystem to realise the learners' fullest entrepreneurial potential.
- Endow continued education and research support to working professionals in liberal arts and sciences to augment their domain expertise in the latest technologies
- Entice the true spirit of environment and societal consciousness in citizens of tomorrow in solving challenges in liberal arts and sciences.

DEPARTMENT OF BIOLOGICAL AND CHEMICAL SCIENCES

Vision

To become a leading center of excellence in the Biological and Chemical Sciences through adapting advanced methods in teaching and research.

Mission

- Inspire science students of tomorrow to take on the challenges in the scientific field and build sustaining society that is free from Biological and Chemical science apprehensions.
- Provide students with an education that combines academics with diligent practical training in a dynamic, research-oriented environment to serve Industry and Societal needs.
- Encourage faculty and staff to achieve bigger goals in their respective fields and exhibit the best of their abilities via continuing education and research.

B.Sc. – Bioinformatics

PROGRAM EDUCATIONAL OBJECTIVES

After few years of graduation, the graduates of B.Sc. Bioinformatics will:

PEO1. Pursue higher education in their core or allied areas of specialization.

PEO2. Employed as a productive and valued professional in industry/teaching/ research.

PEO3. Engaged in innovation and deployment as a successful entrepreneur.

PEO4. Adapt evolving technologies in the core or allied areas by participating in continuing education programs for lifelong learning

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of B.Sc. Bioinformatics will be able to:

PO1. **Knowledge:** To study as well as apply concepts, theories, and practices across the disciplines to gain the foundational knowledge.

PO2. **Problem Analysis:** To identify, analyze and evaluate various experiences and perspectives using foundational disciplinary knowledge for substantiated conclusions.

PO3. **Design/Development of solutions:** To design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Modern tool usage:** To create, select, and apply appropriate techniques, resources and modern tools with an understanding of the limitations.

PO5. **Environment and Sustainability:** Understand the issues of environmental contexts and demonstrate the knowledge for sustainable development.

PO6. **Ethics and Society:** Apply the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities under moral dimensions.

PO7. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, to manage projects and finance in multidisciplinary settings.

PO8. **Effective Communication:** To develop proficiency and efficiency in communicating by connecting people, ideas, books, media, and technology.

PO9. **Life-long learning:** Recognize the need for and acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAM SPECIFIC OUTCOMES

On successful completion of the Program, the graduates of B.Sc. Bioinformatics will be able to:

PSO1 Gain knowledge in fundamentals of bioinformatics, latest tools, software's used in the area of Bioinformatics and recognize different biological database resources and software packages for analysis and interpretation of biological data related to analysis of Genome, proteome and drug design.

PSO2 Analyze various cellular and extracellular components through their theoretical and practical Biochemistry knowledge for understanding the health and disease condition of Plants and Animals.

PSO3 Study and analyze the nature of chemicals and design the reaction mechanism for the synthesis and development of eco-friendly chemicals by applying modern methods for the benefit of public and industrial sector

B.Sc. – Bioinformatics (3 Years Degree Program)

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min.- Max.)
1	SCHOOL CORE	24-36
2	PROGRAM CORE	54-66
3	PROGRAM ELECTIVE	27-36
4	UNIVERSITY ELECTIVE	9-12
	TOTAL CREDITS	**Min. 120**

B.Sc. (Hons.) – Bioinformatics (4 Years Degree Program)

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min.- Max.)
1	SCHOOL CORE	24-36
2	PROGRAM CORE	72-84
3	PROGRAM ELECTIVE	36-45
4	UNIVERSITY ELECTIVE	12-18
	TOTAL CREDITS	**Min. 160**

SCHOOL CORE

(24-36 Credits for 3 years Program); (24-36 Credits for 4 years Program);

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
School Core							
25BS101002	Introduction to Classical Biology	3	-	-	-	3	-
25BS101011	General Chemistry	3	-	-	-	3	-
25LG102402	General English	2	-	2	-	3	-
25LG101402	Telugu	2	-	-	-	2	-
25LG101404	Sanskrit	2	-	-	-	2	-
25LG101403	German Language	2	-	-	-	2	-
25LG101407	French Language	2	-	-	-	2	-
25BS101036	Mind and Behavior	3	-	-	-	3	-
25BS101003	Biodiversity monitoring and management	3	-	-	-	3	-
25LG111001	English Language Proficiency	-	-	-	-	2	-
25BS111001	Internship	-	-	-	-	2	-
25BS108001	Capstone Project	-	-	-	-	8	-
Mandatory Non-Credit Courses							
25CB107601	Essentials of Cyber Security *	2	-	-	-	2	-
25LG107601	Professional Ethics and Human Values	2	-	-	-	2	-
25CE107601	Environmental Science*	2	-	-	-	2	-
25CE107602	Disaster Mitigation and Management	2	-	-	-	2	-
25CE107603	Rural Technology	2	-	-	-	2	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25LG107603	Spoken English	-	1	2	-	2	-
25LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
25AB107601	NSS Activities	-	-	-	-	2	-
25AB107602	Yoga	-	-	-	-	2	-
25AB107603	NCC Activities	-	-	-	-	2	-
25MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
25EE107601	Intellectual Property Rights	2	-	-	-	2	-
25EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-

PROGRAM CORE

(54-66 Credits for 3 years Program)-Minimum 18 credits shall earn from each major;

(72-84 Credits for 4 years Program)-Minimum 24 credits shall earn from each major;

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project-based Learning	Credits	Pre-requisite
		L	T	P	S	C	
Major 1 – Bioinformatics							
25BS102001	Introduction to Bioinformatics	3	-	3	-	4.5	-
25BS102002	Biological Databases and DBMS	3	-	3	-	4.5	Introduction to Bioinformatics
25BS102003	Introduction to Genome Projects	3	-	2	-	4.5	Introduction to Bioinformatics
25BS102004	Computational biology	3	-	3	-	4.5	Introduction to Bioinformatics
25BS101005	Molecular Genetics	3	-	-	-	3	-
25BS102005	Structural Analysis	3	-	3	-	4.5	Introduction to Bioinformatics
25BS101006	Genomics and Proteomics	3	-	-	-	3	Introduction to Bioinformatics
Major 2 -Biochemistry							
25BS102006	Biomolecules	3	-	3	-	4.5	-
25BS102007	Biophysical techniques	3	-	3	-	4.5	Biomolecules
25BS102008	Human Physiology and Nutrition	3	-	3	-	4.5	-
25BS101008	Endocrinology	3	-	-	-	3	Human Physiology and Nutrition
25BS101009	Cell Biology	3	-	-	-	3	Biomolecules
25BS101010	Introduction to Metabolism	3	-	-	-	3	Biomolecules

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project-based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25BS102010	Basic Enzymology	3	-	3	-	4.5	Biomolecules
25BS102011	Molecular biology	3	-	3	-	4.5	Biomolecules
Major 3 – Chemistry							
25BS102013	Inorganic and Physical Chemistry	3	-	3	-	4.5	-
25BS102014	Basic Organic Chemistry	3	-	3	-	4.5	-
25BS102015	Advanced Chemistry-I	3	-	3	-	4.5	-
25BS102016	Advanced Chemistry-II	3	-	3	-	4.5	Advanced Chemistry-I
25BS101012	Transition Elements and Nuclear Chemistry	3	-	-	-	3	-
25BS101013	Phase Equilibria and Kinetics	3	-	-	-	3	-
25BS101014	Basics of Polymer Chemistry	3	-	-	-	3	-
25BS101015	Coordination Chemistry	3	-	-	-	3	-

PROGRAM ELECTIVE

(27-36 Credits for 3 years Program)-Minimum 9 credits shall earn from each major;

(36-45 Credits for 4 years Program)-Minimum 12 credits shall earn from each major;

Course code	Title of the Course	Lecture	Tutorial	Practical	Project-based Learning	Credits	Pre-requisite
		L	T	P	S	C	
Major 1 – Bioinformatics							
25BS101016	Working with a Single DNA Sequence	3	-	-	-	3	Introduction to Bioinformatics
25BS102017	Sequence Alignment and Sequence Analysis	3	-	2	-	4	Introduction to Bioinformatics
25BS101018	Drug Design	3	-	-	-	3	-
25BS101021	Basics of computational molecular biology	3	-	-	-	3	-
25BS101019	Artificial intelligence and Bioinformatics	3	-	-	-	3	Introduction to Bioinformatics
Major 2 – Biochemistry							
25BS101022	Food and Nutrition	3	1	-	-	4	-
25BS102018	Biochemical Correlations in Disease	3	-	3	-	4.5	-
25BS102020	Fundamentals of Bioinformatics and Proteomics	3	-	3	-	4.5	-
25BS101023	Genomics	3	-	-	-	3	-
25BS101024	Embryology	3	-	-	-	3	Human Physiology and Nutrition
25BS102021	Endocrinology	3	-	3	-	4.5	Human Physiology and Nutrition
25BS102022	Neurobiology	3	-	3	-	4.5	Human Physiology and Nutrition
Major 3 – Chemistry							
25BS101025	Basic Reagents and Reaction Mechanism	3	-	-	-	3	-
25BS102023	Basics of Spectroscopy	3	-	3	-	4.5	-

Course code	Title of the Course	Lecture	Tutorial	Practical	Project-based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25BS102024	Fundamentals of Analytical Chemistry	3	-	3	-	4.5	-
25BS101028	Thermodynamics	3	-	-	-	3	-
25BS101029	Organic Functional groups	3	-	-	-	3	-
25BS101030	Chemistry of Materials	3	-	-	-	3	-
25BS101031	Electrochemistry	3	-	-	-	3	-

UNIVERSITY ELECTIVE (9-12 CREDITS)

(9-12 Credits for 3 years Program); (12-18 Credits for 4 years Program)

Course Code	Title of the Course	L	T	P	S	C	Prerequisite
25EC101701	AI in Healthcare	3	-	-	-	3	-
25CM101701	Banking and Insurance	3	-	-	-	3	-
25DS101701	Bioinformatics	3	-	-	-	3	-
25BS101701	Biology for Engineers	3	-	-	-	3	-
25CE101701	Civil Engineering and The Society	3	-	-	-	3	-
25SS101701	Constitution of India	3	-	-	-	3	-
25CM101702	Cost Accounting and Financial Management	3	-	-	-	3	-
25CB101701	Cyber Laws and Security	3	-	-	-	3	-
25EE101701	Electrical Safety and Safety Management	3	-	-	-	3	-
25MG101701	Entrepreneurship for Micro, Small and Medium Enterprises	3	-	-	-	3	-
25CE101702	Environmental Pollution and Control	3	-	-	-	3	-
25EC101702	Essentials of VLSI	3	-	-	-	3	-
25CB101702	Introduction to Ethical Hacking	3	-	-	-	3	-
25BS101703	Forensic Science	3	-	-	-	3	-
25SS101702	Gender and Environment	3	-	-	-	3	-
25ME101701	Global Strategy and Technology	3	-	-	-	3	-
25EE101704	Green Technologies	3	-	-	-	3	-
25ME101702	Human Resource Management	3	-	-	-	3	-
25SS101703	Indian Economy	3	-	-	-	3	-

Course Code	Title of the Course	L	T	P	S	C	Prerequisite
25SS101704	Indian History	3	-	-	-	3	-
25SS101705	Indian Tradition and Culture	3	-	-	-	3	-
25EC101703	Instrumentation in Industries	3	-	-	-	3	-
25EC101704	Introduction to Nano technology	3	-	-	-	3	-
25AI101701	Introduction to Artificial Intelligence	3	-	-	-	3	-
25DS101702	Introduction to Data Science	3	-	-	-	3	-
25AI101702	Introduction to Machine Learning	3	-	-	-	3	-
25CS101701	Introduction to Python Programming	3	-	-	-	3	-
25CB101704	Introduction to Internet of Things	3	-	-	-	3	-
25ME101703	Management Science	3	-	-	-	3	-
25ME101704	Managing Innovation and Entrepreneurship	3	-	-	-	3	-
25ME101705	Material Science	3	-	-	-	3	-
25LG201701	Personality Development	3	-	-	-	3	-
25CE101703	Planning for Sustainable Development	3	-	-	-	3	-
25EC101705	Principles of Communication Engineering	3	-	-	-	3	-
25EE101702	Reliability and Safety Engineering	3	-	-	-	3	-
25CE101704	Remote Sensing, GIS and GPS	3	-	-	-	3	-
25CE101705	Smart Cities	3	-	-	-	3	-
25EC101706	Smart Sensors for Engineering Applications	3	-	-	-	3	-
25EE101703	Sustainable Energy Systems	3	-	-	-	3	-
25CS101702	Web Design Fundamentals	3	-	-	-	3	-
25SS101706	Women Empowerment	3	-	-	-	3	-
25SS101707	Indian Knowledge System in Science	3	-	-	-	3	-
25SS101708	Introduction to Indian Knowledge Systems	3	-	-	-	3	-

Course Code	Title of the Course	L	T	P	S	C	Prerequisite
25CE101706	Indian Knowledge System in Town Planning and Architecture	3	-	-	-	3	-
25LG101702	Quantitative Aptitude and Verbal Ability	3	-	-	-	3	-
25LG101703	Logical Reasoning and Recruitment Essentials	3	-	-	-	3	-
25EC101707	Quantum AI	3	-	-	-	3	-
25CA101702	Software Engineer for AI	3	-	-	-	3	-
25CB101703	Advanced Artificial Intelligence	3	-	-	-	3	Artificial intelligence
25CA101704	Generative AI and Professional Practices	3	-	-	-	3	-
25LG101701	Business Communication and Career Skills	3	-	-	-	3	-
25SS101709	Stress Management and Wellbeing	3	-	-	-	3	-
25SS101710	Strategies for Sustainable Design	3	-	-	-	3	-

Note:

1. If any student has chosen a course or equivalent course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s under University Elective.
2. The student can choose courses from other disciplines offered across the schools of MBU satisfying the pre-requisite other than the above

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS101002	INTRODUCTION TO CLASSICAL BIOLOGY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to living organisms, plant and animal biology, basics of molecular biology, human biology and photosynthesis.

COURSE OUTCOMES: After successful completion of the course, students will be able to

CO1. Identify difference between cells, Cellular components and their functions.

CO2. Understand taxonomy, nomenclature and diseases resulting from parasites.

CO3. Identify Central dogma of Molecular biology and process of Recombinant DNA technology.

CO4. Understand different organ systems and their functions.

CO5. Understand basics and Mechanism of Photosynthesis.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	-	-	-	-	-	3	3	-
CO5	3	2	-	-	-	-	-	-	-	3	3	-
Course Correlation Mapping	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	**3**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO LIVING ORGANISMS (09 Periods)

Differences between Living and Non-Living systems. Cell biology and cell structure, Sub cellular Structures, Difference between Prokaryotes and Eukaryotes, Comparison between Plant and Animal Cells.

Module 2: PLANT AND ANIMAL BIOLOGY (10 periods)

Classification of Plant Kingdom. Concepts of Growth, Economic Importance of Plants, Classification of Animal Kingdom, Functions, morphology, growth and Reproduction, Protozoan Parasites – two important forms in man (Plasmodium, Entamoeba histolytica), Helminthes (Fasciotopsisbuski, Taenia solium, Ascaris, Wucharia bancrafti).

Module 3: BASIC MOLECULAR BIOLOGY (11 Periods)

DNA as genetic material, Structure of DNA, Central dogma of Molecular Biology, DNA replication, Transcription, Translation, Gene expression and regulation, Recombinant DNA technology.

Module 4: HUMAN BIOLOGY (08 Periods)

Introduction of body as a whole, Physiology of Blood. Digestive system, Respiratory system and Endocrine system. Biological axons and neurons, Neuromuscular and synaptic junctions.

Module 5: PHOTOSYNTHESIS (07 Periods)

Bacterial & Plant photosynthesis; oxygenic and anoxygenic photosynthesis; chlorophyll as trapper of solar energy, photosynthetic reaction centres, Hill reaction, PS I & PS II, Photophosphorylation - cyclic & non-cyclic; Dark reaction & CO_2 fixation.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Student will be asked to identify the Cell and Cellular organelle spotters and should write the functions of spotters identified
2. Students will be asked to prepare a table of disease-causing Protozoans.
3. Students will be asked to prepare assignments for Central dogma of Molecular biology
4. Students have to identify different organs in the organ system diagrams.
5. Students will be given assignments on the topic of photosynthesis.

RESOURCES

TEXT BOOKS:

1. C. Ratledge and B. Kristiansen, Basic Biotechnology, 3rd edition, Cambridge University press, 2006.
2. A. Waugh, Ross and Wilson's Anatomy and Physiology in Health and Illness, 13th edition, Elsevier, 2018.

REFERENCE BOOKS:

1. F. B. Salisbury and C.W. Ross, Plant Physiology, 3rd Edition, CBS publisher, 2006.
2. C. C Chatterjee, Human Physiology, Vol 1 & 2, ,13th Edition, CBS publisher, 2020

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=N0Y386SVGN8
2. https://www.youtube.com/watch?v=nqG9zsvd1Rk
3. https://www.youtube.com/watch?v=zBkN-rRleho

WEB RESOURCES:

1. https://www.biologydiscussion.com/plant-taxonomy/quick-notes-on-plant-taxonomy/47582
2. https://www.toppr.com/guides/biology/diversity-in-living-organisms/animal-kingdom/
3. https://www.youtube.com/watch?v=X3TAROotFfM
4. https://www.youtube.com/watch?v=ZW9zPdb_Bs0

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS101011	GENERAL CHEMISTRY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on basis of organic chemistry alkanes, cycloalkanes, alkenes and alkynes. Benzene and its reactivity. Surface chemistry and electrochemistry of organic compounds.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand and explain differential behaviour organic compound based on the fundamental concepts learnt.

CO2. Formulate and identify the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants learnt.

CO3. Describe the concept of aromaticity, molecular structure of benzene based on modern concepts. Ring activating and deactivating groups.

CO4. Explain about colloids, emulsions and their properties. Adsorption isotherms. Formation of molecular orbital, shapes of the molecules and predict the magnetic behaviour of the molecule.

CO5. Correlate and explain stereo chemical properties of organic compounds and configurations.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	3
CO4	3	1	-	1	-	-	-	-	1	-	-	3
CO5	3	-	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	**3**	**1**	-	**1**	-	**-**	-	-	**1**	-	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: THEORIES OF BONDING IN METALS **(08 Periods)**

Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors: n-type and p-type, extrinsic &intrinsic semiconductors, and insulators.

Module 2: MATERIAL SCIENCE **(08 Periods)**

Classification of materials- metals, ceramics, organic polymers, composites

Ceramics-Types and applications

Conducting polymers: Definition, types of conducting polymers: Intrinsic and extrinsic conducting polymers with examples, engineering applications of conducting polymers

Composites – Introduction, types of composites: fiber reinforced particulate and layered composites with examples, advantages of composites and applications

Module 3: CHROMATOGRAPHY **(10 Periods)**

Definition, principles of chromatography, Nature of adsorbents, solvent systems, Rf values, factors effecting Rf values.

Classification of chromatography methods: paper chromatography- choice of paper and solvent systems, developments of chromatogram - ascending, descending and radial, applications; Thin layer Chromatography- Preparation of plates. Development of the chromatogram, Detection of the spots, Applications.

Module 4: CHEMICALBONDING AND MOLECULAR STRUCTURE **(10 Periods)**

Valence bond theory, hybridization, VB theory as applied to ClF_3, $Ni(CO)_4$, Molecular orbital theory - LCAO method, bonding and anti-bonding MOs and their Characteristics, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N_2, O_2, CO and NO), Comparison of VB and MO approaches.

Module 5: SURFACE CHEMISTRY **(09 Periods)**

Colloids: Definition. Solids in liquids (sols), properties - kinetic, optical, electrical. Stability of colloids, Hardy-Schulze law, protective colloid, gold number. Liquids in liquids (emulsions) properties, uses. Liquids in solids (gels) preparation, uses.

Adsorption: physisorption, chemisorption. Freundlich, Langmuir adsorption isotherms. Applications of adsorption.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. How can you use metallic bonding theory to explain the physical properties of metals?
2. Narrate the role of material science modern technology
3. How do you do a chromatography experiment at home?
4. Is chemical bonding and molecular structure important? Justify
5. Describe the role of surface chemistry in day-to-day life

RESOURCES

TEXT BOOKS:

1. G.M. Barrow, Physical Chemistry, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2007.
2. Arun Bahl, B.S. Bahl, and G.D. Tuli. Essential of Physical Chemistry, 28th Edition, S. Chand & Company, New Delhi, 2020

REFERENCE BOOKS:

1. J.C. Kotz, P.M. Treichel, and J.R. Townsend, General Chemistry, 3rd Edition, Cengage Learning India Pvt. Ltd., New Delhi, 2009.
2. G.E. Rodgers, Inorganic and Solid-State Chemistry, 1st Edition, Cengage Learning India Ltd., 2008.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/113/104/113104106/
2. https://www.nagwa.com/en/videos/639142632348/
3. https://www.youtube.com/watch?v=SnbXQTTHGs4

WEB RESOURCES:

1. https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/11%3A_Chemical_Bonding_II%3A_Additional_Aspects/11.7%3A_Bonding_in_Metals
2. https://www.britannica.com/technology/materials-science
3. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Chromatography
4. https://ncert.nic.in/textbook/pdf/kech104.pdf
5. https://www.vedantu.com/chemistry/surface-chemistry

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG102402	GENERAL ENGLISH	2	-	2	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with selected literary works of eminent writers, conversation practice, listening skills, reading comprehensions, writing techniques, vocabulary building and functional grammar.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyse the texts using effective reading techniques.

CO2. Apply grammatically correct English in writing

CO3. Develop ability to understand various accents by developing listening skills.

CO4. Apply general and technical vocabulary in effective communication.

CO5. Apply different communication styles in various situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	2	2
CO3	2	3	-	-	-	-	-	2	2
CO4	2	3	-	2	-	-	-	2	2
CO5	2	2	-	3	-	-	-	2	2
Course Correlation Mapping	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1:	**A Snake in the Grass**	**(06 Periods)**
Reading	'A Snake in the Grass' short story by R.K. Narayan (from the prescribed text book)	
Speaking	Common Everyday Conversations	
Listening	Listening for specific information (from the selected audios and videos)	
Writing	Paragraph Writing: Sentence Structures- use of phrases and clauses - proper punctuation- introducing, logical order, coherence, unity and summarizing.	
Grammar	Parts of Speech: Nouns, Pronouns, Verbs, Adjectives and Adverbs, Prepositions, Conjunctions and Interjections	
MODULE 2:	**On saying Please**	**(06 Periods)**
Reading	On saying Please 'short essay by A. G. Gardiner (from the prescribed text book)	
Listening	Listening for understanding concepts (from the selected audios and videos)	
Speaking	Tongue twisters practice	
Writing	Letter Writing: Parts of a Letter - Formats of Letters- Types of Letters (enquiry, Complaints, seeking permission, seeking internship etc.)	
Grammar	Basic sentence structures, word order in sentences, verb agreement, Pronoun Agreement	
MODULE 3:	**Because I couldn't Stop for Death**	**(06 Periods)**
Reading	Because I couldn't Stop for Death by Emily Dickinson	
Listening	Listening for understanding concepts (from the selected audios and videos)	
Speaking	Communication at Work Place	
Writing	Descriptions: Writing introduction- defining – classifying -describing technical/specific features of an Automobile / gadget/ product or the process-installation manuals	
Grammar	Usage of Articles and omission of Article, Prepositions and phrasal prepositions	
MODULE 4:	**After the Sunset**	**(06 Periods)**
Reading	**'**After the Sunset' short story by Bhoopal (from the prescribed text book)	
Listening	Listening to short audio texts and answering a series of questions	
Speaking	Reviewing a book or movie/ summarizing or reporting any incident	
Writing	Email Communication- Etiquette – Format- Writing Effective Business Email	
Grammar	Tenses- Active Voice & Passive Voice; Conditional Sentences	
MODULE 5:	**Man's Peril**	**(06 Periods)**
Reading	**'**Man's Peril' a speech made by Bertrand Russell (from the prescribed text book)	
Speaking	Prepared or extempore speeches	
Writing	Essay Writing: Writing structured essays on specific topics- Introducing, analyzing and concluding an issue-creating coherence-Usage of proper punctuation.	
Vocabulary	Antonyms, Synonyms**,** Idioms and Phrases, One-word substitutes	
Grammar	Common Errors: Identifying and correcting common errors (articles, prepositions, tenses, subject verb agreement, pronoun agreement etc.)	

Total Periods: 45

EXPERIENTIAL LEARNING:

LIST OF EXERCISES

1. In rainy seasons a lot of snakes are found crawling around. Prepare a write-up on the reactions of people when they found snakes.
2. India is now for entrepreneurs and the government announced a lot of startup programs for that. Prepare a presentation on recent entrepreneurs.
3. Small courtesies play a major role in creating an impression on other people. List out a few examples.
4. Prepare a PowerPoint presentation on the present scenario in higher education and jobs in India.
5. Being a shopkeeper and persuading a customer to buy a product which is introduced newly in the market. Prepare a conversation.
6. The English language has a rich vocabulary. List out the homophones and homonyms and write down the pronunciation and meaning of those words.
7. Describe a situation in your college where teamwork is needed and explain the strategies to manage the team effectively.
8. India is a country of unity in diversity. List out the existence of different racial and religious people and bring out reasons for the harmonious relationship among the people.
9. Forget and forgive are the most important quality of any human being. Prepare a write-up on any two experiences which come across in your life where you forgive or forget to maintain good relationships with friends or relatives.
10. Make a case study on the problems of second language learners of English and suggest solutions to overcome them.
11. Read the story “The Third and Final Continent” written by Jhumpa Lahiri. How does "The Third and Final Continent" portray immigration experiences?
12. Read the popular essay “Google Making us Stupid” written by Nicholas Chor. Do you think that the title of the essay is appropriate?
13. Listen to the audio speeches made in the UNO by several eminent speakers on the theme” The Climate Crisis is human Rights Crisis”. Summarize their speeches in your own words and explain how the Mother Earth is getting spoiled with a number of pollutants.

RESOURCES

TEXTBOOK:

1. G. Damodar "English Language for Undergraduate Students", Cambridge University-2019

REFERENCE BOOKS:

1. Word Power Made Easy by Norman Lewis, Goyal Publishers, 2020.
2. A Communicative Grammar of English, Geoffrey Leech and Prof Jan Svartvik, Pearson Publication, 2013
3. Grammar in Use Intermediate with Answers, Raymond Murphy, Cambridge University Press, 2019.
4. How to Speak Effectively: A Guide to Engaging Conversations, Presentations, Patrik King, Penguin,

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=WnOOKO0CdaM
2. https://www.youtube.com/watch?v=-lTliZO85YM
3. https://www.youtube.com/watch?v=048YjXwgHWE
4. https://www.youtube.com/watch?v=XLLQm7Grmcc

WEB RESOURCES:

1. https://englicist.com/topics/be-the-best
2. https://inspiration624.wordpress.com/wp-content/uploads/2018/01/on-saying-please.pdf
3. https://englishlanguage-lit.blogspot.com/2021/05/after-sunset-short-story-by-bhoopal.html
4. https://www.taylorfrancis.com/chapters/mono/10.4324/9781003090359-31/man-peril-bertrand-russell?context=ubx&refId=1d767e2d-ceb1-4537-9de5-6417eab47d1e
5. https://learnenglish.britishcouncil.org/grammar/english-grammar-reference
6. https://www.usingenglish.com/reference/grammar/
7. https://www.englishclub.com/esl-activities/#google_vignette
8. https://eslvault.com/word-association-games/
9. https://testbook.com/english-grammar/tongue-twisters

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS101036	MIND AND BEHAVIOR	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Mind and Body, Molecules of Life, Story of Heredity and Mind, Neural signaling and Mind behavior, and Functions and Behavior of Brain.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand Mind and body, and coordination of Mind and Body

CO2. Identify Molecules of life such as water, lipids, proteins etc.,

CO3. Gain knowledge on aspects of Heredity and Mind.

CO4. Understand Neural signalling, role of neurotransmitters in neurotransmission.

CO5. Identify the tests for diagnosis of functions of the brain.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	-	-	-	-	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MIND AND BODY (09 Periods)

Human evolution, mind-body problem, nervous systems, brains, neurons, coordination of mind and body.

Module 2: MOLECULES OF LIFE (09 Periods)

Water, polarity, hydrophilic, hydrophobic, phospholipids, membranes, proteins, chemistry and life

Module 3: STORY OF HEREDITY AND MIND (09 Periods)

DNA back story, Darwin, Bohr, Delbrück, gene, genetic code, ion channels and pumps, membrane potential, neural signaling

Module 4: NEURAL SIGNALING AND MIND BEHAVIOR (09 Periods)

Synapses, neurotransmitters, ionotropic and GPCR receptors, autonomic nervous system, seizures, pharmacology, psychoactive drugs, neural wiring and guidance, neuroplasticity.

Module 5: FUNCTIONS AND BEHAVIOR OF BRAIN (09 Periods)

sensory perception, chemotaxis, olfaction, taste, flavor, vision, retina, photoreceptors, receptive fields, cortical visual areas, hearing, Fourier analysis, hair cell, vestibular, soma to sensation, motor circuitry, mirror neurons, lesions, brain imaging, x-ray, CT, MRI, EEG, ECoG, MEG, PET, fMRI

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a document on activities of Brain
2. Discuss about sleep and dreams
3. Assignment on different diagnostic tools used for brain function
4. Seminar on Neural function and Brain
5. Case study of different behaviors
6. Group discussion on Logical thinking

RESOURCES

TEXT BOOKS:

1 S. M. Breedlove, N. V. Watson & M. R. Rosen Zweig: Biological Psychology: An Introduction to Behavioral, cognitive and Clinical Neuroscience, 6th Edition, Sinauer Associates Inc., 2010.

2 V.S. Ramachandran, The Tell-Tale Brain, Ist Edition, RHI publisher, 2012.

REFERENCE BOOKS:

1 R.M. Sapolsky, Behave, The best-selling exploration of why humans behave as they do, 1st edition, Vintage publishers, 2018.

2 J. Mitterer, D. Coon, T. Martini, Introduction to psychology: Gateways to Mind and Behavior, 16th Edition, Wadsworth publishing Co Inc, 2021.

VIDEO LECTURES:

1 www.biopsychology.com

WEB RESOURCES:

1 www.sinauer.com/ebooks

2 www.ncbi.nlm.nih.gov/sites/entrez

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25BS101003	BIODIVERSITY MONITORING AND MANAGEMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Biodiversity, Value of Biodiversity, Threats to Biodiversity, Monitoring and Management of Biodiversity and Ecosystem Management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the natural environment, and to realize the importance of the renewable energy sources.

CO2. Acquire knowledge of various sources of water pollution and the management of municipal and Industrial wastewater.

CO3. Summarize the various environmental pollution and its control measures.

CO4. Get familiarized on climate and social issues arising due to environmental disorders.

CO5. Gain awareness on Green technology and its tools.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	3	2	-	-	-
CO2	3	-	-	-	3	2	-	-	-
CO3	3	-	-	-	3	3	-	-	-
CO4	2	-	-	-	3	3	-	-	2
CO5	3	-	-	2	3	-	-	-	2
Course Correlation Mapping	**3**	**-**	**-**	**2**	**3**	**3**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BIODIVERSITY **(09 Periods)**

Introduction- Definition of Biodiversity, Types of Biodiversity, Genetic diversity, Species diversity, Ecosystem diversity: Structural and functional aspects. the value of biodiversity and conservation, Conservation of Biology, current practice in conservation, conservation of genetic diversity, conservation of species diversity, conservation of ecosystem diversity, relevance of ecosystem diversity as well as services in conservation

Module 2: VALUE OF BIODIVERSITY **(09 Periods)**

Value of Biodiversity- Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values. Utilitarian values of biodiversity- goods, services and information. Biodiversity and ecosystem functioning. Biodiversity and stability of ecosystem functioning. Biodiversity at global, national and local levels India as a Mega Diversity Nation. Hotspots of Biodiversity: Criteria for determining hot spots. Indo-Burma (Eastern Himalaya), Western Ghats and Sri Lanka

Module 3: THREATS TO BIODIVERSITY **(09 Periods)**

Habitat loss, pollution, species introduction, global climate change, overexploitation, poaching of wildlife. Rare species, genetic diversity of rare species, habitat loss and fragmentation. Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species. Human factors: social factors, economics, politics and action. Man wildlife conflicts. Endangered and endemic species of India, common plant species, common animal species.

Module 4: MONITORING AND MANAGEMENT OF BIODIVERSITY **(09 Periods)**

Strategies for conservation: In-situ and ex-situ conservation- environmental assessment, protected areas-biosphere reserves, national parks, sanctuaries, tiger reserves-project tiger. Ex situ conservation-Managed ecosystems, biological resources and gene banks, botanical gardens, bio-parks, In situ conservation- Protected areas, Wildlife sanctuaries, National parks, 8 Biosphere reserves. Strategies for ex situ conservation – Botanical Gardens, Seed banks, Field gene banks, Test tube gene banks, pollen banks, DNA bank, in vitro conservation.

Module 5: ECOSYSTEM MANAGEMENT **(09 Periods)**

Global biodiversity and its importance, Different approaches of biodiversity conservation and management, registering biodiversity. Valuing biodiversity resources and their contribution to agriculture, community health and environment. Causes of biodiversity loss. Techniques of species reintroduction and restoration of the degraded habitat. Biodiversity policy and legislation. Wildlife conservation and management: Status of biodiversity conservation in India

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a document on your plan of action in maintaining the sustainable environment.
2. Visit the nearest Biodiversity hotspot and write a report
3. Present a seminar on Biodiversity management practices.
4. Submit your ideas on the importance of Biodiversity management methods
5. Submit a proposal to maintain Biodiversity
6. Visit nearest Biodiversity reserves and submit your views on it.

RESOURCES

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik, Perspectives in Environmental Studies, New Age International (P) Ltd. Publications, 6th Edition, 2018.
2. Erach Barucha, Environmental Studies, Orient Blackswan, 2nd Edition, 2013.

REFERENCE BOOKS:

1. Benny Joseph, Environmental Studies, Tata McGraw-Hill, 2nd Edition, 2009.
2. Cunningham W.P. and Cunningham M.A., Principles of Environmental Science, Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition,2016.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/102/104/102104068/
2. https://www.youtube.com/watch?v=nYSMyjH3wow
3. https://www.youtube.com/watch?v=nYSMyjH3wow&list=RDCMUCCDzHkpuIuD1ZC0wsCXUuPQ&start_radio=1&rv=nYSMyjH3wow&t=38

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/102/104/102104068/
2. https://www.youtube.com/watch?v=CXEpAmHgXK8
3. https://archive.nptel.ac.in/courses/127/106/127106004/
4. https://onlinecourses.nptel.ac.in/noc22_ag10/preview

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG101403	GERMAN LANGUAGE	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Oral communication; Basic grammar; Basic writing; Berufsdeutcsch (Business German)

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate basic knowledge of the German language and verb conjugation.

CO2. Comprehend and apply the knowledge of vocabulary and phrases in day-to-day real-life conversation.

CO3. Apply the various sentence structures by examining the rules of grammar in speaking and writing.

CO4. Analyze the various verb structure of English and German languages effectively in professional writing

CO5. Apply the various verb structure of English and German languages effectively in professional writing

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	2	-		-
CO2	3	-	-	-	-	2	-		-
CO3	3	-	-	-	-	2	-		-
CO4	3	-	-	-	-	2	-		-
CO5	3	-	-	-	-	2	-		-
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**2**	**-**		**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (06 Periods)

Introduction - German alphabet, numbers, days in a week, names of months, seasons. Grammar: Nouns –(i)Nominative case and (ii) Nominative personal pronouns, simple sentence, Verb Conjugation 1st and 2nd type, verb Conjugation 3rdtype, 'Wh' questions (simple sentences) Nominative (definite and indefinite) Articles

Module 2: CITY AND FOOD (06 Periods)

In the city: naming places and buildings, means of transport, basic directions. Food: drink, groceries and meals. Apartments: rooms, furniture, colours.
Grammar: Nouns-articles negation (kein and nicht); imperative and the accusative case; Nominative Possessive Pronouns.

Module 3: DAY-TO-DAY CONVERSATIONS (06 Periods)

Everyday life, telling time, making appointments, leisure activities, and celebrations. Different types of professions, Health and the body, holidays and weather, Clothes and Dresses.

Module 4: BASIC GRAMMAR (06 Periods)

Grammar: Possessive articles, Prepositions (am, um, von. bis); Modal verbs, Separable verbs, accusative, past tense of 'to have' and 'to be', imperative sentences, dative case, perfect tense.

Module 5: BASIC WRITING (06 Periods)

Translation from English to German and German to English, Contacts, Writing letters and Email Writing.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on the importance of the German language in India
2. Why is German taught in Indian schools?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXTBOOKS:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tana Sieber, Netzwerk Deutsch als Fremdsprache, Arbeitsbuch A1, Goyal Publishers and Distributors Pvt. Ltd. 2015.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=o4GvYa-3BmY
2. https://www.youtube.com/watch?v=mrF9BizWmgk
3. https://www.youtube.com/watch?v=mojirClzQEs
4. https://www.youtube.com/watch?v=0osSyX0MmCM
5. https://www.youtube.com/watch?v=mMDOtG5ucHA

WEB RESOURCES:

1. https://learngerman.dw.com/en/beginners/c-36519789
2. https://storylearning.com/learn/german/german-tips/basic-german-phrases
3. https://study.com/academy/lesson/how-to-write-a-letter-in-german.html

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG101407	FRENCH LANGUAGE	2	-	-	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Oral communication; Basic writing; Basic grammar

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate basic knowledge of the French language.
CO2. Comprehend and apply the knowledge of the alphabet in day-to-day real-life conversation.
CO3. Apply the various styles of greetings in speaking and writing.
CO4. Analyze the various conversations in French languages
CO5. Apply the French words for date and time.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	2	-
CO5	3	-	-	-	-	-	-	2	-
Course Correlation Mapping	3	-	-	-	-	-	-	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION **(06Periods)**

Introduction –Introduction, History of the French Language, Extent of the French Language,
Reasons To Learn French, Book Organization, Learning French, Advice on Studying French

Module 2: THE ALPHABET **(06 Periods)**

Letters, Punctuation, Acute Accent, Grave Accent, Tonic Accent, Stress

Module 3: GREETINGS **(06 Periods)**

Greetings, Good-byes, Names, Vous vs. tu, Courtesy, Formal Speech Titles, Asking for One's Name

Module 4: CONVERSATIONS & NUMBERS **(06 Periods)**

How are you? Asking How One Is Doing, Cardinal Numbers and Ordinal Numbers

Module 5: THE DATE& TIME **(06 Periods)**

Numbers 01-31, Seasons, Days of the week, Months of the Year, Numbers 30-60, Times of Day, Asking for the time.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on the importance of the French language in India
2. Why is French taught in Indian schools?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXTBOOKS:

1. The current, editable version of this book is available in Wiki books, the open-content textbooks collection, at http://en.wikibooks.org/wiki/French

VIDEO LECTURES:

1. https://www.bing.com/videos/riverview/relatedvideo?&q=video+lecture+on+THE+ALPHABET+in+french&qpvt=video+lecture+on+THE+ALPHABET+in+french&mid=D123409C16604E0FDE26D123409C16604E0FDE26&&FORM=VRDGAR
2. https://www.youtube.com/watch?v=hd0_GZHHWeE

WEB RESOURCES:

1. https://vdocument.in/french-lecture-notespdf.html?page=2

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG101402	**తెలుగు**	2	-	-	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: తుమ్మల సీతారామమూర్తి-**ఎక్కట్లు,** తిక్కన-**నాడీజంఘోపాఖ్యానం,** పోతన-**ధ్రువోపాఖ్యానం,** దువ్వూరి రామిరెడ్డి - **కృషీ వలుడు, మరియు తెలుగు వ్యాకరణం మీద అవగాహన.**

COURSE OUTCOMES: కోర్సువిజయవంతంగాపూర్తిచేసినతర్వాత, విద్యార్థులువీటినిచేయగలరు:

CO1. విద్యార్థులలో మానవీయ విలువలు పెరిగి నైతిక వలువలతో జీవించడం

CO2. సమాజంలో మనకు చేతనైన సాయం చెయ్యడం ప్రతి మనిషి బాధ్యత అనే సందేశం

CO3. త్రికరణ శుద్ధితో కృషి చేస్తే ఏదైనా సాధించ వచ్చు అనే సందేశం

CO4. వ్యవసాయ రంగం గూర్చి విద్యార్థులలో అవగాహన కలగడం

CO5. తెలుగు వ్యాకరణం

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

పాఠ్య ప్రణాళిక

Module 1: **ఎక్కట్లు** – తుమ్మల సీతారామమూర్తి *(06 Periods)*

సత్ప్రవర్తన, సచ్ఛీలత, సన్మార్గం, సమసమానత్వం గూర్చి వివరించడం.

Module 2: **నాడీజంఘోపాఖ్యానం** – తిక్కన *(06 Periods)*

సహాయం చేసినివారిని మరచి పోరాదు. చేసిన మేలు మరచిన వారి జీవితం ఎంత హీనంగా ఉంటుందో తెలియజేయడం.

Module 3: **ధ్రువోపాఖ్యానం** – పోతన *(06 Periods)*

ఎటువంటి కష్టాలకు సమస్యలకు కుంగి పోకుండా దీక్షతో పట్టుదలతో కృషితో అనుకున్నది సాధించాలని తెలియజేయడం.

Module 4: **కృషీ వలుడు** – దువ్వూరి రామిరెడ్డి *(06 Periods)*

సమాజానికి వెన్నెముక అయిన రైతు యొక్క కష్టాలను త్యాగాలను వివరించడం.

Module 5: **సంధులు, సమాసాలు, అలంకారాలు.** *(06 Periods)*

తెలుగు భాష యొక్క మూలాలను తెలుసుకోవడం.

Total Periods: 30

EXPERIENTIAL LEARNING

The experiential learning components will be detailed in CHO.

RESOURCES

TEXT BOOKS:

1. **ఎక్కట్లు – కవి తుమ్మల సీతారామమూర్తి చౌదరి.**
2. **నాడీజంఘోపాఖ్యానం – కవి తిక్కన. (మహాభారతం – శాంతి పర్వం – తృతీయా శ్వాసం – 472 నుండి 511 పద్యాల** వరకు).
3. **ధ్రువోపాఖ్యానం** – కవి పోతన (ఆంధ్ర మాహాభాగవతం – చతుర్థ స్కంధం – 216 నుండి 277 పద్యాల వరకు)
4. కృషీ వలుడు – కవి దువ్వూరి రామిరెడ్డి

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=5jX20h6HWzg
2. https://www.youtube.com/watch?v=FFtPSPByBmk
3. https://www.youtube.com/watch?v=nQHF_pgTfL8
4. https://www.youtube.com/watch?v=IEERKL3Q2Cs

Web Resources:

1. http://teluguvignanamvinodam1.blogspot.com/2021/06/maha-bharatam-in-telugu-pdf-free-download_25.html
2. https://www.freegurukul.org/blog/ramayanam-pdf/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG101404	SANSKRIT	2	-	-	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: अस्मिन् पाठ्यक्रमे संस्कृत गद्य, पद्य, व्याकरमेन सह महाभारतम् अपि च रामायणस्य कान्श्चन खण्डानां मेलनं भवति। अयं पाठ्यक्रमः छात्राणां कृते विभिन्न संस्कृत ग्रन्थानां अपि च साहित्यस्य समालोचनात्मक विश्लेषण करणमपि शिक्षयति। संपूर्ण पाठ्यक्रमे अस्मिन्, छात्राः देवनागरी लिपेः लिखनं अधिगच्छति, संस्कृतस्य शब्दानां उच्चारणं तथा हृदिस्थं करिष्यति, अपि च प्राथमिक व्याकरण पठिष्यति तेन ते संस्कृते सरल वाक्यानां निर्माणं कर्तुं प्रभवन्ति।

COURSE OUTCOMES: पाठ्यक्रमस्य सफलसमाप्तेः अनन्तरं छात्राः

CO1 कर्तव्यपरक शैक्षणिक वृत्तिपरक तथा शोधकर्तृणां निर्माणार्थं छात्राणां संज्ञानात्मक, प्रभावशाली तथा व्यवहारिक क्षमतानां आकार प्रदानार्थं सहायतां करोति।

CO2 सामाजिक परिवर्तने भागग्रहणार्थं सक्षमाः भवितुं छात्रेषु सेवायाः धारणा संचारः करोति।

CO3 समकालीन समस्या-समाधान स्थितिषु प्राचीन भारतीय ज्ञानस्य अनुप्रयोगस्य ज्ञानप्राप्तिः। सामान्य रूपेण तथा विशेष रूपेण अभ्यसने तथा तस्य मूल्यांकनस्य संदर्भे च नैतिक उपयुक्ततायाः एकः दृढतर भावनायाः विकासनार्थम्।

CO4 प्राचीन साहित्यतः प्राथमिक जीवनं तथा अवधारणानां ज्ञानप्रदानं यत् कालातीतः जातः तथापि इदानीमपि समाजाय अनुवर्तते।

आवेदनस्य प्रमुख क्षेत्रेषु प्राथमिक कौशलस्य अधिग्रहणे सुगमकरणम् उदा- नेतृत्वे, संचारे, अनुसंधान योग्यतायां, व्यवहार संशोधने इत्यादि।

CO5 सामाजिक विविधतायाः कृते सम्मान-विकसितं करनं तथा सामाजिक अपि च सांस्कृतिक प्रासंगिकतायाः अध्ययने अभिवृद्धि करनम्।

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module-1: प्राचीन पद्यसाहित्यम् **(06 Periods)**

1.आर्य पादुका पट्टाभिषेकः - वल्मीकिः – श्रीमद्रामायणम्

2. यक्षप्रश्नाः - वेदव्यासः – महाभारतम्

Module-2: चम्पूकाव्यम् & आधुनिक पद्यकाव्यम् **(06 Periods)**

3.गङ्गावतरणम् - भोजराजः - चम्पूरामायणम्

4. मोहापनोदः - श्री पमिडिपाटि पट्टाभिरामारावः – मूलकथा-'धर्मसौहृदम्' इति संस्कृत पद्यकाव्यम्

Module-3: गद्यसाहित्यम् **(06 Periods)**

5. अत्युत्कटैः पापपुण्यैः इहैव फलमश्नुते - नारायणपण्डितः - हितोपदेशः

6. शूद्रकवीरवरकथा - हितोपदेशः

Module-4: शब्दाः **(6 Periods)**

देव, कवि, भानु, पितृ, धातृ, गो, रमा, मति

Module 5: महाकवि, शास्त्रकाराः **(6 Periods)**

1.पाणिनिः 2.कौटिल्यः 3.भरतमुनिः 4.भारविः 5.माघः 6.भवभूतिः 7.शङ्कराचार्यः 8.दण्डी

Total Periods: 30

EXPERIENTIAL LEARNING

The experiential learning components will be detailed in CHO.

RESOURCES

TEXT BOOKS:

1.विश्वभारती 2,संस्कृत भारती 3.अमृतवाणी

REFERENCE BOOKS:

1.रामायणम् 2.महाभारतम् 3.अष्टाध्यायी 4.अमरकोशः

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=bh-14xfMeYk
2. https://www.youtube.com/watch?v=6xFkoOpzsvs

Web Resources:

1. https://www.forum.universityupdates.in/threads/ou-sanskrit-2nd-semester-study-material.33659/
2. https://cbpbu.ac.in/study_mat_sanskrit.php

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CB107601	**ESSENTIALS OF CYBER SECURITY**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Cybercrime, Cyber offenses, Phishing, Identity theft, Cybercrime in mobile and wireless devices, Organizational measures for handling mobile devices, Security implications on using mobile devices, Tools and methods used in cybercrime, Forensics of computer and handheld devices.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze methods of cybercrime, cyber offenses to maintain cybersecurity.

CO2. Investigate tools used for cybercrime to protect computational assets.

CO3. Apply appropriate authentication mechanisms to reduce attacks on mobile and wireless devices.

CO4. Use appropriate cyber forensics tools and techniques to maintain cybersecurity.

CO5. Recognize the need for cybersecurity and practice ethics to protect privacy, property rights in cyberspace.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	2	-	-	-	-	-	-	-
CO2	3	2	-	2	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-
Course Correlation Mapping	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CYBERCRIME **(05 Periods)**

Cybercrime and information security, Cybercriminals, Classifications of cybercrimes, how criminals plan the attacks, social engineering

Module 2: CYBER OFFENSES **(07 Periods)**

Cyber stalking, Cybercafe and cybercrimes, Botnets, Attack vector, Cloud computing, Phishing – Methods, Techniques, Spear phishing, Phishing scams, Phishing toolkits, Spy phishing, Countermeasures; Identity Theft – Personally identifiable information, Types, Techniques, Countermeasures, Effacing online identity.

Module 3: CYBERCRIME IN MOBILE AND WIRELESS DEVICES **(06 Periods)**

Proliferation of mobile and wireless devices, Trends in mobility, Credit card frauds in mobile and wireless computing era, Security challenges posed by mobile devices, Registry settings for mobile devices, Authentication service security, Attacks on mobile/cell phones, Security implications of mobile devices for organizations, Organizational measures for handling mobile devices related security issues.

Module 4: TOOLS AND METHODS USED IN CYBERCRIME **(06 Periods)**

Proxy servers and anonymizers, Password cracking, Keyloggers and spywares, Virus and worms, Trojan horses and backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow, Attacks on wireless networks.

Module 5: CYBER FORENSICS **(06 Periods)**

Cyber forensics, Cyber forensics and digital evidence, Forensics analysis of e-mail, Forensics and social networking sites, Forensics of handheld devices – Smartphone forensics

Total Periods:30

EXPERIENTIAL LEARNING

1. Think of a recent cybercrime news report you read.
    - What type of cybercrime was it?
    - Who do you think were the cybercriminals behind it, and what might have been their motive?
    - How could this attack have been prevented?
2. Analyze a phishing email sample.
    - What were the clues indicating it was a phishing attempt?
    - How could an ordinary user fall for it?
    - Suggest three preventive actions users can take against phishing.
3. Reflect on your online presence.
    - List down all Personally Identifiable Information (PII) you share publicly.
    - What risks does this pose for identity theft?
    - What changes will you make to protect your online identity?
4. Our organization allowing BYOD (Bring Your Own Device).
    - What security challenges can arise?
    - Suggest practical measures to ensure device security in such an environment.

RESOURCES

TEXT BOOKS:

1. Nina Godbole, Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2013.

REFERENCE BOOKS:

1. Nilakshi Jain, Ramesh Menon, Cyber Security and Cyber Laws, Wiley, 2020.
2. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Cybersecurity Essentials, 1st Edition, Sybex, 2018.
3. Erdal Ozkaya, Cybersecurity: The Beginner's Guide, 1st Edition, Packt Publishing, 2019.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106129
2. https://www.coursera.org/specializations/intro-cyber-security

WEB RESOURCES:

1. https://www.interpol.int/en/Crimes/Cybercrime
2. https://owasp.org/www-project-mobile-top-10/
3. https://www.netacad.com/courses/cybersecurity-essentials?courseLang=en-US

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG107601	**PROFESSIONAL ETHICS AND HUMAN VALUES**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with personal conviction, and ethics and describes the accepted principles and standards of conduct regarding moral duties and virtues as applied to an organization. Codes of professional ethics guide the stakeholders of an organization about the desirable and undesirable acts related to the profession.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the principles of ethics, professional values, and social responsibility.

CO2. Analyze the problems in the implementation of moral autonomy and use ethical theories in resolving moral dilemmas.

CO3. Develop suitable strategies to resolve problems that arise in practicing professional ethics and Industrial standards.

CO4. Function as a member, consultant, manager, advisor and leader in multi-disciplinary teams.

CO5. Provide solutions to complex problems associated with professional ethics using analysis and interpretation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	-	-	-	2	2	2	-	-
CO2	2	3	2	2	2	2	2	-	-
CO3	2	-	3	2	2	2	2	-	-
CO4	2	-	-	-	2	2	2	-	-
CO5	2	2	3	-	2	2	2	-	-
Course Correlation Mapping	**2**	**3**	**-**	**2**	**2**	**2**	**2**	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: PROFESSIONAL ETHICS (06 Periods)

Scope and significance of ethics, varieties of moral issues, types of ethical inquiry, moral dilemmas, moral autonomy — Kohlberg's theory; Gilligan's theory of moral development.

Module2: PROFESSIONAL IDEALS AND VIRTUES (06 Periods)

Theories of virtues and professional ideals; professional responsibility and accountability; self-respect and integrity; role of customs and religion in ethics; religion and divine command theory; resolving moral dilemmas; moral leadership.

Module 3: SOCIAL EXPERIMENTATION (06 Periods)

Social experimentation and its similarities to standard scientific experiments; learning from the past and knowledge gained; responsibilities of engineers as experimenters; the Challenger's case study; role of industrial standards; issues and limitations in engineering law

Module 4: RESPONSIBILITIES AND RIGHTS (06 Periods)

Collegiality and professional loyalty; respect for authority; collective bargaining and employee rights; confidentiality and trust; occupational crime and ethical misconduct; rights and responsibilities of engineers; whistle-blowing and its implications; the BART case study.

Module 5: HARMONY WITH PROFESSIONALETHICS (06 Periods)

Acceptance and practice of human values; ethical human conduct in personal and professional life; transition from the present state to a universal human order; role of engineers and technologists in promoting social and ecological responsibility; contribution to enriching institutions and organizations.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Demonstrate orally using your experiences of what is naturally acceptable in a relationship – Feeling of respect or disrespect and what is naturally acceptable is to nurture or exploit others.
2. Identify community partners and discuss with a community partner or organization. Prepare a report by identifying and analysing the issues or opportunities.
3. Field experiences may be directed to include a range of time-intensive endeavours that require varying levels of student interaction. Prepare a report on visiting a Juvenile home.
4. Students read a speech in the classroom by former United Nations Secretary-General Kofi Annan on human values.
5. Students are encouraged to bring a daily newspaper to class or to access any news related to the need for human values and note down the points.
6. Bring out the relevance of engineering ethics theory and practice with relevance to current trends.
7. Professional ideals and virtues are important to everyone. Prepare a case study on the professional ideals and virtue of any one of the famous sports personalities from India.

8. Compare the present to the past in engineering experimentations concerning the change in professionalism.

9. Make a study on occupational crime and the role of modern technology in finding solutions.

10. Prepare a case study on how to maintain harmony with different cultural people using professional ethics.

(It's an indicative one. The course instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXTBOOKS:

1. Gaur R R, Sangal R & G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010.
2. Govindarajan, M., Nata Govindarajan, M., Natarajan, S. and Senthilkumar, V. S., Engineering Ethics, Prentice Hall of India, 2004.
3. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw-Hill, 3rd Edition, 2007.

REFERENCE BOOKS:

1. S. Kannan and K. Srilakshmi, Human Values and Professional Ethics, Taxmann Allied Services Pvt Ltd., 2009.
2. Edmund G. See Bauer and Robert L. Barry, Fundamental of Ethics for Scientists and Engineers, Oxford University Press, 2001.
3. Charles F. Fledderman, Engineering Ethics, Pearson Education, 2nd Edition, 2004.
4. R. Subramanian, Professional Ethics, Oxford Higher Education, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=jfGIq_EiXzI
2. https://www.youtube.com/watch?v=QFHOtH54oUc
3. https://www.youtube.com/watch?v=JJshY11nX14
4. https://www.youtube.com/watch?v=TyP09S0UEzA
5. https://www.youtube.com/watch?v=0QMwjV_ZVtc

WEB RESOURCES:

1. https://siiet.ac.in/wp-content/uploads/2020/09/7.1.10-professional-ethics-manual.pdf
2. https://soaneemrana.org/onewebmedia/Professional%20Ethics%20and%20Human%20Values%20by%20R.S%20NAAGARAZAN.pdf
3. https://india.oup.com/productPage/5591038/7421214/9780199475070

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CE107601	ENVIRONMENTAL SCIENCE	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on natural resources, ecosystems, biodiversity, environment pollution and control, social issues and environment, human population and environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze natural resources to solve complex environmental problems and natural resource management considering society, environment and sustainability.

CO2. Analyze ecosystems and biodiversity to solve complex environmental problems by following environmental ethics considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze various types of pollution and their control measures to solve environmental problems through appropriate tools and techniques following latest developments considering society, ethics, environment and sustainability.

CO4. Analyze social issues and its impact on environment, environmental acts to solve complex environmental problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze human population and its impact on environment to solve complex environmental problems through team work and using appropriate tools and techniques considering ethics, society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	1	-	-	-	-
CO2	3	3	-	-	1	1	-	1	-
CO3	3	3	-	1	1	1	-	-	1
CO4	3	3	-	-	1	1	-	1	-
CO5	3	3	-	1	1	1	1	-	-
Course Correlation Mapping	**3**	**3**	**-**	**1**	**1**	**1**	**1**	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NATURAL RESOURCES (07 Periods)

Multidisciplinary nature of environment; Natural Resources: Renewable and non-renewable resources; Forest, Water, Mineral, Food and Energy resources -Causes, Effects, Remedies, Case studies; Role of an individual in conservation of natural resource and equitable use of resources for sustainable lifestyles.

Module 2: ECOSYSTEMS AND BIODIVERSITY (07 Periods)

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem - Producers, Consumers, Decomposers; Food chains, Food webs, Ecological pyramids – Types; Characteristic features, Structure and functions of forest ecosystem, Desert ecosystem, Aquatic ecosystem.

Biodiversity: Concept and value of biodiversity, Role of biodiversity in addressing new millennium challenges, Hot spots of biodiversity, Threats to biodiversity, Man-wild life conflicts, Endemic, Endangered and extinct species of India, Conservation of biodiversity – In-situ and ex-situ.

Module 3: ENVIRONMENTAL POLLUTION AND CONTROL (06 Periods)

Causes, Adverse effects and control measures of pollution - Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, nuclear pollution, Solid waste management – Urban waste, industrial waste; Latest developments in pollution control, Hazards and disaster management – Floods, Earthquakes, Tsunamis, Case studies.

Module 4: SOCIAL ISSUES AND THE ENVIRONMENT (06 Periods)

Sustainable development, Urban problems related to energy, Environmental ethics –Issues, Solutions; Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and case studies, Wasteland reclamation, Consumerism and waste products, Concept of green technologies, Environment justice: National Green Tribunal and its importance; Environment protection act, Air act, Water act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation, Public environmental awareness.

Module 5: HUMAN POPULATION AND THE ENVIRONMENT (04 Periods)

Population growth, Population characteristics and variation among nations, Population explosion, Family welfare programmer, Environment and human health, Human rights, Value education, HIV/AIDS, Women and child welfare, Role of information technology in environment and human health; Case studies - Field Work/Assignment/Seminar on Environmental assets – Water bodies/Forest/Grassland/Hill/Mountain.

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Visit a nearby villages and know the status of availability of local resources that can be improved through proper education.
2. Make an awareness program in the villages for the development of natural resources, ecosystems and biodiversity.
3. Prepare a document by visiting a local urban waste dumping yard near to the Tirupati city.
4. Visit a local village and find a barren land and make the land into a useful land by planting plants or providing the soil and fertilizers required to improve the soil.
5. Visit a local zoological park and identify the species variety and variability.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Anubha Kaushik and Kaushik, C.P., Perspectives in Environmental Studies, New Age International (P) Ltd. Publications, 6th Edition, 2018.
2. Erach Barucha, Environmental Studies, Orient Black swan, 3rd Edition, 2021.

REFERENCE BOOKS:

1. Cunningham, W. P. and Cunningham, M. A., Principles of Environmental Science, Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition, 2016.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill, 2nd Edition, 2009.
3. Anji Reddy, M., Text Book of Environmental Science and Technology, BS Publications, Revised Edition, 2014.
4. Rajagopalan, R., Environmental Studies, Oxford University Press, 3rd Edition, 2015.

VIDEO LECTURES:

1. http:// nptel.ac.in/courses/109/104/109104047
2. https://www.youtube.com/watch?v=mIPBPG-5dUw

WEB RESOURCES:

1. https://nptel.ac.in/courses/122102006
2. https://www.flame.edu.in/academics/ug/program-structure/major-minor courses/environmental-studies
3. https://www.tutorialspoint.com/environmental_studies/environmental_studies_environme nt.htm

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CE107602	DISASTER MITIGATION AND MANAGEMENT	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on disasters, earthquakes, floods, cyclones, droughts, landslides and disaster management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.

CO2. Propose appropriate mitigation strategies for earthquake and tsunami impacts as per code of practice using suitable techniques ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze the causes and impacts of floods, cyclones and droughts using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze the causes and impacts of landslides using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO5. Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	2	2	2	-	-	-
CO2	3	3	3	2	1	2	-	2	-
CO3	3	3	-	2	2	-	-	2	-
CO4	3	3	-	2	2	-	-	-	-
CO5	3	2	3	2	1	2	-	1	2
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**2**	-	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DISASTERS (06 Periods)

Types of disasters - Natural disasters; Impact of disasters on environment, infrastructure and development; Concepts of hazards and vulnerability analysis, Hazard Assessment, Guidelines for hazard assessment and vulnerability analysis, Basic principles and elements of disaster mitigation.

Module 2: EARTHQUAKES (06 Periods)

Introduction to earthquake, Intensity scale (MSK–64), Seismic zones and activity in India, Action plan for earthquake disaster preparedness, Elements at risk, Recovery and rehabilitation after earthquake, Concepts of Earthquake resistant design and construction of buildings; Tsunami – Onset, Types and causes, Warning, Elements at risk, Typical effects, Specific preparedness and mitigation strategies, Case studies.

Module 3: FLOODS, CYCLONES AND DROUGHTS (07 Periods)

Floods and Cyclones: Onset, Types, Causes, Warnings, Elements at risk, Typical effects, Indian floods and cyclones, Hazard zones, Potential for reducing hazards, Mitigation strategies and community-based mitigation, Case studies.

Droughts: Onset, Types and warning; Causes, Impact, Early warning and response mechanisms, Mitigation strategies, Droughts in India, Case studies.

Module 4: LANDSLIDES (06 Periods)

Onset, Types and warning; Causes, Elements at risk, Indian landslides, Hazards zones, Typical effects, Mitigation strategies and community-based mitigation, Case studies.

Module 5: DISASTER MANAGEMENT (05 Periods)

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost–benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Perform hazard assessment and vulnerability analysis for any nearby town/city and prepare a detailed report of possible impacts of various disasters on environment, infrastructure and development.

2. Prepare a detailed report on the causes and effects of Tsunami that was occurred in the year 2004. Also discuss various advancements in Tsunami warning systems.

3. Identify the major causes of urban floods in cities like Chennai, Hyderabad & Mumbai and submit a report along with various mitigation strategies to reduce the impact of floods.

4. Prepare a detailed report on how various man-made activities are directly/indirectly related to the occurrence of landslides that occurred in recent days in India.

5. Visit AP State Disaster Response and Fire Services Department and record about various methods used by them in mitigating disasters and their management.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Sharma V. K., Disaster Management, Medtech Publishing, 2nd Edition, 2013.
2. Anand S. Arya, Anup Karanth, and Ankush Agarwal, Hazards, Disasters and Your Community: A Primer for Parliamentarians, GOI–UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, Natural Hazards and Disasters, Cengage Learning, USA, 5th Edition, 2015.
2. Disaster Management in India, A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers, Springer India, 2014.
4. Singh R. B., Natural Hazards and Disaster Management, Rawat Publications, 2009.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104183
2. https://www.digimat.in/nptel/courses/video/124107010/L01.html

WEB RESOURCES:

1. https://egyankosh.ac.in/handle/123456789/25093
2. https://www.egyankosh.ac.in/handle/123456789/25912
3. https://www.nios.ac.in/media/documents/333courseE/12.pdf
4. https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CE107603	**RURAL TECHNOLOGY**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on technology for rural development, nonconventional energy, technologies for rural development, community development and it in rural development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Compare various technologies for rural development by solving rural problems through different schemes by considering ethics, society, environment and sustainability.

CO2. Analyze non-conventional energy sources using appropriate tools and techniques to solve rural energy problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Select appropriate technologies in different areas of rural development to solve rural issues following latest developments considering society, environment and sustainability.

CO4. Relate water conservation, health, safety and rural employment issues for community development to solve rural problems through appropriate technologies considering ethics, society, environment and sustainability.

CO5. Analyze the impact of IT, public and private partnership on rural development to solve complex rural problems using appropriate tools and techniques considering ethics, society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	-	2	1	1	-	-	-
CO2	2	3	-	2	1	-	-	1	-
CO3	2	3	-	2	1	-	-	-	1
CO4	2	3	-	2	2	1	-	-	-
CO5	2	3	-	2	1	1	-	-	-
Course Correlation Mapping	**2**	**3**	**-**	**2**	**2**	**1**	**-**	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO RURAL DEVLOPMENT (06 Periods)

India - Technology and rural development, pre-and post-independence period, Rural India Life, Indian farmer, Role of science and technology in rural development, Rural technology and poverty eradication, Rural business hubs, Technology in improving rural infrastructure, Various organizations related to innovation, Issues of technology transfer - CAPART, NABARD, CSIR, NIF.

Module 2: NON-CONVENTIONAL ENERGY (06 Periods)

Definition of energy, Types of alternative sources of energy, Sources of non-conventional energy – Solar energy: Solar pump in agriculture, Solar dryer, Solar cooker, Solar heater; Biogas, Recycling and management, Wastes conservation, Assessment and production of biomass products and their utilization.

Module 3: TECHNOLOGIES FOR RURAL DEVELOPMENT (06 Periods)

Food and agro-based technologies, Tissue culture, Nursery, Building and construction technologies, Cultivation and processing of economic plants, Cottage and social industries, Latest developments in rural technologies.

Module 4: COMMUNITY DEVELOPMENT (06 Periods)

Water conservation, Rain water Harvesting, drinking water Standards and simple treatments used, Environment and Sanitation, Bio fertilizers, Medical and aromatic plants, Employment generating technologies – Apiculture, Pisciculture, Aquaculture.

Module 5: IT IN RURAL DEVELOPMENT (06 Periods)

Role of information technology (IT) in rural areas, Impact of IT in rural development, Need and necessity of technology, Corporate social responsibilities, Private sector participation (Activities in different spheres: Employment, Education, Health, Agriculture and service sectors) and Sansad Adarsh Gram Yojana (SAGY), Village adoption schemes.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Visit a nearby village and know the status of small-scale industries which are implanted and to be established based on the availability of the local resources.
2. Visit a local village and make an awareness program on energy utilization using biomass products.
3. Make a awareness program in the villages for the rural development in terms of home-made products.
4. Construct rain water harvesting structures in nearby villages where water scarcity is more and prepare a document.
5. Develop a small IT application the village area which will be used for the growth of the village.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Virdi, M. S., Sustainable Rural Technologies, Daya Publishing House, 2nd Edition 2018.
2. Prabhath, S. V. and P. Ch. Sita Devi, Technology and Rural India, Serials Publications, 1st Edition, 2012.

REFERENCE BOOKS:

1. Chakravarthy, R., and Murthy, P. R. S., Information Technology and Rural Development, Pacific Book International, 1st Edition, 2012.
2. Shivakanta Singh, Rural Development Policies and Programmes, Northern Book Centre, 1st Edition, 2002.
3. Katar Singh, and Anil Shishodia, Rural Development: Principles, Policies, and Management, SAGE Publications India Private Limited, 4th Edition, 2016.
4. Vinayak Reddy, A. and Yadagira Charyulu, M., Rural Development in India: Policies & Initiatives, New Century Publications, 1st Edition, 2008.

VIDEO LECTURES:

1. http:// nptel.ac.in/courses/109/104/109104047
2. https://www.youtube.com/channel/UCEZxAQu3ZBulN-pYMYO2i_A/videos
3. https://www.youtube.com/watch?v=HnrIB-QmvlQ

WEB RESOURCES:

1. en.wikibooks.org/wiki/Technologies_for_Rural_Development/Complete
2. https://www.oecd-ilibrary.org/sites/ae6bf9cd-en/index.html?itemId=/content/component/ae6bf9cd-en
3. https://crdt.iitd.ac.in/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG107603	**SPOKEN ENGLISH**	-	1	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with the development of fluency and intelligibility in spoken English. Through individual and group activities, students work on improving pronunciation, practicing conversation strategies, and delivering oral presentations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of functional English for effective communication.

CO2. Analyze different types of vocabulary for fluency in communication

CO3. Apply correct usage of English grammar in writing and speaking.

CO4. Apply speaking strategies in terms of usage of English with accuracy, appropriacy, and fluency.

CO5. Analyze techniques to use communication skills for effective presentation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	-	-	-	-	-	2	-	3
CO2	2	3	-	-	-	-	2	-	3
CO3	2	-	3	-	3	-	2	-	3
CO4	2	-	-	-	3	-	2	-	3
CO5	2	3	2	-	3	-	2	-	3
Course Correlation Mapping	**2**	**3**	**-**	**-**	**3**	**-**	**2**	**-**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNCTIONAL ENGLISH (06 Periods)

Concepts of Functional Spoken English, Self Introduction; Listening and Speaking: Do's and Don'ts; Expressions: Ability, Admiration, Agreement, Annoyance, Appreciation, Pleasure, Sarcasm, Satisfaction, Surprise, Approval, Certainty, Doubt, Gratitude, Possibility, Fear, Worry, Condolences; Asking for: Advice, Clarification, Direction, Information, Permission; Making: Predictions, recommendations

Module 2: VOCABULARY BUILDING (06 Periods)

Vocabulary for day-to-day conversations: Vegetables, Groceries, Fruits, Weather, Parts of a Human body, Dresses, Furniture; Relations: Birds, Cries of Animals, Food, Hospitality, Houses, Rooms, Tools, Airport, News Paper, Books, Gems, Corporate Vocabulary, Jobs, Occupations, Diseases; British and American spelling; Slang Words and Technical Jargons.

Module 3: FUNCTIONAL GRAMMAR - I (06 Periods)

English Grammar and the Indian Student, Parts of Speech, Verb forms: Tenses, Voice and Speech.

Module 4: FUNCTIONAL GRAMMAR -II (06Periods)

Universal Auxiliaries: Sentence Structure, WH Questions, framing of Questions with answers; Question Tags, Subject and verb agreement, Spotting Errors.

Module 5: COMMUNICATION SKILLS (06 Periods)

Polite, Courteous and diplomatic expressions, good manners and Etiquette, Conversation Techniques, Narrating Stories.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Critically analyse the value of Indian money and its impact on the common man and Prepare a PowerPoint Presentation.
2. Prepare a conversation between you and a sanitary officer regarding sanitary conditions in your locality.
3. The English Language has a rich vocabulary and it increases day by day. Present a seminar on the norms adhered to in adding new words and list out the words added in the last five years with their meaning.
4. Enact roleplays in different situations.
5. Participate in group discussions and debate on present issues
6. A conversation is an exchange of ideas, thoughts, and feelings between two or more persons. Explain it with suitable examples
7. Prepare a schedule and identify various committees to be formed for celebrating the Annual Day of a college and explain team involvement in the celebration.
8. Gather various ideas on discussing with parents the role of higher education and job opportunities.

9. Imagine you see a person wasting water. Write a dialogue objecting to such wastage of natural resources.
10. Since social media offers a wide reach easily, it becomes easier for bullies to spread gossip or issue threats. How do you think Cybercrime is a menace brought about by social media?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXTBOOKS:

1. L. Adinarayana and V. Prakasam, "Spoken English", Neelkamal Publications Pvt. Ltd., New Delhi, 2008.
2. Ram Bhasker Raju, "The Complete Book on Spoken English" Goutham Buddha Publications, Hyderabad, 2002.

REFERENCE BOOKS:

1. Sabina Pillai, Spoken English for my World, Oxford University Press, New Delhi, 2016.
2. K. R. Lakshminarayanan, Speak in English, SciTech Publications, Chennai, 2009.

VIDEO LECTURES:

1. https://www.britishcouncil.in/programmes/english-partnerships/state/skills-projects/AP-English-Skills
2. https://www.fluentu.com/blog/english/websites-to-learn-english/

WEB RESOURCES:

1. https://study.sagepub.in/kakarla_fec
2. https://www.theconfidentteacher.com/2018/04/five-useful-vocabulary-websites/
3. https://ling.sprachwiss.uni-konstanz.de/pages/home/lfg/resources.html
4. https://www.makeuseof.com/tag/improve-communication-skills-7-websites/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG107602	ESSENTIAL LIFE SKILLS FOR HOLISTIC DEVELOPMENT	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with different types of thinking skills, self-awareness, coping with stress and emotion, transformational skills, group and team dynamics, and leadership.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand different life skills required in personal and professional life.

CO2. Analyze well-defined techniques to cope with emotions and stress.

CO3. Apply appropriate thinking and problem-solving methods to solve problems.

CO4. Function effectively in a team and as an individual.

CO5. Demonstrate the qualities of an effective leader.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	2	2
CO2	2	3	-	-	2	-	-	2	2
CO3	2	3	-	-	2	-	-	2	2
CO4	2	2	-	-	2	-	3	2	2
CO5	2	2	-	-	-	-	-	2	3
Course Correlation Mapping	**2**	**3**	**-**	**-**	**2**	**-**	**3**	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: OVERVIEW OF LIFE SKILLS (06 Periods)

Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem-solving, Effective Communication, interpersonal relationships, coping with stress, coping with emotion. Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

Module 2: STRESS MANAGEMENT (06 Periods)

Stress Management: Stress, reasons, and effects, identifying stress, stress diaries, the four A's of stress management, techniques,

Approaches: action-oriented, emotion-oriented, acceptance oriented, resilience, Gratitude Training,

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method, and relaxation techniques.

Module 3: TRANSFORMATIONAL SKILLS (06 Periods)

Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity,

Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Module 4: GROUP AND TEAM DYNAMICS (06 Periods)

Introduction to Groups: Composition, formation, Cycle, thinking, clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, and Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5: LEADERSHIP (06 Periods)

Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Prepare an attitude test and measure the attitudes of your class.
2. Prepare a Case study on the Campus Interview pressure and stress of students using SWOT analysis.
3. Record and prepare videos of various cultural people and make a comment on their accents.
4. Prepare a short film of a leader of your choice and list out the best qualities.
5. Prepare a presentation on the impact of social media on leadership management.
6. 'Knowledge of present technologies helps us to live a harmonious life.'
   Make a video to justify the statement.
7. Identify life skills needed in our day-to-day life and explain their importance.
8. Come up with strategies to become successful in professional life.
9. Find methods and solutions to overcome the self-pity of a person.
10. Identify the persons who are irregular to class. Find out their problems and come up with solutions.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXTBOOK:

1. Dr. K Alex, "Soft Skills". S Chand & Company Pvt.Ltd.2013.
2. Manmohan Joshi, "Soft Skills". Boolkboon.com, First Edition, 2017.

REFERENCE BOOKS:

1. Barun K. Mitra. "Personality Development & Soft Skills", First Edition; Oxford Publishers. 2011.
2. Kalyana. "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd. 2015.
3. Shalini Verma. "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company, 2014.
4. John C. Maxwell. "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc. 2014.
5. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
6. Ramesh S., Vishnu R.G. "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
7. Butterfield Jeff. "Soft Skills for Everyone", Cengage Learning India Pvt Ltd; 1 edition, 2011.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=xM0fajUl7Bg
2. https://www.youtube.com/watch?v=HwLK9dBQn0g
3. https://www.youtube.com/watch?v=sxX5LoojdJw
4. https://www.youtube.com/watch?v=xJBgqW9-lzc
5. https://www.youtube.com/watch?v=QVwTVM1Iv1c

WEB RESOURCES:

1. https://www.clarke.edu/campus-life/health-wellness/counseling/articles-advice/developing-a-positive-attitude/
2. https://www.skillsyouneed.com/ps/personal-swot-analysis.html
3. https://ecampusontario.pressbooks.pub/profcommsontario/chapter/cross-cultural-communication/
4. https://thepeakperformancecenter.com/educational-learning/thinking/#:~:text=There%20are%20several%20core%20thinking,storing%20and%20then%20retrieving%20information.
5. https://www.webmd.com/anxiety-panic/guide/stage-fright-performance-anxiety
6. https://www.ktunotes.in/ktu-syllabus-life-skills/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MG107601	INNOVATION, INCUBATION AND ENTREPRENEURSHIP	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To sensitize students on the prospects, opportunities, and challenges in entrepreneurship and the potential for value creation from prospective idea

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basics of generating new business ideas

CO2. Explain the concept of design thinking and product innovation.

CO3. Illustrate the roles of digital technology in entrepreneurship.

CO4. Understand the need for startup economics and market conditions

CO5. Evaluate the reasons for successful entrepreneurship.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	2	-	-	-	-	-	-
CO2	1	1	1	-	-	-	1	-	-
CO3	2	2	1	-	-	-	-	-	-
CO4	3	1	1	-	-	-	-	-	1
CO5	2	2	-	-	-	1	-	-	1
Course Correlation Mapping	**2**	**2**	**1**	**-**	**-**	**1**	1	**-**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (06 Periods)

Concept & Definition, taking product or service ideas to creating value: Why should one choose to become an entrepreneur, Entrepreneurial mind-set, Intrapreneurship

Module 2: PRODUCT INNOVATION (06 Periods)

Product innovation process, engineering design process and the concept of frugal engineering for developing innovative affordable products, effective user-interface.

Module 3: DIGITAL TECHNOLOGY ENTREPRENEURSHIP (06 Periods)

Industry 4.0 landscape and innovations using digital technologies like AI, IOT, AR/VR, Cloud, SAAS, User Applications.

Module 4: STARTUP ECONOMICS & MARKET CONSIDERATIONS (06 Periods)

Economic consideration for starting a venture, Understanding Feasibility analysis, understanding market, targeting customer and positioning product

Module 5: SUCCESSFUL BUSINESS INCUBATION (06 Periods)

Business model innovation, Business process management, competitive advantages, Business model canvas, Bootstrapping.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Create and present a prototype of a new product of your choice.
2. Present at least three cases of successful business Ideas in recent times
3. Discuss in the group Entrepreneurship opportunities in terms of Orientation and Develop mentation.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Robert D. Hisrich, Entrepreneurship,
2. Kuratko & Hodgetts, Entrepreneurship- Theory, Process & Practice, Thompson South-Western Publication

REFERENCE BOOKS:

1. Peter Drucker, Innovation and Entrepreneurship, Harper Collins
2. Thomas N. Duening, Robert D. Hisrich and Michael A. Lechter, Technology Entrepreneurship Taking Innovation to the Marketplace, Elsevier
3. Prof. Nigel Cross, Bloomsbury Design Thinking Understanding How Designers Think and Work, 2019 Edition

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_mg63/preview
2. https://onlinecourses.nptel.ac.in/noc22_de08/preview

WEB RESOURCES:

1. nhttps://ciie.iitism.ac.in/files/CIIE-POLICY.pdf
2. https://www.nios.ac.in/media/documents/249_Enterpreneurship/English_pdf/249_Enterpreneurship_Lesson_16.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE107601	INTELLECTUAL PROPERTY RIGHTS	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course is designed to provide comprehensive knowledge to the students regarding the general principles of intellectual property rights, Concepts and Theories, Criticisms of Intellectual Property Rights, and International Regime Relating to IPR. The course provides awareness on how to protect one's unique creation, claim ownership, knowledge of what falls under the purview of someone's rights and what doesn't, and safeguard their creations and gain a competitive edge over their peers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the need and the concepts of intellectual property right and avenues for filling intellectual property rights.

CO2. Understand the legislative practices and protocols for the acquisition of trademarks and the judicial consequences for violating laws of trademark protection.

CO3. Understand the legislative practices and protocols for the acquisition of copyrights and the judicial consequences for violating laws of copyright protection.

CO4. Understand the fundamentals of patent laws, legislative practices, and protocols for acquisition of trade secrets and the judicial consequences for violating laws of trade secrets protection.

CO5. Understand the importance of geographical indications and various laws and protocols for protecting geographical indications.

CO-PO Mapping Table:

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	2
CO2	3	-	-	1	-	3	-	-	2
CO3	3	-	-	1	-	3	-	-	2
CO4	3	-	-	1	-	3	-	-	2
CO5	3	-	-	1	-	3	-	-	2
Course Correlation Mapping	**3**	**-**	**-**	**1**	**-**	**3**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (06 Periods)

Introduction and the need for intellectual property rights (IPR); types of intellectual property-Design; International organizations, agencies, and treaties.

Module 2: TRADEMARKS (06 Periods)

Introduction to trademark, Purpose, and function of trademarks, acquisition of trademark rights, protectable matter, selecting and evaluating trademark, trademark registration processes.

Module 3: LAW OF COPYRIGHTS (06 Periods)

Fundamental of copyright law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, copyright registration, a notice of copyright, and international copyright law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Module 4: TRADESECRETS (06 Periods)

Trade secret law, determination of trade secret status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

Module 5: GEOGRAPHICAL INDICATIONS (06 Periods)

The Geographical indications law in India, The objectives and features, the registry of geographical indications powers and functions. Types of goods offered. Protection: Agriculture goods, manufactured goods, and natural goods. Registration of indications and the requirements. Prohibition of misleading use of indications of geographical origins, prohibition of dilution of geographical origins.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Should conduct a survey based on the real scenario, where IPR is misused or unethically used and present an article.

2. Prepare an article on the registration processes of IPR practically (copy right/trade mark/ patents).

3. Should study a case of conflict on trademarks/patents and should produce an article mentioning the circumstances and remedial measures.

4. Prepare an article on the latest development in the international intellectual property rights.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Deborah, E. Bou choux, Intellectual property: The law of Trademarks, Copyright, Patents, and Trade Secrets, Cengage learning, 4th Edition, 2013.
2. Prabuddha Ganguli, Intellectual property right - Unleashing the knowledge economy, Tata McGraw Hill Publishing Company Ltd.
3. Marsha Aechols; Geographical Indications for Food Products, Wolters, 2008

REFERENCE BOOKS:

1. Neeraj P., & Khusdeep D. Intellectual Property Rights. India, IN: PHI learning Private Limited. 1st Edition 2019.
2. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited. 2019

VIDEO LECTURES:

1. https://nptel.ac.in/courses/110105139

WEB RESOURCES:

1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organization. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organization (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE107602	FUNDAMENTALS OF RESEARCH METHODOLOGY	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course is developed for the students to understand the underlying concepts of research methodology and a systematic approach for carrying out research in the domain of interest. The course is emphasized on developing skills to recognize and reflect on the strength and limitations of different types of research; data collection methods, and methods of Processing and analyzing data. The course also emphasizes interpreting the findings and research articulating skills.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understands the underlying concepts of research methodology, types of research and the systematic research process.

CO2. Understand the philosophy of research design, types of research design and develop skills for a good research design.

CO3. Understand the philosophy of formulation of a research problem, methods of data collection, review of literature and formulation of working hypothesis.

CO4. Understand various data processing and analyzing techniques and their significance in the research.

CO5. Develop skills to interpret the findings and research articulating skills along with the ethics of research.

CO-PO Mapping Table:

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	1	-	-	-	-	-	-
CO3	3	-	-	2	-	-	-	-	-
CO4	3	2	-	3	-	-	-	-	-
CO5	3	-	-	-	-	-	3	3	-
Course Correlation Mapping	**3**	**2**	**1**	**3**	-	-	**3**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module 1: INTRODUCTION TO RESEARCH METHODOLOGY (06 Periods)

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research.

Module 2: RESEARCH DESIGN (06 Periods)

Research design—Basic Principles, Need of research design, Features of good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs, Developing a research plan.

Module 3: RESEARCH FORMULATION (06 Periods)

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Data collection – Primary and secondary sources; Critical literature review – Identifying gap areas from literature review, Development of working hypothesis.

Module 4: PROCESSING AND ANALYSIS OF DATA (06 Periods)

Processing Operations, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Relationship, Simple Regression Analysis.

Module 5: INTERPRETATION AND REPORT WRITING (06 Periods)

Interpretation: Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation.

Report Writing: Significance, Different Steps, Layout, Types of reports, Mechanics of Writing a Research Report, Precautions in Writing Reports.

Total Periods: 30

EXPERIENTIAL LEARNING:

1. Should conduct a survey based on a hypothesis, analyze the data collected and draw inferences from the data.

2. Should review the literature on the given topic and should identify the scope/gaps in the literature and develop a research hypothesis.

3. Should study a case, formulate the hypothesis and identify an appropriate testing technique for the hypothesis.

4. Study an article and submit a report on the inferences and should interpret the findings of the article.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International Publishers, 2nd revised edition, New Delhi, 2004.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.

REFERENCE BOOKS:

1. R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009.
2. Singh, Yogesh Kumar. Fundamental of research methodology and statistics. New Age International, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/121106007
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
3. https://www.youtube.com/watch?v=VK-rnA3-41c

WEB RESOURCES:

1. https://www.scribbr.com/category/methodology/
2. https://leverageedu.com/blog/research-design/
3. https://prothesiswriter.com/blog/how-to-formulate-research-problem
4. https://www.formpl.us/blog/hypothesis-testing
5. https://www.datapine.com/blog/data-interpretation-methods-benefits-problems/
6. https://leverageedu.com/blog/report-writing/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102001	**INTRODUCTION TO BIOINFORMATICS**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Bioinformatics, Biological databases, data storage and retrieval methods, sequence alignments, and sequence structure and visualization tools. Also, hands-on experience on different basic Bioinformatics tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand interdisciplinary nature of bioinformatics, different tools used in Molecular biology.

CO2. Identify databases to be searched for Biomolecules data.

CO3. Analyze protein and nucleic acid sequences with appropriate sequence alignment methods using different tools.

CO4. Analyse Biological data using different bioinformatics tools.

CO5. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	3	-	-	-	-	-	3	-	-
CO4	3	3	-	3	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	3	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BIOINFORMATICS (10 Periods)

Introduction to Bioinformatics, Inter disciplinary nature of Bioinformatics, bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT,), databases (PubMed, PDB)). Generation of large-scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.

Module 2: BIOLOGICAL DATABASE (11 Periods)

Introduction to data types, Classification and Presentation of Data. General Introduction of Biological Databases; Nucleic acid databases, NCBI, DDBJ, and EMBL. Protein databases, Primary, Composite, and Secondary. Specialized Genome databases: (SGD, TIGR, and ACeDB). Human Genome database. Structure databases (CATH, SCOP, and PDB sum).

Module 3: DATA STORAGE AND RETRIEVAL (09 Periods)

Flat files, relational, object-oriented databases and controlled vocabularies. File Format (GenBank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Neighboring search. Ontologies.

Module 4: SEQUENCE ALIGNMENTS (09 Periods)

Introduction to sequences, alignments and Dynamic Programming, Local alignment and Global alignment, pairwise alignment (BLAST and FASTA Algorithm), multiple sequence alignment – progressive alignment, (Clustal W, Clustal Omega, CINEMA), databases of multiple alignment and searching. Phylogenetic trees. Alignment Matrices – BLOSUM and PAM.

Module 5: SEQUENCE AND STRUCTURE VISUALIZATION TOOLS (06 Periods)

Sequence visualization tools (Artemis, Seqvista), Structure visualization tools (Rasmol, SPDBV, Cn3d, PyMol, Chimera), Comprehensive packages-ExPASy Commercial packages, Molecular operational Environment (MOE) and Schrodinger.

Total Periods: 45

EXPERIENTIAL LEARNING (Minimum 10 experiments shall be conducted)

1. Introduction to databases and database searching.
2. Database searching – Nucleic acid and protein sequence identification.
3. Pair wise sequence analysis using BLAST.
4. Pair wise sequence analysis using FASTA.
5. Multiple sequence alignment using different programs.
6. Colour schemes for Multiple sequence alignment using different editors.
7. Generation of Phylogenetic trees.
8. Molecular display program Rasmol.
9. Molecular display program SPDBV.
10. Molecular display program PyMol.
11. Molecular display program Chimera.
12. Demonstration of different Molecular drawing tools.

RESOURCES

TEXT BOOKS:

1. Zoe Lacroix and Terence Critchlow, Bioinformatics, 1st edition, Morgan Kaufmann Publishers, 2003.
2. Orpita Bosu and S. K. Thukral, Bioinformatics, 1st edition, Oxford University press, 2007.

REFERENCE BOOKS:

1. D. W. Mount, Bioinformatics: Genome and sequence analysis, 2nd edition, CBS Publications, New Delhi, 2004.
2. I. F. Tsigelny, Protein Structure Prediction, Bioinformatics approach, 1st edition, International University Line, 2002.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/content//storage/102/106/102106065/MP4/mod01lec01.mp4
2. https://archive.nptel.ac.in/content//storage/102/106/102106065/MP4/mod01lec06.mp4
3. https://archive.nptel.ac.in/content//storage/102/106/102106065/MP4/mod02lec11.mp4

WEB RESOURCES:

1. https://www.youtube.com/watch?v=28lMfTQTFas
2. https://www.youtube.com/watch?v=g9PJEDmoWn4
3. https://www.youtube.com/watch?v=LhpGz5--isw
4. https://www.youtube.com/watch?v=cq5lpR2Hqgw

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101005	MOLECULAR GENETICS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Molecular Genetics, Gene expression and regulation, Types of genetic variations and mutations, Molecular Biology techniques, Genomics and Functional genomics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand structure and function of DNA and RNA
CO2. Gain knowledge in Expression of Genes and control of gene regulation.
CO3. Understand the types of Genetic variations and mutations.
CO4. Identify the techniques used in Molecular Biology.
CO5. Understand the importance of Genomics and Functional genomics.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MOLECULAR GENETICS (09 Periods)

Definition and scope of molecular genetics, Historical development and milestones, Importance and applications in various fields, Double helical structure of DNA, Replication of DNA, DNA repair, RNA structure and function, Genetic code and Protein synthesis.

Module 2: GENE EXPRESSION AND REGULATION (09 Periods)

Transcriptional Regulation: Transcription factors and enhancers, Promoters and enhancer elements, Mechanisms of gene activation and repression, Post-transcriptional Regulation, mRNA processing and splicing, RNA interference (RNAi), Role of non-coding RNAs in gene regulation

Module 3: TYPES OF GENETIC VARIATIONS AND MUTATIONS (09 Periods)

Types of Genetic Variation, Single nucleotide polymorphisms (SNPs), Insertions and deletions, copy number variations, Mutations and their Causes, Types of mutations (point mutations, insertions, deletions), Environmental and genetic factors contributing to mutations, Consequences of mutations on gene function

Module 4: MOLECULAR BIOLOGY TECHNIQUES (09 Periods)

DNA Cloning and Recombinant DNA Technology, Plasmids and vectors, Restriction enzymes and DNA ligases, Gene cloning techniques, DNA Sequencing methods, Sanger sequencing, Maxam-Gilbert sequencing, Polymerase chain reaction (PCR), Gel electrophoresis for separation of DNA

Module 5: GENOMICS AND FUNCTIONAL GENOMICS (09 Periods)

Genomics and Functional Genomics, Human genome project, Comparative genomics, Functional genomics approaches, Personalized Medicine and Molecular Diagnostics, Biomarkers and diagnostic tools, Targeted therapies, Challenges and future perspectives, Emerging Technologies in Molecular Genetics, Single-cell sequencing, Nanotechnology in molecular biology, Artificial intelligence applications in genomics

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a report on different types of regulatory RNA's and their functions.
2. Should prepare a report on latest technologies in Molecular biology.
3. Analyze different sequences using bioinformatics tools
4. Seminars on advances in Genomics and Comparative Genomics.
5. Prepare assignment on various methods used for separation of DNA and analysis of DNA.

RESOURCES

TEXT BOOKS:

1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. Molecular Biology of Gene, Cold Spring Harbor Laboratory Press, 2013
2. Lewin, B. Genes XI. Jones & Bartlett Learning, 2013.
3. Snustad, P., & Simmons, M. J. Principles of Genetics. Wiley, 2016.

REFERENCE BOOKS:

1. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. Introduction to Genetic Analysis. W.H. Freeman & Company, 2014.
2. Hartwell, L., Goldberg, M. L., Fischer, J., & Hood, L**.** Genetics: From Genes to Genomes. McGraw-Hill Education, 2017.

VIDEO LECTURES:

1. http://thebiologyprimer.com/lecture-video-dna-synthesis-and-repair
2. https://www.youtube.com/watch?v=FHcw09lZF24
3. https://www.youtube.com/watch?v=kOCcmJ3nVQ4
4. https://www.youtube.com/watch?v=urpRzE5GCbk

WEB RESOURCES:

1. https://egyankosh.ac.in/handle/123456789/76470
2. https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20techiniques%20of%20biochemistry%20and%20molecular%20biology%207th%20ed%20wilson%20walker.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102002	**BIOLOGICAL DATABASES AND DBMS**	3	-	3	-	4.5

Pre-Requisite Introduction to Bioinformatics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Biological databases, Nucleic acid databases, Protein Sequence and structure databases, Pathway databases and DBMS. Also, hands-on experience on different basic tools used for sequence analysis and docking studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand biological databases and identify scientific article search methods.

CO2. Identify databases to use search for Nucleic acid information and analysis

CO3. Identify Protein databases to search sequence and structure information.

CO4. Evaluate biological pathways using different databases.

CO5. Understand DBMS, types of DBMS and use of DBMS in data management.

CO6. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-
CO6	3	3	-	-	-	-	3	3	-	3	-	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	-	**3**	**3**	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module 1: INTRODUCTION TO BIOLOGICAL DATABASES (09 Periods)

Introduction to Biological databases, types of databases-Primary, secondary and composite databases. Public Biological databases-NCBI, EMBL. Sequence submission methods and tools - Sequin and Bank it. Sequence retrieval systems- (Entrez and SRS). Sequence file formats and conversion tools. Finding scientific articles through PubMed search.

Module 2: NUCLEIC ACID DATABASES (09 Periods)

Primary Nucleic acid sequence databases - GenBank, EMBL and DDBJ, Secondary sequence databases- Unigene, SGD, Omniome, Fly Base, ACeDB. Nucleic acid structural database-nDB. Genome database - Human genome database, Plant Genome database, Microbial genome database.

Module 3: PROTEIN SEQUENCE AND STRUCTURE DATABASES (10 Periods)

Primary protein sequence databases: Swissprot, PIR, UNIPROT, EMBL, TrEMBL.

Secondary Sequence databases: PROSITE, PRINTS, MHCpep, Pfam, Mobidb, InterPro.

Protein structure databases: RCSB, PDB, ePDB, MMDB.

Protein secondary structure databases-CATH, SCOP, MODBASE, PDBTM, ProtCID, Disprot

Module 4: PATHWAYS AND OTHER DATABASES (07 Periods)

Databases involving Pathways and Bioinformatics tools - KEGG, BRENDA, ExPASy, Biocyc, Ecocyc, MANET, HMDB, ENCODE, CCDS database, BioGRID.

Module 5: DATA BASE MANAGEMENT SYSTEM (10 Periods)

Overview of DBMS; biological database management system (BDBMS), BDBMS system architecture, Storing and indexing annotations, Indexing and query processing. Relational Database Design - Anomalies in a Database, Query processing and optimization; Security, backup and recovery.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 10 experiments shall be conducted)

1. List of Biological Databases
2. Searching Scientific data using PubMed.
3. Searching Nucleic acid sequence in GenBank and DDBJ.
4. Searching Protein sequence information in the NCBI protein and Swissprot.
5. Searching Protein sequence information in the UNIPROT.
6. Searching Protein and Nucleic acid structure information in RCSB and MMDB.
7. Searching Biological pathways database in KEGG.
8. Searching for Enzyme data in BRENDA.
9. Searching for Genome data in NCBI Genome.
10. Searching for small molecule data using ZINC and PubChem.
11. Searching and analysis of different tools in the ExPASy.
12. Small molecule drawing tools such as Ketcher and Chem sketch.

RESOURCES

TEXT BOOKS:

1. P. B. Kavi Kishor and L. N. Chavali, Principles of Biological databases, 1st Edition, Himalaya publishing house, 2013.
2. Orpita Bosu and S. K. Thukral, Bioinformatics, 1st edition, Oxford University press, 2007.
3. H. D. Ismail, Bioinformatics, Ist edition, Chapman and Hall/CRC, 2022.

REFERENCE BOOKS:

1. David W Mount, Bioinformatics: Genome and sequence analysis, 2nd edition, CBS Publications, New Delhi, 2004.
2. S. A. Krawetz and D. D. Womble, Introduction to Bioinformatics,1st edition, Springer-Humana press, 2003.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=JmKD5SnQtFE
2. https://www.youtube.com/watch?v=CM4JH78kVms
3. https://www.youtube.com/watch?v=rDhElW5ox6w
4. https://www.youtube.com/watch?v=T7AxM7Vqvaw

WEB RESOURCES:

1. https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology/Book%3A_Investigations_in_Molecular_Cell_Biology_(O'Connor)/05%3A_Introduction_to_databases
2. http://mccollegeonline.co.in/attendence/classnotes/files/1586267644.pdf
3. http://www.icet.ac.in/Uploads/Downloads/bio2.pdf
4. https://www.stat.berkeley.edu/~sandrine/Teaching/PH296.F02/Disc/Biodatabases5.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102003	**INTRODUCTION TO GENOME PROJECTS**	3	-	3	-	4.5

Pre-Requisite Introduction to Bioinformatics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Genomes and Genome projects, Design and execution of Genome projects, Bioinformatics for Genome analysis, Application of genome projects in various fields and Future directions and ethical considerations and hands-on experience on tools for Genome and Genome projects.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Explain the fundamental concepts of genomics and genome projects.
CO2. Describe different types of genome projects and their applications.
CO3. Discuss the steps involved in designing and executing a genome project.
CO4. Analyze and interpret genomic data using bioinformatics tools.
CO5. Evaluate the ethical, social, and legal implications of genome projects.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO GENOMICS AND GENOME PROJECTS (09 Periods)

Definition and key concepts of genomics, History and evolution of genome projects, Types of genome projects (whole-genome sequencing, transcriptomics, epigenomics, metagenomics), Applications of genome projects in various fields (medicine, agriculture, biotechnology, etc.), Case studies of landmark genome projects (Human Genome Project, ENCODE Project)

Module 2: DESIGN AND EXECUTION OF GENOME PROJECTS (09 Periods)

Experimental design considerations (sample collection, quality control), Sequencing technologies and platforms (Illumina, PacBio, Nanopore), Data generation and storage (big data challenges), Assembly and annotation of genomic sequences (reference genomes, de novo assembly), Quality control and validation of genomic data.

Module 3: BIOINFORMATICS FOR GENOME ANALYSIS (09 Periods)

Introduction to bioinformatics tools and databases (NCBI, Ensemble, KEGG), Sequence alignment and homology searching (BLAST, Clustal), Differential gene expression analysis (RNA-seq data analysis) Variant calling and analysis (SNPs, CNVs), Functional annotation of genes and pathways (GO, KEGG enrichment analysis).

Module 4: APPLICATIONS OF GENOME PROJECTS IN VARIOUS FIELDS (09 Periods)

Precision medicine and personalized healthcare, Crop improvement and agricultural biotechnology Microbial genomics and environmental applications Forensic genomics and personalized ancestry analysis, Synthetic biology and genome engineering

Module 5: FUTURE DIRECTIONS AND ETHICAL CONSIDERATIONS (09 Periods)

Emerging genome technologies (long-read sequencing, single-cell genomics), Big data challenges and opportunities in genomics, Ethical considerations and societal implications of genome projects, (privacy, discrimination, gene editing), Responsible conduct of research and data sharing

Total Periods: 45

EXPERIENTIAL LEARNING (Minimum 6 experiments shall be conducted)

List of Exercises

1. Introduction Bioinformatics tools.
2. Human Genome analysis.
3. Comparative Genomic analysis.
4. Tools for Gene prediction.
5. ORF prediction tools.
6. Multiple sequence alignment.
7. KEGG and Genome ontology.
8. TIGR, SGD, ACedb and other genome databases.

RESOURCES

TEXT BOOKS:

1. T. A. Brown (2015), Genomes, Garland publishers.
2. D. W. Mount, (2004), Bioinformatics: Sequence and Genome analysis, Cold Spring harbor press publishers.
3. A. M. Lesk, (2017) Introduction to Bioinformatics, Oxford University Press.

REFERENCE BOOKS:

1. S. B. Primrose and R. Twyman, (2003), Principles of Genomes and Genome analysis, Wiley publishers.
2. M. Starkey and E. Ramnath, (2010), Genomic: Essential methods, John Wiley and Sons publishers.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=qOW5e4BgEa4
2. https://www.youtube.com/watch?v=ugjCwAsz2Ik
3. https://www.youtube.com/watch?v=MvuYATh7Y74
4. https://www.youtube.com/watch?v=mmgIClg0Y1k

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/102/104/102104056/
2. https://egyankosh.ac.in/bitstream/123456789/35566/3/Unit-3.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102004	COMPUTATIONAL BIOLOGY	3	-	3	-	4.5

Pre-Requisite Introduction to Bioinformatics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Computational Biology, Phylogenetics, Protein structure, modelling and simulations, systems biology and other advanced topics, PERL and Unix for Bioinformatics. Also, hands-on experience on different basic tools used for sequence analysis and docking studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand different aspects of computational biology and will identify database search, sequence analysis methods and theory of alignments.

CO2. Analyze multiple sequences for Phylogenetic tree construction to know the relationship among different species.

CO3. Evaluate predicted protein structures through simulations for Structure based Drug design.

CO4. Gain knowledge in systems biology and Microarray technology for the analysis of Nucleic acids and Proteins.

CO5. Gain knowledge in different software's for computational biology and analyze different types of biological data using computational methods.

CO6. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	3	-	-	-	-	-	3	-	-
CO4	3	3	-	3	-	-	-	-	-	3	-	-
CO5	3	3	-	3	-	-	-	-	-	3	-	-
CO6	3	3	-	-	-	-	3	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**3**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO COMPUTATIONAL BIOLOGY (10 Periods)

Molecular sequences, Genome sequencing: Next generation sequencing data, biological databases: Protein and Nucleotide databases, Sequence Alignment, Dynamic Programming for computing, Local and Global Alignment, Functional Annotation, Progressive and Iterative Methods for Multiple sequence alignment, Applications.

Module 2: PHYLOGENETICS (09 Periods)

Introduction to Phylogenetics, Distance and Character based methods for phylogenetic tree construction: UPGMA, Neighbour joining, Ultra metric and Min ultra metric trees, Parsimonous trees, Additive trees, Bootstrapping.

Module 3: PROTEIN STRUCTURE, MODELLING AND SIMULATIONS (10 Periods)

Protein Structure Basics, Structural organization of proteins, Structural Visualization, Prediction of Secondary Structure and Tertiary Structure, Homology Modeling, Structural Genomics, Molecular Docking principles and applications, Molecular dynamics simulations.

Module 4: SYSTEMS BIOLOGY AND OTHER ADVANCED TOPICS (09 Periods)

Artificial Neural Networks and Hidden Markov Models: Applications in Protein Secondary Structure Prediction and Gene Finding, Introduction to Systems Biology, Microarrays and Clustering techniques for microarray data analysis, informatics in Genomics and Proteomics, DNA computing.

Module 5: PERL AND UNIX FOR BIOINFORMATICS (07 Periods)

Importance of Perl in Bioinformatics, File handling, Programs to handle biological data and parse output files for interpretation, Basic Unix commands, Importance of Unix in Bioinformatics.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 10 experiments shall be conducted)

LIST OF EXPERIMENTS

1. Biological Databases
2. Blast family of programs
3. Clustal W for multiple sequence alignment
4. Phylogenetics software
5. Homology Modeling and Model evaluation
6. Homology Modeling and Model evaluation2
7. Introduction to different docking methods
8. Docking using Auto Dock.
9. Prokaryotic and Eukaryotic Gene finding software
10. GROMACS
11. Programming in PERL
12. UNIX commands

RESOURCES

TEXT BOOKS:

1. M. S. Waterman, Introduction to Computational Biology, 1st edition, Chapman and Hall, 1995.
2. Orpita Bosu and S. K. Thukral, Bioinformatics, 1st edition, Oxford University press, 2007.
3. B. Haubold and T. Wiehe, Introduction to Computational Biology: An evolutionary approach, 1st Corrected edition, Birk hauser publisher, 2007.

REFERENCE BOOKS:

1. D. W. Mount, Bioinformatics: Genome and sequence analysis, 2nd edition, CBS Publications, New Delhi, 2004.
2. I.F. Tsigelny, Protein Structure Prediction: Bioinformatics approach, 1st edition, International University Line, 2002.

VIDEO LECTURES:

1. https://cbd.cmu.edu/about-us/what-is-computational-biology.html
2. https://www.youtube.com/watch?v=C7otoSo9CJk
3. https://www.youtube.com/watch?v=ipRnvs7_CxA

WEB RESOURCES:

1. https://www.youtube.com/watch?v=mNSQ-prhgsw
2. https://www.coursera.org/lecture/bioinformatics-methods-1/lecture-mDDW2
3. https://www.youtube.com/watch?v=05NvuW48DGQ
4. https://www.youtube.com/watch?v=IoLVCEr207w

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101006	GENOMICS AND PROTEOMICS	3	-	-	-	3

Pre-Requisite Introduction to Bioinformatics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Proteomics, Gene Identification and expression, Proteomics and tools, Analysis of Proteomics, and Applications of Genomics and Proteomics, and hands on experience on different Genomics and Proteomics tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts of Proteomics and Genomics.
CO2. Identify different tools used to study Genomics.
CO3. Gain knowledge in Proteomics and Proteomics tools.
CO4. Analyze Proteomics data and Identify applications of Microarrays.
CO5. Identify the applications of Genomics and Proteomics.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO PROTEOMICS AND GENOMICS (08 Periods)

Introduction to Genome, Organization of genomes, Genome size, Sequence complexity, Introns and Exons, Genome structure in viruses and prokaryotes, Introduction to Proteomics – The Proteome, mining proteomes, Bridging Genomics and Proteomics. Proteomics and the new biology.

Module 2: GENE IDENTIFICATION AND EXPRESSION (10 Periods)

Genome annotation, traditional routes of gene identification, ORF, ORF identification, Tools for finding genes, Identifying the function of a new gene, gene ontology, Brief description of types of Genomics, determining gene function by sequence comparison. Introduction to EST, traditional approaches to expression profiling, Analysis of RNA expression, applications of genome analysis.

Module 3: PROTEOMICS AND PROTEOMIC TOOLS (09 Periods)

Introduction to Proteome and Proteomics, Techniques used in Proteomics, Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilization, 2-dimensional gel electrophoresis, Detection of proteins in PAGE, analysis of 2-D gel images.

Module 4: ANALYSIS OF PROTEOMICS DATA (09 Periods)

Mass spectrometry-based methods for protein identification- MALDI-TOF, De novo sequencing using mass spectrometric data- 2-DE gel electrophoresis coupled with mass spectrometry, Micro array techniques- Types of microarrays, Applications of Microarrays.

Module 5: GENOMICS AND PROTEOMICS APPLICATIONS (09 Periods)

Analysis of Genomes – Human, Mouse, Plasmodium falciparum, Saccharomyces cerevisiae, Mycobacterium tuberculosis. Human Genome Project-advantages and disadvantages, Application of proteome analysis- drug development, Pharmaceutical Applications, Proteomics in drug Discovery.

Total Periods: 45

EXPERIENTIAL LEARNING:

LIST OF EXERCISES:

1. Assignment on latest techniques in Genomics
2. Assignment on latest techniques in Proteomics
3. Analysis of Proteomics data from different organisms
4. Identify Genes for the Genome sequence provided
5. Analyze the mass spectroscopy data from cellular proteins
6. Write report on Human genome projects
7. Select any important fruit or vegetable genomes and identify the key genes
8. Group discussion on Latest applications of Proteomics and Genomics
9. Prepare a report on Proteomics and drug design.
10. Prepare report on Genomics of rare plants.

RESOURCES

TEXT BOOKS:

1. S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7th Edition, Blackwell Publishing, 2006.
2. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999

REFERENCE BOOKS:

1. Andrezej K Konopka and James C. Crabbe, Compact Hand Book - Computational Biology, Marcel Dekker, USA, 2004
2. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1st edition, Academic Press, San Diego, 1996.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/102/101/102101007/
2. https://archive.nptel.ac.in/courses/102/101/102101007/
3. https://archive.nptel.ac.in/courses/102/104/102104056/

WEB RESOURCES:

1. https://www.youtube.com/watch?v=rg-e_fbJ6iw
2. https://www.youtube.com/watch?v=jEJp7B6u_dY
3. https://www.youtube.com/watch?v=F4LfSsnPwUs
4. https://www.youtube.com/watch?v=k_1YSdmBmo0

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102005	**STRUCTURAL ANALYSIS**	3	-	3	-	4.5

Pre-Requisite Introduction to Bioinformatics
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on and hands-on experience on tools for Protein structure analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Explain the importance of protein structure and its relationship to function.
CO2. Describe different experimental and computational methods for protein structure determination.
CO3. Analyze protein structures using visualization tools and software.
CO4. Identify and understand key structural features of proteins like secondary structure, domains, and motifs.
CO5. Apply computational tools to predict protein structure, function, and interactions with other molecules.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO PROTEIN STRUCTURE AND ANALYSIS (09 Periods)

Importance of protein structure in function, Levels of protein structure (primary, secondary, tertiary, quaternary), Experimental methods for protein structure determination (X-ray crystallography, NMR), Introduction to computational methods for protein structure prediction (homology modeling, ab initio modeling), Applications of protein structure analysis in various fields (drug discovery, enzyme engineering, etc.)

Module 2: PROTEIN VISUALIZATION AND ANALYSIS TOOLS (09 Periods)

Introduction to molecular visualization software (PyMOL, ChimeraX) Analyzing protein structure (secondary structure, solvent accessibility, interatomic interactions), Identifying and characterizing structural motifs and domains, Introduction to protein structure databases (PDB, UniProt)

Module 3: COMPUTATIONAL PROTEIN STRUCTURE PREDICTION (09 Periods)

Homology modeling: principles and methods, Protein threading and fold recognition, Ab initio protein structure prediction, Evaluating the accuracy and limitations of predicted structures, Docking simulations and protein-protein interaction analysis

Module 4: ADVANCED TECHNIQUES AND APPLICATIONS (09 Periods)

Cryo-electron microscopy (cryo-EM) and its applications in protein structure determination, Protein dynamics and molecular simulations, Machine learning and artificial intelligence in protein structure analysis, Structural analysis of membrane proteins, Protein structure-based drug design and other applications

Module 5: FUTURE DIRECTIONS AND ETHICAL CONSIDERATIONS (09 Periods)

AlphaFold and the future of protein structure prediction, Integration of multi-modal data for comprehensive protein understanding, Emerging technologies like Micro ED and single-molecule FRET, Future directions in protein design and engineering, Gene editing and the ethical implications of altering protein function, Access to protein structure analysis tools and resources, Responsible conduct of research and data sharing in protein science.

Total Periods: 45

EXPERIENTIAL LEARNING **(Minimum 6 experiments shall be conducted)**

List of Exercises

1. Structure display programs, Chimera and PyMol
2. Structural analysis tools
3. Structure prediction programs, ITASSER
4. Secondary structure prediction tools, SSPred etc.,
5. CD spectroscopy data analysis
6. Comparison of Structures
7. Drug design programs
8. Protein structure quality programs.

RESOURCES

TEXT BOOKS:

1. Doublié, S. (2017). Crystallography and NMR of Proteins. John Wiley & Sons
2. Creighton, T.E. (2018). Proteins: Structures and Molecular Principles**.** W.H. Freeman and Company
3. Sali, A., & Blundell, T.L. (1993). Comparative Protein Structure Modelling. Academic Press

REFERENCE BOOKS:

1. Lesk, A.M. (2010). Introduction to Computational Biochemistry. Cambridge University Press.
2. Branden, C., & Tooze, J. (1999). Introduction to Protein Structure. Garland Science.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=eobc7cMMpeY
2. https://www.youtube.com/watch?v=TUyo8NFi_3Q
3. https://www.youtube.com/watch?v=Hz7oHd1mu8k
4. https://www.youtube.com/watch?v=u49k72rUdyc

WEB RESOURCES:

1. https://www.bioinformatics.babraham.ac.uk/training/Deep%20View%20Course%20Manual.pdf
2. www.ncbi.nlm.nih.gov/CBBresearch/Przytycka/download/lectures/CAMS_05_Struct_Comp.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102006	**BIOMOLECULES**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Carbohydrates, Aminoacids and Proteins, Lipids and Fatty acids, Nucleic Acids and chromatin, Porphyrins and cytochromes, and hands on experience on carbohydrate, amino acid, lipid and nucleic acid analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts of carbohydrates' structures, reactions and functions.

CO2. Identify different amino acids present in the proteins and their functions.

CO3. Demonstrate the role of lipids in the formation of bio-membranes.

CO4. Understand the composition, structure and function of Nucleic acids and Porphyrins and Renaturation kinetics of DNA.

CO5. Analyze carbohydrates, amino acids, proteins, lipids and nucleic acids qualitatively, and work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CARBOHYDRATES (10 Periods)

Classification of carbohydrates, Anomers, Epimers, Monosaccharides, disaccharides- Maltose, Lactose, Sucrose, Cellobiose, Trehalose. Trisaccharides- Melezitose, Gentianose, Polysaccharides- structural (Cellulose and Chitin), Storage Polysaccharides-Starch, Glycogen, Mucopolysaccharides- Hyaluronic acid, Heparan sulfate, Dermatan sulfate, Keratan sulfate, Heparin, Chondroitin sulfate. Bacterial cell wall polysaccharides.

Module 2: AMINOACIDS AND PROTEINS (10 Periods)

Aminoacid classification, Essential aminoacids, Reactions due to carboxyl and Amino groups, Peptide bond, Titration curve of Glycine and Side chain containing aminoacids, Proteins- Primary, Secondary, Tertiary and Quaternary structures, Protein sequencing methods. Denaturation and Renaturation of proteins, Structure of Hemoglobin, Natural peptides- Glutathione.

Module 3: LIPIDS AND FATTY ACIDS (09 Periods)

Classification of Lipids, Essential Fatty acids, Triglycerides, Phospholipids, Membrane structure and composition, Membrane theories, Bilayer formation, Micelles, Liposomes, Vesicles, Poly unsaturated fatty acids (PUFA's), Saponification number, Iodine number, Acid number, RM number, Rancidity, Waxes and oils, Fats, Sphingolipids, Prostaglandins and their functions.

Module 4: NUCLEIC ACIDS AND CHROMATIN (10 Periods)

Structures of Nitrogenous bases, Nucleosides, Nucleotides. Phosphodiester bond and its formation, Types of DNA and RNA, Nucleases, Watson Crick model, Denaturation Kinetics, melting temperature (Tm), Hyperchromic effect, Hypochromic effect, Renaturation Kinetics, Cot curves, Chargaff's rule, Chromatin, Histones.

Module 5: PORPHYRINS (06 Periods)

Porphyrin types, Porphobilinogen, Heme, Chlorophyll, cytochromes, cyanocobalamin, Identification of Porphyrins, Porphyria's, synthesis of heme.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 10 experiments shall be conducted)

LIST OF EXERCISES:

1. Qualitative Analysis of Carbohydrates–Glucose, Fructose, Xylose.
2. Qualitative Analysis of Carbohydrates - Disaccharides Lactose, Maltose, Sucrose.
3. Qualitative Analysis of Carbohydrates - Polysaccharide Starch.
4. Qualitative Analysis of Aminoacids Aromatic aminoacids- Phenyl alanine, Tyrosine, Tryptophan.
5. Qualitative Analysis of Aminoacids - Methionine, Histidine.
6. Qualitative Analysis of Aminoacids - Arginine and Proline.
7. Qualitative Analysis of Lipids.
8. Qualitative analysis of Nucleotides and Nitrogen bases.
9. Preparation of Acidic, Basic and Neutral Buffers using pH meter.
10. Absorption spectra of Proteins and Nucleic acids.
11. Absorption spectra of proteins.
12. Absorption maxima of p-Nitro phenol.

RESOURCES

TEXT BOOKS:

1. E. S. West, W. Todd, H. S. Mason, J.T Van Bruggen, Text book of Biochemistry, 4th Edition, MacMillan, 1974.
2. D. Voet and J. G. Voet, Biochemistry, 5th Edition, John Wiley and Sons, 2018.
3. J. Jayaraman, Laboratory manual of Biochemistry, 2nd Edition, New Age, 2012.

REFERENCE BOOKS:

1. D. L. Nelson and M. M. Cox, Lehninger's Principles of Biochemistry, Eighth Edition, W. H. Freeman publishers, 2021.
2. J. M. Berg, L. Stryer, J. Tymoczko and G. Gatto, Biochemistry, W. H. Freeman Publishers, 9th Edition,2019.

VIDEO LECTURES:

1. https://www.Youtube.com/watch?v=ArKSKLGk304
2. https://www.Youtube.com/watch?v=sEVJXB5ZidA
3. https://www.Youtube.com/watch?v=s1MoBTEcVYY

WEB RESOURCES:

1. https://www.Youtube.com/watch?v=b1nxDW5HPjE
2. https://www.Youtube.com/watch?v=6u0jHuG3kgc
3. https://www.Youtube.com/watch?v=piXHivrTT-E
4. https://www.Youtube.com/watch?v=o_-6JXLYS-k

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102007	**BIOPHYSICAL TECHNIQUES**	3	-	3	-	4.5

Pre-Requisite BIOMOLECULES

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Biophysical concepts, Chromatography, Centrifugation, Electrophoresis, Spectroscopy and Radioisotopes, and hands-on experience on Isolation and characterization of biomolecules.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand biophysical concepts, water quality parameters and water pollutants.

CO2. Identify different tools for tissue homogenization and techniques to separate Biochemical constituents.

CO3. Analyze various biochemical constituents in biological mixtures by using techniques such as Chromatography, Electrophoresis and identification by spectroscopy.

CO4. Gain knowledge on Radioisotopes, radioactive emission, radioactive hazards and applications of radioisotopes in biology.

CO5. Apply suitable methods for isolation and characterization of different biological constituents.

CO6. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	1	3	-	-	-	-	-	3	-
CO2	3	3	-	2	-	-	-	-	-	-	3	-
CO3	3	3	-	2	-	-	-	-	-	-	3	-
CO4	3	3	-	2	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	-	-	-	-	3	-
CO6	3	3	-	-	-	-	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**2**	**3**	-	**3**	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BIOPHYSICAL CONCEPTS (08 Periods)

Water as biological solvent, Buffers, Henderson Hassel Balch equation. Acid dissociation Ka, pKa, measurement of pH, biological relevance of pH, pH meter, Oxygen electrode, water quality parameters, BOD, COD, DO and TDS, Electrical conductivity.

Module 2: HOMOGENIZATION AND CENTRIFUGATION (07 Periods)

Homogenization techniques - Ultra sonication, French press and Micro fluidizer. Principles of centrifugation, Svedberg, Centrifugal force, RCF, RPM, Preparative centrifugation, Differential centrifugation Density Gradient-Rate zonal and isopycnic, Ultracentrifugation, Analytical ultra-centrifugation, sedimentation equilibrium and Sedimentation velocity.

Module 3: CHROMATOGRAPHY (10 Periods)

Chromatography principle, Types of chromatography, Paper chromatography, Rf Value and its importance. Partition Principle and Partition coefficient, thin layer chromatography, Gel filtration, Ion exchange chromatography, Affinity chromatography, Determination of Molecular weight of protein by Gel filtration chromatography.

Module 4: ELECTROPHORESIS (10 Periods)

Basics of Electrophoresis, Paper Electrophoresis, capillary electrophoresis, SDS PAGE, Native PAGE, Determination of Molecular weight using SDS PAGE, Isoelectric focusing, Immuno Electrophoresis.

Module 5: SPECTROSCOPY AND RADIOISOTOPES (10 Periods)

Laws of Absorption, Absorbance, Transmittance, Colorimeter, U.V- Visible spectroscopy and its applications, Fluorescence, Jabalonski diagram, Stoke's shift and Fluorimetry, Radio activity, Half-life period, Radio activity units, safety measures in radiation laboratories, Uses of Radio isotopes in Biology, Units of Radioactivity.

Total Periods: 45

EXPERIENTIAL LEARNING **(Minimum 10 experiments shall be conducted)**

1. Separation of Amino acids by Paper Chromatography
2. Separation of carbohydrates by TLC
3. Separation of Plant pigments by TLC
4. Separation of Nucleic acids by Agarose Gel Electrophoresis
5. Extraction of starch from potatoes
6. Isolation of DNA from Plant source
7. Isolation of DNA from bacteria/yeast
8. Isolation of Albumin from Egg
9. Isolation of Cholesterol from Egg yolk.
10. Isolation of Casein from milk
11. Immobilization of Yeast
12. Paper Electrophoresis of serum proteins.

RESOURCES

TEXT BOOKS:

1. A. Upadhyay, K. Upadhyay and N. Nath, Biophysical Chemistry Principles and Techniques, Fourth Revised Edition, Himalaya publishing house, 2020.
2. J. Jayaraman, Laboratory manual in Biochemistry, 3rd Edition, New Age, 2012.

REFERENCE BOOKS:

1. K. Wilson and J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge University Press, 2018.
2. G. Karp, J. Iwasa and W. Marshall, Cell and Molecular Biology: Concepts and Experiments, 8th Edition, Wiley publisher, 2015.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ZCzgQXGz9Tg
2. https://www.youtube.com/watch?v=bFzHhM1iMKA

WEB RESOURCES:

1. https://www.youtube.com/watch?v=saJIWFUGEbw
2. https://www.youtube.com/watch?v=8cYvyYOjzOc

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102008	HUMAN PHYSIOLOGY AND NUTRITION	3	-	3	-	4.5

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Digestive system, Circulatory system, Renal Physiology, Muscular system and Vitamins and Minerals. And also, hands on experience on blood profiles and Vitamin analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand process of digestion and digestive system
CO2. Identify different aspects of Circulatory system, composition of blood and oxygen transport.
CO3. Understand how excretory system functions in humans through renal physiology
CO4. Identify mechanism of Muscles contraction and how various potentials are required for Muscle function.
CO5. Analyze the importance of vitamins and Minerals and their deficiency disorders.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DIGESTIVE SYSTEM (08 Periods)

Anatomy of organs and tissues of digestive system. Composition, functions and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Hormones of GIT.

Module 2: CIRCULATORY SYSTEM (10 Periods)

Blood: Formation and Composition of blood. Functions of blood, role of Blood buffers in acid base balance, Hemostasis, Pathways of blood coagulation. Clot retraction. Structure and Anatomy of Heart, systemic circulation of blood, Blood pressure, ECG/EKG, Cardiac cycle, Cardiac output. Blood gas transport.

Module 3: RENAL PHYSIOLOGY (09 Periods)

Urinary system: Structure and anatomy of Kidney, functions of kidney, structure of nephrons, types of nephrons, steps of urine formation by the kidneys, micturition, JGA, normal and abnormal constituents of urine

Module 4: MUSCULAR SYSTEM (09 Periods)

Types of muscles, structure of skeletal muscle, contractile proteins, Action potential, Resting membrane potential, NMJ, Properties of skeletal muscle: excitability, contractility, all or none law, summation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus. Mechanism of muscle contraction and relaxation. Energetic of muscle contraction, role of calcium in muscle contraction

Module 5: VITAMINS AND MINERALS (09 Periods)

Vitamins: Thiamin, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid, Ascorbic Acid, Inositol. Vitamins A, D, E and K. Chemistry, dietary sources, daily requirements, biochemical roles (coenzyme roles) and functions, deficiency symptoms, hypervitaminosis, antivitaminosis. Minerals: Sources, biological functions, metabolism and regulation of sodium, potassium, calcium, phosphorus, iron, zinc, iodine and fluoride.

Total Periods: 45

EXPERIENTIAL LEARNING (Minimum 08 experiments shall be conducted)

1. Hemoglobin estimation by Hemocytometer.
2. Hemoglobin estimation by Colorimetric methods.
3. Differential Cell count and Total cell count.
4. Estimation of Vitamin C.
5. Abnormal constituents of Urine.
6. Estimation of Urinary Urea.
7. Estimation of Creatine in Urine.
8. Estimation of Bilirubin.
9. Amylase assay.
10. Pepsin assay.

RESOURCES

TEXT BOOKS:

1. Dee Unglaub Silverthorn, (2018) Human Physiology: An Integrated Approach, Publisher: Pearson
2. Kenneth S. Saladin, (2020) Anatomy & Physiology: The Unity of Form and Function" McGraw-Hill Education publisher.

REFERENCE BOOKS:

1. Frances Sizer and Ellie Whitney, (2019) Nutrition: Concepts and Controversies Cengage Learning publishers.
2. Catherine Geissler and Hilary Powers (2017) Human Nutrition, Oxford University press.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=opmAYaq04_Y
2. http://acl.digimat.in/nptel/courses/video/102103091/L40.html
3. https://www.youtube.com/watch?v=fNkPV-WpXMo
4. https://www.youtube.com/watch?v=h1pvqj4z9aM

WEB RESOURCES:

1. https://sdmiramar.edu/sites/default/files/2023-04/physiol_text_ch_1.pdf
2. https://archive.nptel.ac.in/content/storage2/courses/downloads_new/102104058/noc19_bt11_Assignment11.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101008	**ENDOCRINOLOGY**	3	-	-	-	3

Pre-Requisite Human Physiology and Nutrition

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course delves into the anatomy, physiology, and biochemistry of major endocrine glands (pituitary, thyroid, parathyroid, adrenals, pancreas, gonads), and their diverse hormonal messengers. Learn how these hormones orchestrate essential functions like growth, metabolism, reproduction, and stress response, and how their imbalance can lead to various endocrine disorders

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Identify the major endocrine glands and their locations and describe the main hormones produced by each gland and their general effects.

CO2. Identify common disorders of the pituitary (e.g., acromegaly) and thyroid (e.g., hyperthyroidism)

CO3. Understand the functions of adrenal hormones (cortisol, aldosterone) and pancreatic hormones (insulin, glucagon).

CO4. Analyze the anatomy and physiology of the gonads and their role in hormone production

CO5. Apply diagnostic and treatment strategies to complex endocrine cases.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ENDOCRINOLOGY (09 Periods)

The endocrine system overview: Major endocrine glands, General functions of different hormones, Mechanism of hormone action, Hormonal regulation: Receptor types, second messenger systems, hormonal secretion.

Module 2: THE PITUITARY AND THYROID GLANDS (09 Periods)

Pituitary gland: Pituitary hormones (e.g., growth hormone, prolactin, TSH, ACTH) and their functions, Pituitary disorders (e.g., acromegaly, Cushing's syndrome, diabetes insipidus).

Thyroid gland: Thyroid hormones (T3, T4) and their actions on metabolism, Regulation of thyroid hormone secretion, Thyroid disorders (e.g., hyperthyroidism and hypothyroidism).

Module 3: THE ADRENAL GLANDS AND PANCREAS (09 Periods)

Adrenal glands: Anatomy and physiology of the adrenal cortex and medulla, Adrenal hormones (cortisol, aldosterone, epinephrine, norepinephrine) and their functions, Regulation of adrenal hormone secretion, Adrenal disorders (e.g., Cushing's syndrome, Addison's disease, pheochromocytoma).

Pancreas: Pancreatic hormones (insulin, glucagon, somatostatin) and their roles in glucose metabolism, Regulation of insulin and glucagon secretion, Diabetes mellitus (type 1, type 2, gestational) and its pathophysiology.

Module 4: THE GONADS AND BONE METABOLISM (09 Periods)

Gonads: physiology of the testes and ovaries, Sex hormones (testosterone, estrogen, progesterone) and their diverse functions, Reproductive disorders (e.g., PCOD, infertility)

Bone metabolism: Roles of hormones (parathyroid hormone, vitamin D) and other factors in bone formation and resorption, Calcium and phosphorus homeostasis.

Module 5: INTEGRATION AND APPLICATION (09 Periods)

Clinical case studies and presentations, Current advancements and research in endocrinology; emerging therapies, diagnostic tools, and ongoing research relevant to various endocrine conditions, Ethical considerations in endocrinology practice, public health and advocacy

Total Periods: 45

EXPERIENTIAL LEARNING

1. Analyze a clinical scenario involving an endocrine disorder.
2. Interview a simulated patient with a diagnosed endocrine condition.
3. Collaborate with students from other healthcare disciplines to manage a complex endocrine case.
4. Shadow an endocrinologist in a simulated clinical setting.
5. Develop and deliver an educational session for patients with a specific endocrine condition.

RESOURCES

TEXT BOOKS:

1. S. Melmed, R. Koenig, C.J. Rosen, R.J. Auchus A.B. Goldfine (2019), Williams Textbook of Endocrinology (14th Edition), Elsevier Publisher
2. L. L. Brunton, B. C. Knollmann (2022), Goodman & Gilman's The Pharmacological Basis of Therapeutics (14th Edition), McGraw Hill publisher.
3. David G. Gardner, Dolores Shoback (2017), Greenspan's Basic and Clinical Endocrinology (10th Edition), McGraw Hill publisher.

REFERENCE BOOKS:

1. Jameson and De Groot, Endocrinology: Adult and Pediatric (8th Edition)
2. "The Endocrine System: An Overview" by National Institutes of Health (NIH) Publishers.

VIDEO LECTURES:

1. https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/cell-communication/v/intro-to-the-endocrine-system
2. https://www.ted.com/talks/emma_bryce_how_do_your_hormones_work?language=en

WEB RESOURCES:

1. The Endocrine Society: Image of The Endocrine Society logo: https://www.endocrine.org/
2. National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK): Image of National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) logo: https://www.niddk.nih.gov/).

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101009	CELL BIOLOGY	3	-	-	-	3

Pre-Requisite Biomolecules
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion an overview of cell and cell organelles, Cytoskeleton and cell movement, Cell Communication, Cell development and Cancer development and treatment. This course also hands on training mentioned experiential learning syllabus.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand structures and functions of basic components of prokaryotic and eukaryotic cells
CO2. Identify structural organization of cell, cellular components, specific functions of Cells, Cell signaling and mechanism underlying mitotic and meiotic cell division related to the Cell.
CO3. Understand concepts of Stem cells, tissue culture and Cloning methods.
CO4. Evaluate the problems related to Cancer, mechanism underlying for the development of Cancer and treatment for Cancer.
CO5. Analyze functions of different sub cellular organelle, cell division using different tools

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	-	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: AN OVERVIEW OF CELL AND CELL ORGANELLES (10 Periods)
Prokaryotic and eukaryotic cells, cell size and shape, molecules of cell, cell membranes and cell proteins., transport across nuclear envelope, The endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, chloroplast, peroxisomes. Nuclear Envelope- structure of nuclear pore complex, nuclear lamina Chromatin: molecular organization, nucleolus and rRNA processing.

Module 2: CYTOSKELETON AND CELL MOVEMENT (10 Periods)
Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules. Mechanism of vesicular transport. Endocytosis. Bacterial and Eukaryotic Cell Wall; The plasma membrane structure; Transport of small molecules, the extracellular matrix and cell matrix interactions; cell-cell interactions.

Module 3: CELL COMMUNICATION (10 Periods)
Signaling molecules and their receptor; functions of cell surface receptors; Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Intracellular signal transduction pathway; signaling networks.

Module 4: CELL DEVELOPMENT (07 Periods)
Events of Mitotic Phase, Meiosis and Fertilization. Programmed Cell Death, Stem Cells and Maintenance of adult tissues, Embryonic Stem Cells and Therapeutic cloning.

Module 5: CANCER DEVELOPMENT AND TREATMENT (08 Periods)
Cancer and mutation: Development and Causes of Cancer, Tumor Viruses, Oncogenes, Tumor Suppressor genes, Mutation, types of mutation. Cancer Treatment- molecular approach

Total Periods: 45

EXPERIENTIAL LEARNING:

LIST OF EXERCISES:

1. Write essay on Comparison of different types of Cells.
2. Assignment on different types of signalling pathways.
3. Illustrate different types of cells and their functions.
4. Deliver seminars on Mitotic and Meiosis cell divisions.
5. Find different types of diagnostic tests for Cancers.
6. Visit a hospital and find different types of treatments for Cancer.

RESOURCES

TEXT BOOKS:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. In
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology.

REFERENCE BOOKS:

1. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach.
2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London

VIDEO LECTURES:

1. https://nptel.ac.in/courses/102106025
2. https://nptel.ac.in/courses/10210301

WEB RESOURCES:

1. https://www.youtube.com/watch?v=URUJD5NEXC8
2. Hemocytometer:https://vlab.amrita.edu/?sub=3&brch=188&sim=336&cnt=1
3. Mitosis in Onion Root Tips: https://vlab.amrita.edu/?sub=3&brch=188&sim=1102&cnt=1
4. Lignin Staining: https://vlab.amrita.edu/?sub=3&brch=188&sim=778&cnt=1

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101010	**INTRODUCTION TO METABOLISM**	3	-	-	-	3

Pre-Requisite Biomolecules

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to metabolism, Carbohydrate metabolism, Lipid Metabolism, Protein metabolism and Nucleic acid metabolism.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand Basics of Metabolism and Electron Transport Chain.

CO2. Gain knowledge on Carbohydrate metabolism.

CO3. Identify different pathways related to Lipid metabolism.

CO4. Analyze pathways involved in the Protein metabolism.

CO5. Discuss different Nucleic acid metabolic pathways.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO METABOLISM (09 Periods)

Introduction to concepts of Metabolism, Anabolism and Catabolism. Basic Principles of Thermodynamics, Enthalpy, Entropy, Free energy change, Cellular Organization of Metabolism- Mitochondria, Chloroplast and Cytoplasm.

Module 2: CARBOHYDRATE METABOLISM (09 Periods)

The role of carbohydrates in living organisms, Structure and function of monosaccharides, disaccharides, and polysaccharides, Glycolysis (the breakdown of glucose), The fate of pyruvate: fermentation and cellular respiration, The citric acid cycle (Krebs cycle), Regulation of Glycogen metabolism

Module 3: LIPID METABOLISM (09 Periods)

The structure and function of lipids (fats, oils), Fatty acid metabolism (oxidation and synthesis), Cholesterol metabolism and its importance, Phospholipid metabolism, Regulation of lipid metabolism

Module 4: PROTEIN METABOLISM (10 Periods)

Protein metabolism, Metabolism of amino acids, Biogenic amines, protein degradation, The role of the urea cycle in nitrogen metabolism, Regulation of protein metabolism.

Module 5: NUCLEIC ACID METABOLISM (08 Periods)

Metabolism of Nucleic Acids: Synthesis (Salvage and denovo synthesis) and Degradation of Purines and Pyrimidines, Synthesis of Nucleotides and its regulation,

Total Periods: 45

EXPERIENTIAL LEARNING

List of Exercises

1. Prepare a List of Carbohydrate disorders
2. Discussion on Diabetes is a Metabolic disorder.
3. Assignment related to Lipid metabolic disorders.
4. Correlate Cholesterol metabolism and Cardio vascular diseases.
5. Deliver a seminar on Lipid metabolism and Obesity.

RESOURCES

TEXT BOOKS:

1. Lehninger-Principles of Biochemistry, D. L. Nelson and M. M. Cox, Pub: W.H. Freeman, 5th Edition, 2008.
2. Fundamentals of Biochemistry-Life at molecular level, Donald Voet, Judith D Voet and Charlotte. W. Pratt, Wiley Publisher, Fifth edition, 2016.
3. Text book of Biochemistry, E. S. West, W. R. Todd, H. S. Mason and J. T. Vanbruggen, Macmillan publisher, 4th Edition, 1966.

REFERENCE BOOKS:

1. The Biochemistry of Nucleic acids, Adams et al., Pub: Springer, 11th Edition, 1992
2. Harper's Illustrated Biochemistry, Robert K., and Granner, Daryl K., and Mayes, Peter A. Murray, Mc-Graw-Hill Medical publisher, 26th Edition,2003.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=BYiNUOdbEk4
2. https://www.youtube.com/watch?v=2_ceHsFmLVk
3. https://www.youtube.com/watch?v=0M-B2dOfcUo

WEB RESOURCES:

1. https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf
2. https://archive.nptel.ac.in/courses/103/105/103105054/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102010	**BASIC ENZYMOLOGY**	3	-	3	-	4.5

Pre-Requisite Biomolecules
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Introduction to Enzymes, Enzyme Kinetics, Enzyme Inhibition, Mechanism of Enzyme action, coenzymes, monomeric, oligomeric and allosteric enzymes, and hands on training mentioned in the Experiential learning techniques.
COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the nature of enzyme, nomenclature of enzymes and mechanism of enzyme action
CO2. Analyze enzyme activity with the help of enzyme kinetics.
CO3. Identify different types of enzyme Inhibition, methods of inhibiting enzyme activity through which controlling of metabolic pathways involved in different disease states.
CO4. Gain knowledge in Enzyme catalysis, cofactors that help in enzyme action, different types of enzymes and their catalytic mechanisms.
CO5. Apply modern tools to assay enzyme activities and through which applications of enzymes in different fields. Also work independently and as well as in team to perform practical.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	2	-
CO2	3	3	-	-	-	-	-	-	-	-	2	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ENZYMES (08 Periods)

Nomenclature and classification of enzymes according to I.U.B. Convention, enzyme specificity and active site. Definition of Zymogen, Apoenzyme, Coenzyme, Cofactor and Zymogen activation. Enzyme units, Enzyme assays.

Module 2: ENZYME KINETICS (07 Periods)

Factors affecting enzyme activity: Enzyme concentration, substrate concentration, pH and temperature. Derivation of Michaelis-Menten equation for unit-substrate reactions. Km and its significance. Line Weaver Burk plot and its limitations. Importance of Kcat/ Km.

Module 3: ENZYME INHIBITION (10 Periods)

Definition to Inhibitor, Different types of Inhibition, Reversible and irreversible inhibition, competitive, non–competitive and uncompetitive inhibitions, determination of Km & Vmax in presence and absence of inhibitor, Allosteric enzymes.

Module 4: ENZYME CATALYSIS (10 Periods)

Chemical nature of enzyme catalysis: General acid – base catalysis, electrostatic catalysis, covalent catalysis, intermolecular-catalysis, metal ion catalysis, and proximity and orientation. Bi-substrate reactions, Sequential mechanism compulsory order and random order mechanism, non-sequential mechanism, Ping-pong mechanism.

Module 5: MECHANISM OF ENZYME ACTION (10 Periods)

Mechanism of reactions catalyzed by the following enzymes – Chymotrypsin and Trypsin, Co-enzymes – the mechanistic role of the following co-enzymes in enzyme catalyzed reactions– Nicotinamide nucleotides, Flavin nucleotides, Co-enzymes A, Lipoic acid, Thiamine pyrophosphate, Biotin, Tetrahydrofolate and Co-enzyme B12.
Monomeric enzymes – the Serine proteases, Oligomeric enzymes – Isoenzymes, Lactate dehydrogenase (LDH) and multienzyme complexes (pyruvate dehydrogenase complex).

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Preparation of Buffers
2. Demonstration of Isolation of enzymes.
3. Assay of Salivary Amylase
4. Assay of Invertase from Yeast
5. Kinetics of Salivary amylase/Invertase
6. Isolation and Assay of Acid Phosphatase from Potato
7. Study of effect of temperature on enzyme activity
8. Study of effect of pH, activators and inhibitors on enzyme activity
9. Assay of Trypsin
10. Demonstration of Immobilization of enzymes

RESOURCES

TEXT BOOKS:

1. Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1998
3. Lehninger's Principles of Biochemistry. David L. Nelson and Michael M. Cox, W. H. Freeman publisher, 2004.

REFERENCE BOOKS:

1. Principles of enzymology for food sciences: Whitaker, John R. Routledge publisher, 2018.
2. Methods in enzymology Ed. Colowick and Kaplan, Academic PR (Continuing series)
3. Enzyme kinetics Siegel interscience– Wiley 1976.
4. Practical Biochemistry by T Plummer

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=KCG5fDKr9HQ
2. https://www.youtube.com/watch?v=sa4QVjTpnF0
3. https://www.youtube.com/watch?v=6cGdWi_DSGk
4. http://bcs.whfreeman.com/WebPub/Biology/hillis1e/Animated%20Tutorials/at0302/at_0302_enzyme_catalysis.html

WEB RESOURCES:

1. https://www.birmingham.ac.uk/teachers/study-resources/stem/biology/stem-legacy-enzymes.aspx

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102011	MOLECULAR BIOLOGY	3	-	3	-	4.5

Pre-Requisite Biomolecules

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to gene, replication, transcription, translation and DNA damage and its repair. Also, hands-on experience on different basic tools used for DNA assessment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand structure of nucleic acid, types of genes and their importance.

CO2. Understand the role of each enzyme in replication and know the mechanism of replication.

CO3. Identify how the transcription process takes place in the cell as a part of gene expression.

CO4. Gain knowledge on translation process and importance of gene regulation with suitable examples, also mutations, DNA damage and Repair mechanisms.

CO5. Perform different programs to analyse biological sequences, work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	3	3	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO GENE (09 Periods)

DNA Structure and its types. Types of RNA and their functions. Organization of prokaryotic and eukaryotic DNA. DNA and RNA as genetic Material.

Types of genes - structural, constitutive, regulatory, clustered genes, jumping genes, overlapping genes.

Module 2: REPLICATION (09 Periods)

Replication of DNA: Bidirectional and unidirectional replication, Rolling circle Replication. Mode of Replication- Messelson and Stahl Experiments, Mechanism of DNA replication: Initiation – Ori C – elongation - Okazaki fragments, synthesis Termination – interaction between polymerase III and Ter sequence. Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends, inhibitors of DNA replication.

Module 3: TRANSCRIPTION (10 Periods)

Transcription - Definition, promoter - concept and strength of promoter. Prokaryotic and Eukaryotic Transcription. Transcriptional Machinery and Mechanism of transcription, post-transcriptional modification – Capping, polyadenylation and splicing. Inhibitors of transcription, Structure of ribosomes.

Module 4: TRANSLATION (07 Periods)

Translation - Genetic code, Translational machinery and translation mechanism, inhibitors of Translation, translational proof-reading, translational inhibitors, post-translational modification of proteins- glycosylation and phosphorylation.

Regulation of gene expression in bacteria - operon concepts - Negative and positive control of the Lac Operon, Trp Operon

Module 5: DNA DEMAGE AND ITS REPAIR (10 Periods)

Mutagens - Physical and Chemical mutagens

Mutations – Gene Mutation and chromosomal mutation, Somatic mutations and Germinal Mutations

Spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions.

Outlines of DNA damage and repair mechanisms

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 10 experiments shall be conducted)

LIST OF EXPERIMENTS

1. Study of different types of DNA and RNA using micrographs and model / schematic representations.
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from bacterial, plant and animal cells
4. Estimation of DNA using UV spectrophotometer.
5. Isolation of protein from yeast.
6. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
7. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS - PAGE).
8. Induction of mutations in bacteria by UV light.
9. Problems related to DNA and RNA characteristics.
10. Problems related to Transcription and Translation.
11. Instrumentation in molecular biology - Ultracentrifuge, Trans illuminator
12. Determination of melting temperature (Tm) of DNA

RESOURCES

TEXT BOOKS:

1. Strick Berger, M.W. (1967). Genetics. Oxford publisher & IBH, New Delhi.
2. Verma, P. S. and Agarwal, V. K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.
3. Ram Reddy, S., Venkateswarlu, K. and Krishna Reddy, V. (2007). A text Book of Molecular Biotechnology. Himalaya Publishers, Hyderabad.
4. Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.

REFERENCE BOOKS:

1. Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.
2. Lewin, B. (2000). Genes VIII. Oxford University Press, England.
3. Molecular Biology of the Gene - By Watson, Hopkins, Goberts, Steitz and Weiner (Pearson Education)
4. Maloy, S. R., Cronan, J.E. and Freifelder, D. (1994). Microbial Genetics, Jones and Bartlett Publishers, London.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc24_bt07/
2. https://onlinecourses.nptel.ac.in/noc21_bt02/

WEB RESOURCES:

1. https://drive.google.com/file/d/13wl_xG6yLuCqMMTrpuw6anAVgfZVDR0d/view
2. https://www.ncbi.nlm.nih.gov/CBBresearch/Przytycka/download/lectures/PCB_Lect03_Scoring_Matr_Motifs.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102013	**INORGANIC AND PHYSICAL CHEMISTRY**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on the chemistry of p, d and f block elements, colligative properties of solutions, liquid state, Solutions and applications of X-ray diffraction to study solids.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the advanced concepts of p, d and f block elements.

CO2. Study and analyze the properties and conductivity of metals.

CO3. Explain the colligative properties of solutions.

CO4. Identify and summarize the important feature of solutions.

CO5. Know basics and role of X-ray diffraction to study solids.

CO6. Work independently and in teams to solve problems with effective communications

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	2	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	3
CO4	3	1	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	1	-	-	-	-	2	-	-	-
CO6	-	-	-	-	-	-	3	3	-	-	-	-
Course Correlation Mapping	**3**	**1**	**2**	**1**	**-**	**-**	**3**	**3**	2	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CHEMISTRY OF p-BLOCK ELEMENTS **(08 Periods)**

Group 13: Synthesis and structure of diborane and higher Boranes (B_4H_{10} and B_5H_9), Boron nitrogen compounds ($B_3N_3H_6$ and BN), Lewis acid nature of BX_3
Group 14: Preparation, classification and uses of silicones.
Group 15: Nitrides –Classification –ionic, covalent and interstitial. Reactivity–hydrolysis. Preparation and reactions of hydrazine, hydroxyl amine, phosphazenes.
Group 16: Oxides and Oxoacids of Sulphur (structures only).
Group 17: Pseudohalogens, Structures of Interhalogen compounds.

Module 2: CHEMISTRY OF d AND f -BLOCK ELEMENTS **(10 Periods)**

D-block Elements: Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states.

F-block Elements: Chemistry of lanthanides - electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties. Chemistry of actinides - electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides.

Module 3: COLLIGATIVE PROPERTIES **(08 Periods)**

Colligative properties. Raoult's law, relative lowering of vapour pressure, its relation to molecular weight of non-volatile solute. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods of determination. Osmosis, osmotic pressure, experimental determination. Determination of molecular weight of non-volatile solute from osmotic pressure. Abnormal colligative properties.

Module 4: LIQUIDSTATE AND SOLUTIONS **(10 Periods)**

Liquid State: Structural differences between solids, liquids and gases. Liquid crystals, Classification of liquid crystals, Properties of Liquid crystals, Application of liquid crystals.

Solutions: ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Azeotropes-HCl-H_2O, ethanol-water systems, partially miscible liquids-phenol-water, Effect of impurity on consulate temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

Module 5: SOLID STATE **(09 Periods)**

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law. Defects in crystals.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:(Minimum 10 exercises shall be conducted)

Qualitative inorganic analysis
Analysis of mixture salt containing two anions and two cations (From two different groups) from the following.

Anions:	**Cations:**
Carbonate	Lead
Sulphate	Copper
Chloride	Iron
Bromide	Aluminum
Acetate	Zinc
Nitrate	Manganese
Borate	Calcium
Phosphate	Strontium
	Barium
	Potassium
	Ammonium

A student has to identify two cations and two anions from the mixture selected by the faculty on the given day.

RESOURCES

TEXT BOOKS:

1. Madan Malik Tuli, Text Book of Inorganic Chemistry, 4th Edition, S. Chand & Company, New Delhi, 2018
2. Samuel Glasstone, Text book of Physical Chemistry, 2nd Edition, D. Van Nostrand company, inc., 1940.

REFERENCE BOOKS:

1. J.E. Huheey, Inorganic Chemistry, 2nd Edition, McGraw Hill, 2015.
2. Bahl and Tuli, Advanced physical chemistry, 28th Edition, s chand publishers, 2020.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Nmp6APGBtz0
2. https://youtu.be/ALAaALyxayM

WEB RESOURCES:

1. https://books.google.co.in/books?id=UOV9_MJH7w8C&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. https://www.ebooknetworking.net/ebooks/inorganic-chemistry-malik-madan-tuli.html
3. https://www.sciencedirect.com/book/9780120442621/a-textbook-of-physical-chemistry
4. https://chemistryhall.com/best-physical-chemistry-textbook/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102014	BASIC ORGANIC CHEMISTRY	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on basis of organic chemistry alkanes, cycloalkanes, alkenes and alkynes. Benzene and its reactivity. Surface chemistry and electrochemistry of organic compounds.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Recall and apply the basic concepts of nomenclature, classification and basic properties of organic compounds.

CO2. Understand and explain differential behaviour organic compound based on the fundamental concepts learnt.

CO3. Formulate and identify the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants learnt.

CO4. Describe the concept of aromaticity, molecular structure of benzene based on modern concepts. Ring activating and deactivating groups.

CO5. Correlate and explain stereo chemical properties of organic compounds and configurations.

CO6. Develops independent working ability, through problem solving and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	1	-	-	-	-	-	-	3
CO3	3	1	-	-	1	-	-	-	-	-	-	3
CO4	2	1	-	-	1	-	-	-	-	-	-	3
CO5	2	2	-	-	-	-	-	-	-	-	-	3
CO6	3	-	1	1	1	2	2	1	1	-	-	3
Course Correlation Mapping	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	1	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NOMENCLATURE, CLASSIFICATION AND BASIC PROPERTIES (09 Periods)

Trivial, IUPAC nomenclature, Classification, Geometry of molecules, Hybridization. Cleavage of bonds: homolytic and heterolytic cleavages. Inductive, mesomeric, resonance, hyperconjugation and steric effects. Tautomerism: Definition, keto-enol tautomerism. Stability of reaction intermediates, carbocation, carbanion, and free radicals.

Module 2: ALKANES AND CYCLOALKANES (08 Periods)

Alkanes: General methods of preparation of alkanes Wurtz, Wurtz-Fitting and Corey-House reaction. Physical and chemical properties of alkanes, isomerism and its effects on properties. Free radical substitution, Halogenation, concept of reactivity v/s selectivity.

Cycloalkanes: Nomenclature, Preparation by Freund's method, Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformations of cyclohexane with energy diagram.

Module 3: ALKENES AND ALKYNES (10 Periods)

Alkenes: General methods of preparation, physical and chemical properties.

Reaction Mechanisms: Elimination (E1, E2, E1Cb, Hoffmann and Saytzeff), electrophilic addition (Markownikoff's/Anti-Markownikoff), Free radical addition, addition of hydrogen, halogen, hydrogen halide (Markownikoff's rule), hydrogen bromide (peroxide effect). Hydroboration, ozonolysis, hydroxylation.

Dienes: Stability of dienes (conjugated, isolated and cumulative dienes)

General methods of preparation, mechanism of dehydrohalogenation.

Reactions: Mechanism of 1, 2- and 1,4-additions, Diels-Alder reactions.

Alkynes: Preparation: Mechanism of dehydrohalogenation and dehydrogenation.

Reactions: Acidity of alkynes, Mechanism of addition of water, hydrogen halides and halogens, oxidation, ozonolysis and hydroboration/oxidation.

Module 4: BENZENE AND ITS REACTIVITY (08 Periods)

Concept of aromaticity - aromaticity (definition), Huckel's rule – application to Benzenoid (Benzene, Naphthalene) and Non-Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation), Molecular structure of Benzene based on modern concepts (VBT and MOT).

Reactions: Mechanism of nitration, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution-Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens.

Module 5: STEREOCHEMISTRY OF CARBON COMPOUNDS (10 Periods)

Optical isomerism: Optical activity-wave nature of light, plane polarized light, optical rotation and specific rotation.

Chiral molecules-definition and criteria (Symmetry elements)-Definition of enantiomers and diastereomers–Explanation of optical isomerism with examples Glyceraldehyde, Lactic acid, Alanine, Tartaric acid, 2, 3-dibromopentane.

D, L and R, S configuration methods and E, Z- configuration with examples.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:(Minimum 10 exercises shall be conducted)

ORGANIC QUALITATIVE ANALYSIS

1. Determination of melting and boiling points of organic substances.

2. Analysis of Organic compounds:
   a. Identification of acidic, basic, phenolic, and neutral organic substances.
   b. Detection of N, S and halogens.
   c. Test for aliphatic and aromatic nature of substances.
   d. Test for saturation and unsaturation.
   e. Identification of functional groups:
   i) Carboxylic acids ii) Phenols iii) Aldehydes iv) Ketones v) Esters
   vi) Carbohydrates vii) Amines viii) Amides ix) Halogen compounds
   f. Preparation of derivatives for the functional groups

RESOURCES

TEXT BOOKS:

1. R.P. Goyal, Unified Chemistry-1, Shivalal Agarwala & Company, New Delhi, 8th edition, 2015.
2. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry, Pearson Education, London, 5th edition, 2005.

REFERENCE BOOKS:

1. Jerry March, Advanced Organic Chemistry, John Wiley and Sons, New York, 4th Edition, 1992.
2. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, Wiley Eastern Ltd, New Delhi, 2nd edition, 1993.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/101/104101115/
2. https://archive.nptel.ac.in/courses/104/106/104106127/
3. https://www.youtube.com/watch?v=nDV5yWfHKko

WEB RESOURCES:

1. https://www.vedantu.com/chemistry/benzene-reactions
2. https://www.angelo.edu/faculty/kboudrea/organic/IUPAC_Handout.pdf
3. https://www.vanderbilt.edu/AnS/Chemistry/Rizzo/chem220a/Ch3slides.pdf
4. https://faculty.ksu.edu.sa/sites/default/files/vogel_-_practical_organic_chemistry_5th_edition.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102015	ADVANCED CHEMISTRY-I	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on heterocyclic compounds, nitrogen containing functional groups, photochemistry, electrochemistry, and chemical kinetics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the preparation, properties and reactivity of heterocyclic compounds**.**

CO2. Design the synthesis of new nitrogen containing functional groups.

CO3. Illustrate the laws of photochemistry and photochemical reaction mechanism.

CO4. Understand the advanced concepts of electro chemistry and its applications.

CO5. Explain kinetics of a chemical reactions and factors influences chemical reactions.

CO6. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	1	-	-	-	-	-	-	-	-	-	3
CO6	1	-	-	-	-	-	3	2	1	-	-	1
Course Correlation Mapping	**3**	**1**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: HETEROCYCLIC COMPOUNDS (09 Periods)

Introduction, Classification, systematic method of nomenclature, structure and aromaticity of pyrrole, furan, thiophene and pyridine, Methods of preparation and chemical reactions- pyrrole, furan, thiophene and pyridine, applications of the heterocyclic compounds

Module 2: NITROGEN CONTAINING FUNCTIONAL GROUPS (09 Periods)

Introduction, Nomenclature, Classification into 1°, 2°, 3° Amines and Quaternary ammonium compounds. Preparation methods**-**Ammonolysis of alkyl halides, Gabriel synthesis, Hoffman's bromamide reaction. Chemical properties- Alkylation, Acylation, Carbylamine reaction, Hinsberg reaction, Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophilic substitution of Aromatic amines–Bromination and Nitration. Oxidation of aryl and Tertiary amines, Diazotization.

Diazonium Salts-Preparation and their Synthetic applications.

Module 3: PHOTOCHEMISTRY (09 Periods)

Difference between thermal and photochemical processes. Laws of photochemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen-chlorine, hydrogen-bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized reactions- energy transfer processes (simple example)

Module 4: ELECTROCHEMISTRY (09 Periods)

Specific conductance, equivalent conductance, Variation of equivalent conductance with dilution, Migration of ions, Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, Ostwald's dilution law, Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorf’s method, Conduct metric titrations, Fuel cell-H_2-O_2 and Solid oxide fuel cell.

Module 5: CHEMICAL KINETICS (09 Periods)

Rate of reaction-Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES: Minimum 10 exercises have to be done

Organic Qualitative Analysis: Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives.

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic Primary Amines, Amides and Simple sugars.

RESOURCES

TEXT BOOKS:

1. I. L. Finar, A Text Book of Organic chemistry, Vol I., 4th edition, Pearson publications, 2015.
2. Bahl and Arun Bahl, A Text Book of Organic Chemistry, Chand publications-India, 1997.
3. P. Atkins, J. de Paula and J. Keeler, Atkin's Physical Chemistry, 11th edition Oxford University Press, 2018.

REFERENCE BOOKS:

1. G. Mare loudan, Organic Chemistry, 5th Edition, Purdue University, 2009.
2. B.S. Bahl, G. D. Tuli and Arun Bahl, Essentials of Physical Chemistry, 28th Edition, S. Chand & Company Ltd, 2020.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/105/104105034/
2. https://archive.nptel.ac.in/courses/104/106/104106077/
3. https://archive.nptel.ac.in/courses/104/106/104106132/
4. https://archive.nptel.ac.in/courses/104/101/104101128/

WEB RESOURCES:

1. https://byjus.com/chemistry/heterocyclic-compound/
2. https://www2.chem.wisc.edu/areas/reich/handouts/chem343-345/nitrogen-functional-groups.pdf
3. http://photobiology.info/Photochem.html
4. http://vazecollege.net/wp-content/uploads/2016/08/ggp-sybsc_electrochemistry_10feb14.pdf
5. https://www.vssut.ac.in/lecture_notes/lecture1425072667.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS102016	**ADVANCED CHEMISTRY-II**	3	-	3	-	4.5

Pre-Requisite Advanced Chemistry-I

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on organometallic compounds, metallurgy, phase equilibria, electrochemical analytical methods and green synthesis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Use the organometallic reagents for the synthesis of organic compounds

CO2. Apply the new techniques in the process of metallurgy.

CO3. Explain the phase equilibria and eutectic mixtures in the real word applications.

CO4. Understand and apply the concept of electrochemical method of analysis.

CO5. Design alternate green synthesis to conventional synthesis.

CO6. Develops independent working ability, through problem solving and effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	1	-	-	3	-	-	-	-	-	-	3
CO6	2	-	-	-	-	-	3	2	1	-	-	1
Course Correlation Mapping	**3**	**1**	**-**	**-**	**3**	**-**	**3**	**2**	**1**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ORGANOMETALLIC COMPOUNDS (09 Periods)

Introduction, Grignard reagent preparation and uses – Synthetic applications: Conversion of methyl magnesium iodide to primary, secondary and tertiary alcohols, ethanoic acid ethanol, propanone and ethanamine. Monocarboxylic acids and their simple derivatives descriptive studies of dicarboxylic acids, viz. malic, oxalic, tartaric, maleic, General methods of preparation of aliphatic aldehydes and ketones keto-enol tautomerism; aceto-acetic ester and malonic ester.

Synthetic applications – preparation of higher alkanes.

Advancement in the applications of Organometallic Compounds in Health Care Industry.

Module 2: METALLURGY (09 Periods)

Introduction to isolation/separation of metals, Ellingham's diagram: principle, salient features, Curves corresponding to formation of CO, CO_2 and oxides of Cr, Al, Mg, Ca, Hg& Ag. Applications with reference to selection of reducing agents using carbon for ZnO and Al for Cr_2O_3.

Extraction of Nickel from pentlandite ore Thorium from monazite sand and Uranium from pitch blende.

Power metallurgy: Advantages of powder metallurgy and its applications, methods of production of metal powders. Production of Tungsten powder from Wolframite.

Module 3: PHASE EQULIBRIA (09 Periods)

Introduction and Concept of phase, components, degrees of freedom. Thermodynamic Derivation of Gibbs phase rule – Derivation of Clausius – Clapeyron equation and its importance in phase equilibria.

Phase equilibrium of one component system (water and sulphur) and two component system, solid-liquid equilibrium. Simple eutectic diagram of Pb-Ag system, simple eutectic diagram, desilverisation of lead, NaCl-Water system and Freezing mixtures.

Recent Concepts in phase equilibria application.

Module 4: ELECTROCHEMICAL ANALYTICAL METHODS (09 Periods)

Introduction, Circuit diagram of simple potentiometer – Indicator electrodes- hydrogen electrode, quinhydrone electrode, antimony electrode and glass electrode. Reference electrodes- Calomel electrode, Ag/AgCl electrode.

Theory of potentiometric titrations, Acid-base, redox, precipitation and complexometric titrations.

Module 5: GREEN SYNTHESIS (09 Periods)

Introduction, Green synthesis of adipic acid, catechol, disodium imino di acetate (alternative Strecker's synthesis); Microwave assisted reaction in water – Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols – microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction. Ultrasound assisted reactions – Simmons –Smith reaction.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES: Minimum 10 exercises have to be done

1. **Preparation of Complexes:** (i) tetramine copper (II) sulphate (ii) potassium trioxalatoferrate (III)
   Determination of their conductance and comparison with simple salts like $MgCl_2$, $AlCl_3$, etc.
   Preparation of buffers and determination of pH values of fresh fruit juices using pH meter
2. **Determination of system:** (i) Potentiometric titration using electrodes
   (ii) Determination of miscibility temperature of phenol-water system
   (ii) Phase diagram of a simple eutectic system and determination of unknown composition.
   (iii) Determination of pH of buffer solution and unknown solution
   (iv) Conductometric titrations: (a) Strong Acid-Strong base and (b) Weak acid–strong base

RESOURCES

TEXT BOOKS:

1. B.S. Bahl, G. D. Tuli and Arun Bahl, Essentials of Physical Chemistry, 28thEdition, S. Chand & Company Ltd, 2020.
2. S.M. Mukherjee and S.P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, Macmillan India Ltd., New Delhi.

REFERENCE BOOKS:

1. G. Mare loudan, Organic Chemistry, 5thEdition, Purdue University, 2009.
2. Morrison Boyd, Organic Chemistry, 7thEdition, Printice Hall of India, New Delhi, 2015.
3. P. Atkins, J. de Paula and J. Keeler, Atkin's Physical Chemistry, 11th edition Oxford University Press, 2018.
4. Anastas, P.T. & Warner J.K., Green Chemistry –Theory and Practical, Oxford University Press 1998
5. I. L. Finar, A Text Book of Organic chemistry, Vol I., 4th edition, Pearson publications, 2015.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/101/104101079/
2. https://archive.nptel.ac.in/courses/113/106/113106105/
3. https://www.youtube.com/watch?v=o6LvdHU8hKI
4. https://archive.nptel.ac.in/courses/104/106/104106137/
5. https://archive.nptel.ac.in/courses/112/104/112104225/

WEB RESOURCES:

1. https://www.vedantu.com/chemistry/organometallic-compounds
2. https://archive.nptel.ac.in/courses/113/104/113104005/
3. https://archive.nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_07_m.pdf
4. https://www.sciencedirect.com/topics/engineering/electrochemical-method
5. https://asdlib.org/activelearningmaterials/files/2015/08/electrochemical_text.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101012	TRANSITION ELEMENTS AND NUCLEAR CHEMISTRY	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on transition elements, Lanthanides and Actinides, Coordination chemistry, Nucleus and radiochemistry and nuclear reactions

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Understand the tendency of transition metals to exhibit variable valency.
CO2. Familiar with the basic concepts of coordination chemistry and early theory.
CO3. Predict the metal properties of metal complexes.
CO4. Know the occurrence of lanthanides and actinides in nature and their uses.
CO5. Know the importance of nuclear reactions in the modern world.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	1	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	**3**	**1**	**-**	**-**	-	-	-	-	-	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: TRANSITION ELEMENTS (09 Periods)

Overview of the abundance and occurrence of transition metals; reactivity and passive behavior-reactivity toward oxygen, water, halogens; standard reduction potentials; important uses of transition metals and their alloys; differences between the first and the other rows, horizontal comparison with Fe, Co, Ni groups; toxicity of Cd and Hg. Variable oxidation states, catalytic properties. M-M bonding and cluster compounds; oxides, mixed oxides, halides, and oxohalides of transition metals; Biological importance of transition metals: biological roles of Cr, Mo, Mn, Fe, Co, Cu, Zn (mention of metal containing proteins and enzymes and their biological roles).

Module 2: COORDINATION CHEMISTRY (08 Periods)

IUPAC nomenclature - bonding theories - Review of Werner's theory and Sidgwick's concept of coordination - Valence bond theory - geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory - splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes - low spin and high spin complexes - factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds - structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

Module 3: PROPERTIES OF METAL COMPLEXES (10 Periods)

Spectral and magnetic properties- Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility-Gouy method.

Stability of metal complexes- Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

Module 4: NUCLEUS AND RADIOCHEMISTRY (09 Periods)

The nucleus: subatomic particles, structure of the nucleus-shell model, liquid drop model; forces in the nucleus-mesons; stability of nucleus-n/p ratio, binding energy; radioactive elements Radiochemistry: natural and induced radioactivity; radioactive decay-a-decay, b-decay, g-decay; neutron emission, positron emission, electron capture; unit of radioactivity (Curie); half-life period; Geiger-Nuttal rule, radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger counters, scintillation counters.

Module 5: NUCLEAR REACTIONS (09 Periods)

Nuclear reactions: types of nuclear reactions, nuclear cross section, spallation, nuclear fission-theory of nuclear fission; chain reaction, critical mass; nuclear reactors-fast breeder reactors, fuels used in nuclear reactors, separation of isotopes, moderators, coolants; nuclear fusion; Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labeling studies, nuclear medicine-99mTc

Total Periods: 45

EXPERIENTIAL LEARNING

1. The natural occurrence and ores of transition metals.
2. The common and stable oxidation states of transition metals.
3. The minerals of lanthanides and actinides and their occurrence in India.
4. The electronic configurations of lanthanides and their positions in the periodic table.
5. Survey of common monodentate and bidentate ligands.

6. Illustration of the failure of EAN rule and the limitations of VB theory with examples.
7. Radioactive isotopes and their applications
8. Chernobyl and Fukushima Daichi nuclear disasters

RESOURCES

TEXT BOOKS:

1. J. D. Lee, Concise Inorganic Chemistry, 5th ed., Blackwell Science, London, 1996.
2. H. J. Arnikar, Essentials of Nuclear Chemistry, 4th ed., New Age International, New Delhi, 1995

REFERENCE BOOKS:

1. F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman, Advanced Inorganic Chemistry, 6th ed., John Wiley, New York, 1999.
2. J. E. Huheey, E. A. Kieter and R. L. Keiter, Inorganic Chemistry, 4th ed., Harper Collins, New York, 1993.
3. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., Delhi, 1996.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/101/104101136/
2. https://archive.nptel.ac.in/courses/104/105/104105085/
3. https://archive.nptel.ac.in/courses/104/101/104101137/
4. https://archive.nptel.ac.in/courses/112/103/112103243/

WEB RESOURCES:

1. https://chem.libretexts.org/Bookshelves/General_Chemistry/Chemistry_-_Atoms_First_1e_(OpenSTAX)/19%3A_Transition_Metals_and_Coordination_Chemistry/19.2%3A_Coordination_Chemistry_of_Transition_Metals
2. https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/6.14/primary/lesson/lanthanides-and-actinides-chem/
3. https://archive.nptel.ac.in/courses/104/106/104106064/
4. https://archive.nptel.ac.in/courses/103/106/103106071/
5. https://archive.nptel.ac.in/courses/103/106/103106101/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101013	**PHASE EQUILIBRIA AND KINETICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Phase Equilibria, Colligative Properties of solutions, Chemical kinetics- kinetic parameters, Types and theories of chemical reaction rates, Catalysis

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the effect of pressure and temperature on phase equilibrium.
CO2. Know the relation between collegiate properties and molecular weight of solutes.
CO3. Relate the rates of chemical reactions under different physical parameters.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	-	-	-	-	-	-	-	3
CO3	3	1	-	-	-	-	-	-	1	-	-	2
Course Correlation Mapping	**3**	**1**	**-**	**-**	-	-	-	-	**1**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PHASE EQUILIBRIA (09 Periods)

Phase Rule: Concepts of phase, component and degrees of freedom, with examples. Gibb's phase rule – derivation. Clapeyron and Clausius-Clapeyron equations and their applications to equilibria in phase transitions. (solid – liquid, liquid – vapour, solid – vapour) One-component system: Phase diagrams: Water and sulphur systems. Two component system: (i) Simple eutectic: Lead-silver system. (ii) Formation of compound with congruent melting point: Ferric chloride – water system. Three component systems: General account of graphical representation of three component systems, examples of three component systems having one, two partially miscible pairs.

Module 2: COLLIGATIVE PROPERTIES OF SOLUTIONS (10 Periods)

Ideal solutions: Vapour pressure- Composition diagrams of solutions. Raoults law, positive and negative deviations from the law. Principle of fractional distillation: Binary systems. Vapour diagram and azeotropic distillation, partially miscible binary systems (CST-UCST, LCST, and both UCST and LCST). Effect of addition of solute on CST. Steam distillation. Solubility of gases in liquids; Henry's law, its relationship with Raoults law.

Lowering of vapour pressure: Thermodynamics derivation for elevation of boiling point and depression of freezing point. Relationship between osmotic pressure and V.P. VantHoff's theory of dilute solutions. Analogy between solute particles and gas molecules. Distribution law: Thermodynamic derivation; limitation of the law, application in studying association, dissociation and solvation. Study of formation of complex ions. Extraction with solvents; efficiency of extraction.

Module 3: CHEMICAL KINETICS- KINETIC PARAMETERS (08 Periods)

Rate, order, rate law, rate constants. Simple reactions involving zero, first, second and third– order reactions. Derivation of rate equations for zero, first and second order reactions. Pseudo-first – order reactions. Determinations of rate, rate constant and order by different methods. Simple mechanisms and molecularity of reactions (SN1 and SN2).

Module 4: TYPES AND THEORIES OF CHEMICAL REACTION RATES (09 Periods)

Factors affecting chemical reactions – nature of reactants, concentration, catalyst, solvent polarity and ionic strength (only qualitative ideas). Arrhenius theory of chemical reaction rates. Collision theory of bimolecular and unimolecular reactions. Lindemann hypothesis. Transition state or absolute reaction rate theory (ARRT) (no derivation expected).

Module 5: CATALYSIS (09 Periods)

Homogeneous catalysis- Reactions in gases and in solutions (Acid, base and Wilkinson's catalysts). Kinetics of enzyme catalysis: Michaelis Menton equation. Factors affecting enzyme catalysis

Heterogeneous catalysis-Langmuir adsorption isotherm. Its application to slightly, strongly, and moderately adsorbed systems. Theory of heterogeneous catalysis on the basis of Langmuir adsorption-Uni- and bimolecular reactions on solid surfaces.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Formation of compound with incongruent melting point.
2. Determination of molecular weight by Cottrell's, Beckmann's and Berkeley and Hartley method.
3. Study of kinetics of pseudo-first-order reactions – acid and base catalyzed hydrolysis of ester and inversion of cane sugar.
4. Comparison of thermal and photochemical chain reactions.
5. Enzyme catalysis in biological systems.

RESOURCES

TEXT BOOKS:

1. B.R. Puri and L.R. Sharma, Principles of physical chemistry, Shoban Lal Nagin Chand and Co. 33rd edition, 1992.
2. S.H. Maron and J.B. Lando, Fundamentals of physical chemistry, Macmillan limited, New York, 1966.

REFERENCE BOOKS:

1. S.K. Dogra and S. Dogra, Physical chemistry through problems, New age international, 4th edition 1996.
2. P.W. Atkins, Physical chemistry, Oxford university press, 1978.
3. K. L. Kapoor, A textbook of Physical chemistry, (volume-2 and 3) Macmillan, India Ltd, 1994.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/112/104/112104248/
2. https://archive.nptel.ac.in/courses/103/104/103104129/
3. https://www.youtube.com/watch?v=SfKVX2K9u88
4. https://www.youtube.com/watch?v=W8FhlGNnMkg
5. https://www.youtube.com/watch?v=o6LvdHU8hKI

WEB RESOURCES:

1. https://opengeology.org/petrology/8-igneous-phase-diagrams-and-phase-equilibria/
2. https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch15/colligative.php
3. https://www.britannica.com/science/chemical-kinetics/Some-kinetic-principles
4. https://www.sciencedirect.com/science/article/abs/pii/S0896844608003483
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9620980/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101014	**BASICS OF POLYMER CHEMISTRY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to polymer, kinetics and mechanism for polymerization, techniques of polymerization and polymer degradation, industrial polymers, introduction to polymer processing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Get an exposure to polymer science.
CO2. Know the mechanism and techniques in polymerization.
CO3. Understand the industrial importance polymers and polymer processing.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	-	-	-	-	-	-	-	3
CO3	3	1	-	-	-	-	-	-	-	-	-	2
Course Correlation Mapping	**3**	**1**	**-**	**-**	-	-	-	-	**-**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO POLYMER (09 Periods)

Monomers, Oligomers, Polymers and their characteristics
Classification of polymers: Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers
Bonding in polymers: Primary and secondary bond forces in polymers; cohesive energy and decomposition of polymers. Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers and determination by (i) viscosity (ii)Light scattering method (iii) Gel Permeation Chromatography (iv) osmometry and ultracentrifuging.

Module 2: KINETICS AND MECHANISM FOR POLYMERIZATION (09 Periods)

Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular Polymers, Ziegler Natta polymers. Polycondensation-non catalyzed, acid catalyzed polymerization, molecular weight distribution, Step growth polymers

Module 3: CRYSTALLIZATION, CRYSTALLINITY AND DEGRADATION (08 Periods)

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers.

Module 4: INDUSTRIAL POLYMERS (10 Periods)

Raw material, preparation, fibre forming polymers, elastomeric material.
Thermoplastics: Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester.
Thermosetting Plastics: Phenol formaldehyde and epoxide resin Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene.

Module 5: INTRODUCTION TO POLYMER PROCESSING (09 Periods)

Compounding: Polymer Additives: Fillers, Plasticizers antioxidants and thermal stabilizers fire retardants and colourants.
Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding, extrusion moulding and reinforcing.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Molecular weight determination of high polymers by different methods.
2. Conducting Polymer and their engineering applications.
3. Solid and gas phase polymerization.
4. Poly methyl methacrylate, polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropylene glycols.
5. Film casting, Thermoforming, Foaming.

RESOURCES

TEXT BOOKS:

1. V.R. Gowariker, Polymer Science, Wiley Eastern, 1995.
2. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Limited, 1996.

REFERENCE BOOKS:

1. F. N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971.
2. A. Kumar and S. K. Gupta, Fundamentals and Polymer Science and Engineering, Tata McGraw-Hill, 1978.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/105/104105124/
2. https://archive.nptel.ac.in/courses/104/105/104105039/

WEB RESOURCES:

1. https://www.eng.uc.edu/~beaucag/Classes/Properties/Books/Paul%20C.%20Hiemenz%20-%20Polymer%20chemistry_%20the%20basic%20concepts-M.%20Dekker%20(1984).pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25BS101015	COORDINATION CHEMISTRY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Theory of Coordination Compounds, Reaction Mechanisms in Coordination compounds, Synthesis of Coordination Compounds, Organometallic Compounds and Catalysis, Inorganic Biochemistry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the nature of bonding in coordination compounds.

CO2. Know the importance and application of coordination compounds in industry and in medicine.

CO3. Study the active roles played by metal ions and coordination compounds in biological systems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	2
Course Correlation Mapping	**3**	**-**	**-**	**-**	-	-	-	-	**-**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: THEORY OF COORDINATION COMPOUNDS (09 Periods)

Crystal field splitting of transition metal ions in tetrahedral and octahedral fields. Jahn Teller theorem, crystal field splitting in tetragonally distorted octahedral geometry, and in square planar geometry. Covalency in transition metal complexes: evidences for covalency-intensity of d-d transitions, spin-spin splitting, hyperfine splitting, adjusted crystal field theory MO Theory: Metal orbitals and LGOs suitable for σ and ∏bonding in octahedral geometry, construction of qualitative MO energy level diagram for σ bonding in octahedral geometry.

Module 2: REACTION MECHANISMS IN COORDINATION COMPOUNDS (10 Periods)

Substitution reactions in octahedral complexes: dissociative and associative and interchange mechanisms.

Electron transfer reactions: inner-sphere and outer-sphere mechanisms, noncomplementary electron transfer reactions.

Inorganic photochemistry: principles, photo substitution, photoisomerization, and photo redox reactions. Substitution reactions in square complexes: dissociative and associative mechanisms.

Module 3: SYNTHESIS OF COORDINATION COMPOUNDS (08 Periods)

Cis- and trans-effects in synthesis of square planar and octahedral complexes. Metal template synthesis-metal phthalocyanins and Schiff bases

Module 4: ORGANOMETALLIC COMPOUNDS AND CATALYSIS (09 Periods)

Nomenclature of organometallic compounds, 16- and 18-electron rule.

Structure and bonding in transition metal carbonyls: polynuclear carbonyls, bridging and terminal carbonyls, transition metal alkyls, carbenes, and carbynes, and metallocenes. Wilkinson's catalyst and alkene hydrogenation, hydroformylation, Monsanto acetic acid process, Ziegler-Natta catalyst and polymerization of olefins.

Module 5: BIOINORGANIC CHEMISTRY (09 Periods)

Metal ions present in biological systems, classification of elements according to their action in biological system. Na/K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Hemoglobin and myoglobin. Inorganic medicinal chemistry-radiopharmaceuticals, chelate therapy, and contrast agents in MRI.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Synthesis and properties of metal carbonyls, bridging and terminal carbonyls, metal alkyls, carbenes, and carbynes, and metallocenes.
2. Essential and trace elements in biological systems.
3. IUPAC nomenclature of coordination compounds.
4. Role of chemistry in human biological system.

RESOURCES

TEXT BOOKS:

1. Huheey, J. E.; Keiter, E. A.; Keiter, R. L. Inorganic Chemistry, Principles of Structure and Reactivity, 4thed., Harper Collins, 1993.
2. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. Advanced Inorganic Chemistry, 6th ed., John Wiley, 1999.

REFERENCE BOOKS:

1. Shriver, D. F.; Atkins, P. W.; Langford, C. H. Inorganic Chemistry, 3rded., Oxford University Press, 2000.
2. Tobe, M. L.; Burgess, J. Inorganic Reaction Mechanisms, Addison Wesley Longman, 1999.
3. Basalo, F.; Pearson, Inorganic Reaction Mechanisms, 2nd ed., Wiley Interscience, 1969.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=REJPwUQDjxA
2. https://www.youtube.com/watch?v=2mRNr8vcj-I

WEB RESOURCES:

1. https://www.britannica.com/science/coordination-compound
2. https://www.geo.utexas.edu/courses/376m/coord_chem.htm

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101016	WORKING WITH A SINGLE DNA SEQUENCE	3	-	-	-	3

Pre-Requisite Introduction to Bioinformatics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to DNA sequencing and data retrieval, sequence analysis and annotation, phylogenetic analysis and evolutionary relationships and Genome organization and analysis tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Explain the basic concepts of DNA sequence and its organization.

CO2. Gain knowledge on Clean and pre-process raw DNA sequence data using quality control tools. Perform basic sequence analysis tasks like finding genes, open reading frames, and regulatory elements. Utilize BLAST and other similarity search tools to identify homologs and functional annotations.

CO3. Perform phylogenetic analysis to infer evolutionary relationships.

CO4. Analyze sequence variations and identify potential mutations and polymorphisms. Apply advanced computational tools for specific analyses (e.g., RNA-seq analysis, motif discovery).

CO5. Identify Genes in Genomes and analyze Genomes for understanding gene organization.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO DNA SEQUENCING AND DATA RETRIEVAL (09 Periods)

Introduction to DNA structure and function, Overview of DNA sequencing technologies (Illumina, Sanger, PacBio), Public DNA sequence databases (NCBI GenBank, ENA) and data access tools, Downloading and preparing DNA sequence data for analysis, Introduction to basic bioinformatics concepts and tools.

Module 2: SEQUENCE ANALYSIS AND ANNOTATION (10 Periods)

Gene identification and annotation tools (Gene Marks, Prodigal), Finding open reading frames (ORFs) and predicting protein sequences, identifying regulatory elements and promoters (MEME, FIMO), Functional annotation using BLAST and other similarity search tools, Introduction to variant calling and analysis (GATK).

Module 3: PHYLOGENETIC ANALYSIS AND EVOLUTIONARY RELATIONSHIPS (08 Periods)

Principles of phylogenetic analysis and tree construction, Multiple sequence alignment tools (Clustal Omega, MAFFT), Phylogenetic tree inference methods (maximum likelihood, parsimony), Interpreting phylogenetic trees and evolutionary relationships, molecular clock dating, ancestral sequence reconstruction

Module 4: ADVANCED TECHNIQUES AND ANALYSIS (08 Periods)

Introduction to RNA-seq data analysis (differential gene expression), Motif discovery and analysis (MEME, HOMER), Structural analysis of DNA sequences (prediction of RNA secondary structure), Exploring specialized tools and databases for specific research areas.

Module 5: GENOME ORGANIZATION AND ANALYSIS (10 Periods)

Definition and Scope of Genome organization, Structural components of Genomes, Chromosomes, Genome mapping methods, Physical mapping methods (FISH and BAC libraries), Genome based diagnostics, Genome editing in Cancer and genetic disorders. Basics of Microarray.

Total Periods: 45

EXPERIENTIAL LEARNING

List of Exercises

1. Perform BLAST search and interpret the results.
2. Prepare a phylogenetic tree with assigned sequences.
3. Analyze the organization of genes for given Genome sequence.
4. Deliver a seminar on recent advances in the DNA sequencing methods.
5. Write assignment on Comparative genomics and its role in the identification of Cancer.

RESOURCES

TEXT BOOKS:

1. T. A. Brown (2015), Genomes, Garland publishers.
2. D. W. Mount, (2004), Bioinformatics: Sequence and Genome analysis, Cold Spring harbor press publishers.
3. B. M. Lesk, (2017) Introduction to Bioinformatics, Oxford University Press.

REFERENCE BOOKS:

1. S. B. Primrose and R. Twyman, (2003), Principles of Genomes and Genome analysis, Wiley publishers.
2. M. Starkey and E. Ramnath, (2010), Genomic: Essential methods, John Wiley and Sons publishers.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=qOW5e4BgEa4
2. https://www.youtube.com/watch?v=ugjCwAsz2Ik
3. https://www.youtube.com/watch?v=MvuYATh7Y74

WEB RESOURCES:

1. https://egyankosh.ac.in/bitstream/123456789/35566/3/Unit-3.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS102017	**SEQUENCE ALIGNMENT AND SEQUENCE ANALYSIS**	3	-	2	-	4

Pre-Requisite Introduction to Bioinformatics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Nucleic acid sequences, Introduction to Protein sequences, Protein, DNA, RNA pairwise sequence alignments, Multiple sequence alignment and Phylogenetics. Also, hands-on experience on different basic tools used for sequence analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand nucleic acid sequencing methods and analysis of sequences.

CO2. Understand protein sequencing methods and analysis of sequence.

CO3. Identify Protein/DNA/RNA sequence alignment methods and their applications.

CO4. Gain knowledge on multiple sequence alignment and Phylogenetics.

CO5. Perform different programs to analyse biological sequences, work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	3	3	-	3	-	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO NUCLEOTIDE SEQUENCES (09 periods)

Introduction to sequence. Nucleotide sequence methods: Sanger's method, Maxam and Gilbert method, Whole genome sequencing methods, Next generation sequencing methods: Illumina and Roche methods. Basic concepts of Insertions, Deletion and Indels. Nucleotide sequence databases: DDBJ, EMBL and Genbank.

Module 2: INTRODUCTION TO PROTEIN SEQUENCES (09 periods)

Introduction to Protein sequence, three letter and single letter codes of amino acids, Amino acid sequencing methods: Sanger's method, Edman's method. Protein sequence databases: PIR, SPDBV and UniProt.

Module 3: PROTEIN/DNA/RNA PAIRWISE SEQUENCE ALIGNMENTS (09 periods)

Introduction to Pairwise sequence alignment, Comparison between Local and Global sequence alignment, Dot plot method, Dynamic programming methods: Needleman-Wunch and Waterman and Smith, Word or K-tuple methods: BLAST, BLAT and FASTA. Scoring Matrices: BLOSUM and PAM.

Module 4: MULTIPLE SEQUENCE ALIGNMENT (09 periods)

Introduction to Multiple sequence alignment, Different methods of Multiple sequence alignment, Programs used for Multiple sequence alignments, Multiple sequence alignments color editors, CINEMA.

Module 5: PHYLOGENETICS (09 periods)

History of Phylogenetic, Modern Phylogenetic methods, Construction of Phylogenetic trees, Different types of Phylogenetic trees. Importance of Phylogenetic trees in the study of Evolution. Programs used for Phylogenetic tree construction.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 10 experiments shall be conducted)

LIST OF EXPERIMENTS

1. List of sequence Databases.
2. Sequence visualization tools.
3. Conversion of sequence formats using different tools.
4. Pairwise sequence alignment methods BLAST.
5. Pairwise sequence alignment methods FASTA.
6. Multiple sequence alignment methods-CLUSTAL.
7. Multiple sequence alignment methods-TCOFFEE, MUSCLE etc.,
8. Generation of Phylogenetic tree-PHYLIP.
9. Structure alignment methods.
10. Analysis of Sequence alignment methods.
11. Analysis of Structures.

RESOURCES

TEXT BOOKS:

1. K. Nguyen, X. Guo and Y. Pan, Multiple Biological alignment, scoring functions, algorithms and applications, John Wiley and Sons publishers, 2016.
2. Orpita Bosu and S. K. Thukral, Bioinformatics, 1st edition, Oxford University press, 2007.
3. H. D. Ismail, Bioinformatics, 1stedition, Chapman and Hall/CRC, 2022.
4. M. S. Rosenberg, Sequence Alignment Methods, Models, Concepts and strategies, University of California press, 2009.

REFERENCE BOOKS:

1. David W Mount, Bioinformatics: Genome and sequence analysis, 2nd edition, CBS Publications, New Delhi, 2004.
2. S. A. Krawetz and D. D. Womble, Introduction to Bioinformatics,1st edition, Springer-Humana press, 2003.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/102/106/102106065/
2. https://www.digimat.in/nptel/courses/video/102106065/L15.html
3. hhttps://www.youtube.com/watch?v=vzOoLMCyG4w
4. https://www.youtube.com/watch?v=9EX_NjMseIs

WEB RESOURCES:

1. https://bip.weizmann.ac.il/education/course/introbioinfo/03/lect12/phylogenetics.pdf
2. https://archive.nptel.ac.in/courses/102/106/102106065/
3. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/1(7).pdf
4. https://www.ncbi.nlm.nih.gov/CBBresearch/Przytycka/download/lectures/PCB_Lect03_Scoring_Matr_Motifs.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101018	DRUG DESIGN	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to drug design, Target identification and validation, drug design methods, Pre-clinical and Clinical development and future directions in drug design.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Explain the fundamental principles of drug design.
CO2. Techniques Analyze and interpret drug-target interactions.
CO3. Apply various drug design methods.
CO4. Evaluate the challenges and ethical considerations in drug development.
CO5. Discuss the future directions of drug design.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO DRUG DESIGN (09 Periods)

History and importance of drug design, Drug discovery and development process, Key concepts: targets, leads, hits, ADME/Tox properties, Classification of drugs and drug design approaches, successful drugs and design challenges

Module 2: TARGET IDENTIFICATION AND VALIDATION (09 Periods)

Molecular targets for drug action (enzymes, receptors, etc.), Target validation methods and techniques, Computational approaches for target identification, target validation success stories and failures

Module 3: DRUG DESIGN METHODS (09 Periods)

Ligand-based drug design (LBDD), Structure-based drug design (SBDD), Virtual screening and docking techniques, High-throughput screening and fragment-based methods, drugs designed using different methods

Module 4: PRECLINICAL AND CLINICAL DEVELOPMENT (10 Periods)

Understanding drug absorption, distribution, metabolism, and excretion (ADME), Concepts of pharmacodynamics, Factors influencing drug response, ADME/Tox considerations in drug design, In vitro and in vivo testing methods, Regulatory requirements and approval process, Clinical trials and ethical considerations, challenges and failures in drug development.

Module 5: FUTURE DIRECTIONS IN DRUG DESIGN (08 Periods)

Personalized medicine and targeted therapies, Artificial intelligence and machine learning in drug design, Novel drug delivery systems and nanotechnology, promising new approaches in drug design

Total Periods: 45

EXPERIENTIAL LEARNING

List of Exercises

1. Search the drug databases and identify the drugs that have been withdrawn and prepare a report
2. Write assignment on novel approaches in drug design.
3. Prepare a report on how to obtain a FDA approval for new drugs.
4. Present seminars on pre-clinical and different phases in the Clinical trials.
5. Prepare report on recently designed drugs and success stories.

RESOURCES

TEXT BOOKS:

1. U. Nielsch, U. Fuhrmann and S. Jaroch, (2016) New approaches to drug discovery, 1st edition, Springer publications.
2. R. Kumar, A. Sharma and R. Kumar (2014), Introduction to Drug design and development, 1st edition, Nova science publishers Inc.
3. R. C Wade, O. M. H. Salo-Ahen, (2019), Molecular modelling in Drug Design, Mdpi AG publishers.

REFERENCE BOOKS:

1. R. P. Singh, K.R. B. Singh, J. Singh and C.O. Adetunji (2023) Nanotechnology for drug delivery and Pharmaceuticals, Academic Press publishers.
2. Branden, C., & Tooze, J. (1999). Introduction to Protein Structure. Garland Science.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=3Gl0gAcW8rw
2. https://www.youtube.com/watch?v=hEUj-ZcxkcM
3. https://www.youtube.com/watch?v=7p-FOgUiXSQ
4. https://www.youtube.com/watch?v=4mc-g-m_wSA

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/102/106/102106070/
2. http://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod15.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101021	BASICS OF COMPUTATIONAL MOLECULAR BIOLOGY	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to computational molecular biology, sequence analysis, structural bioinformatics, Principles of Systems Biology and Integration of Multi-OMICS data.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand different aspects of Computational Molecular Biology.
CO2. Identify different tools for sequence analysis.
CO3. Analyze Bio-molecule structures for understanding their function.
CO4. Gain knowledge on network analysis and biological pathways.
CO5. Discuss different sequence techniques and will understand the significance of those methods.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO COMPUTATIONAL MOLECULAR BIOLOGY (09 Periods)

Definition and scope of computational molecular biology, Historical development and milestones, Applications in biological research, Types of biological data (DNA, RNA, proteins, structures), Introduction to biological databases (GenBank, UniProt, PDB), Data formats and standards in bioinformatics, Basics of algorithms and data structures, Algorithmic techniques in bioinformatics, Applications of algorithms to biological problems

Module 2: SEQUENCE ANALYSIS (09 Periods)

Pairwise sequence alignment (Smith-Waterman, Needleman-Wunsch), Multiple sequence alignment (Clustal W, MUSCLE), Practical considerations in sequence alignment, BLAST (Basic Local Alignment Search Tool), Homology search and sequence similarity, Interpretation of search results, Introduction to HMMs, Applications in sequence analysis, Profile HMMs for motif discovery, Evolutionary significance of sequence conservation, Phylogenetic analysis and tree building, Identification of conserved motifs and functional elements

Module 3: STRUCTURAL BIOINFORMATICS (09 Periods)

Overview of protein structure prediction methods, Homology modeling and ab initio methods, Model evaluation and validation, Principles of molecular dynamics, Applications in simulating biomolecular systems, Analysis of simulation results, Ligand docking and virtual screening, Pharmacophore modeling, Integration of structural bioinformatics in drug discovery

Module 4: PRINCIPLES OF SYSTEMS BIOLOGY (10 Periods)

Systems-level understanding of biological processes, Network representation of biological systems, Role of feedback and feedforward loops, Construction of biological networks (protein-protein interaction, metabolic), Network analysis methods (centrality, clustering, motifs), Visualization and interpretation of biological networks, Pathway databases and resources, Enrichment analysis and functional annotation, Identification of key pathways in biological processes

Module 5: INTEGRATION OF MULTI-OMICS DATA (08 Periods)

Integration of genomics, transcriptomics, and proteomics data, Challenges and opportunities in multi-omics integration, Case studies in data integration, Principles of NGS technologies, Applications in genomics and transcriptomics, Data analysis pipelines for NGS data, Techniques in metabolomics, Functional genomics approaches (CRISPR, RNAi), Integration of metabolomics and functional genomics data

Total Periods: 45

EXPERIENTIAL LEARNING

List of Exercises

1. Search the different databases for Protein and Nucleic acid databases.
2. Write assignment on novel approaches in docking methods.
3. Prepare a report on different types of pathway databases.
4. Present seminars Next generation sequence methods.
5. Prepare report on Application of data integration techniques to biological datasets

RESOURCES

TEXT BOOKS:

1. Richard Durbin, Sean R. Eddy, Anders Krogh, and Graeme Mitchison (1998), Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids" Cambridge University Press publisher
2. Supratim Choudhuri, (2014) Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools" Academic Press publisher
3. David W. Mount, (2004) Bioinformatics: Sequence and Structural Analysis" Cold Spring Harbor Laboratory Press

REFERENCE BOOKS:

1. Arthur M. Lesk (2019) Introduction to Protein Science: Architecture, Function, and Genomics, Oxford University Press.
2. Mark E. J. Newman, (2010) Networks: An Introduction, Oxford University press publishers

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=JmKD5SnQtFE
2. https://www.youtube.com/watch?v=wn26ov9UB6w
3. https://www.youtube.com/watch?v=ANehpGhbuF4
4. https://www.youtube.com/watch?v=Y_6Su4yAGrY&list=PLyqSpQzTE6M88xI8FIcKarSBN2yPqMKbd

WEB RESOURCES:

1. https://www.youtube.com/watch?v=vxOMd-1NZH8&list=PLHkR7OTZy5OPhDKvFJ_Xc-PuQFw4-oCZ4
2. https://nptel.ac.in/courses/102106035

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101019	ARTIFICIAL INTELLIGENCE AND BIOINFORMATICS	3	-	-	-	3

Pre-Requisite INTRODUCTION TO BIOINFORMATICS

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Bioinformatics and Artificial Intelligence, Machine learning in Bioinformatics, Deep learning in Bioinformatics, Natural language processing in Bioinformatics and Advance topics in AI and Bioinformatics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand aspects of Artificial Intelligence and its role in Bioinformatics

CO2. Identify the use of Machine learning in Bioinformatics.

CO3. Gain knowledge on Deep learning in Bioinformatics

CO4. Identify language processing in Bioinformatics

CO5. Gain knowledge on applications of AI in Bioinformatics.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BIOINFORMATICS AND ARTIFICAL INTELLIGENCE (09 Periods)

Definition, scope, and applications. Biological databases (GenBank, PDB, UniProt). Sequence alignment (BLAST, FASTA). Phylogenetic analysis. Introduction to AI, machine learning, and deep learning. Basic concepts of algorithms and data structures

Module 2: MACHINE LEARNING IN BIOINFORMATICS (09 Periods)

Supervised Learning: Classification (Naïve Bayes, SVM, Decision Trees) and Regression (Linear Regression, Logistic Regression). Unsupervised Learning: Clustering (K-means, Hierarchical Clustering) and Dimensionality reduction (PCA).Applications in Bioinformatics: Gene expression analysis, protein structure prediction, drug discovery.

Module 3: DEEP LEARNING IN BIOINFORMATICS (09 Periods)

Neural Networks: Introduction, architecture, and training. Convolutional Neural Networks (CNNs): Image processing in bioinformatics (protein structure prediction, image-based drug discovery).Recurrent Neural Networks (RNNs): Sequence analysis (gene prediction, protein sequence analysis). Drug discovery, genomics, proteomics.

Module 4: NATURAL LANGUAGE PROCESSING (NLP) IN BIOINFORMATICS (08 Periods)

NLP Basics: Text preprocessing, tokenization, stemming, and lemmatization. Word Embeddings: Word2Vec, Glove. Text mining in biological literature, named entity recognition, relation extraction.

Module 5: ADVANCED TOPICS IN AI AND BIOINFORMATICS (10 Periods)

Genomic Data Analysis: Genome assembly, variant calling, and analysis. Proteomics Data Analysis: Mass spectrometry data analysis, protein-protein interaction networks. Bioinformatics and Healthcare: Precision medicine, drug repurposing, and medical image analysis. Ethical Considerations: Privacy, data security, and bias in AI algorithms.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Assignment on AI role in Bioinformatics
2. Seminar presentations on topics such as deep learning in Bioinformatics
3. Group discussion on Machine learning in Bioinformatics
4. Students need to prepare a report on applications of AI in genomics
5. Demonstration of different AI based tools and their applications

RESOURCES

TEXT BOOKS:

1. Keedwell E **(**2005) Intelligent Bioinformatics: The applications of Artificial Intelligence techniques to Bioinformatics Problems. Ist Edition, Publisher: John Wiley and Sons,
2. Mario Cannataro, Pietro Hiram Guzzi, Giuseppe Agapito, Chiara Zucco, Marianna Milano (2022). Artificial Intelligence in Bioinformatics, From Omics analysis to Deep Learning and Network Mining. 1stEdition, Publisher: Elsevier.

REFERENCE BOOKS:

1. Baldi Pierre and Soren Brunak (2001), Bioinformatics, second edition: The Machine Learning Approach, Second Edition Publisher: Bradford books

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=46aAVSRpFes
2. https://www.youtube.com/watch?v=9o7GQtbJ8Fk

WEB RESOURCES:

1. https://nptel.ac.in/courses/106104019/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101022	FOOD AND NUTRITION	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Food and Wellness, Energy value of food, Nutritional value of Carbohydrates, Nutritional value of Protein and Lipids, and Nutritional value of Vitamins and Minerals.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fact that "Food as medicine", different functions of food, balanced diet and health cum wellness.

CO2. Analyze parameters of Obesity via BMR and Calorific values of different food components.

CO3. Identify the importance of carbohydrates and fiber food on health.

CO4. Analyze nutritional value of proteins, lipids and fatty acids.

CO5. Identify sources of vitamins and minerals, and their vital role in normal functioning of the body.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	3	-	-	-	-	3	-
CO2	3	3	-	-	-	3	-	-	-	-	3	-
CO3	3	3	-	-	-	3	-	-	-	-	3	-
CO4	3	3	-	-	-	3	-	-	-	-	3	-
CO5	3	3	-	-	-	3	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	-	-	3	-	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FOOD AND WELLNESS (09 Periods)

Food and its Importance: Definition-food, nutrition, optimum nutrition. Functions of foods physiological, psychological and social functions. Basic five food groups. Balanced diet-definition and objectives, food guide pyramid and its uses. Definition of health and wellness - Factors affecting health and wellness. Physiological, psychological and social health.

Module 2: ENERGY VALUE OF FOOD (08 Periods)

Energy: Energy - Units of energy - Calorie, Joule, Determination of energy content of foods: RQ, SDA of food, Basal Metabolic rate (BMR), Determination of BMR (Benedict's oxy calorimeter), Factors affecting BMR. Thermic effect of food, Factors affecting Thermic effects of food.

Module 3: NUTRITIONAL VALUE OF CARBOHYDRATES (10 Periods)

Nutrition: Nutrients, Nutritional Status, Health. Carbohydrates –Nutritional classification, Function, Digestion and Absorption, effects of deficiency, sources and requirements Fibre-Definition, Types, and Role of fibre in health.

Module 4: NUTRITIONAL VALUE OF PROTEIN AND LIPIDS (10 Periods)

Protein: Protein- Nutritional value, Functions, Digestion and Absorption, Sources and Requirements, Deficiency. Evaluation of protein quality - PER, BV, NPU, NPR, chemical score, mutual and amino acid supplementation of proteins. Lipids value, Functions, Digestion and Absorption, Sources and Requirements, Deficiency. Essential fatty acids – Functions, Sources.

Module 5: NUTRITIONAL VALUE OF VITAMINS AND MINERALS (08 Periods)

Vitamins and Minerals - Vitamins – Fat Soluble Vitamins (A, D, E, K): Functions, Sources, Requirements, Deficiency and Excess. Water Soluble Vitamins (B1, B2, B3, B4, B6, B12 & C).

Total Periods: 45

EXPERIENTIAL LEARNING:

1. Assignment on effect of heat and pH on vegetable pigments like: chlorophyll, carotenoids, anthocyanin, anthoxanthin.
2. Assignment on Factors affecting the quality of pulses- Use of hard water, soft water, sodium bicarbonate, vinegar; pressure cooking and preparation of few pulse-based recipes.
3. Seminar on smoking temperature of different fats and oils (safflower oil, groundnut oil & palm oil)
4. Report writing on Fruits - Study of different methods of preventing enzymatic browning of cut fruits, pectin content of fruits.
5. Assignment on analysis for protein in given food samples
   a) Albumin (egg)
   b) Casein (milk)
6. Seminar on minerals in given food samples.
   a) Calcium (Ragi)
   b) Iron (Red rice flakes)
   c) Phosphorus (Ragi)
   d) Magnesium (Agathi)
7. Prepare a report on General visit to food Industry and Factories

RESOURCES

TEXT BOOKS:

1. T. Swaminathan, Essentials of Food and Nutrition, Bangalore Printing Publishing Co, 2018.
2. B. Srilakshmi, Nutrition Science, Fifth Edition, New Age International (P) Ltd, New Delhi 2008.

REFERENCE BOOKS:

1. W. W. K. Hoejer et al., Life time Physical Fitness and Wellness, 15th Edition, Cengage Learning, 2018.
2. S. J. Greenberg, and D. Pargman, Physical Fitness - A Wellness Approach, Prentice Hall International (UK) Limited, London, 1989.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6hFxSJcq-KU&ab_channel=Reactions
2. https://www.youtube.com/watch?v=p79D6u-6pN4&ab_channel=UniversityofCaliforniaTelevision%28UCTV%29

WEB RESOURCES:

1. https://fssai.gov.in/upload/knowledge_hub/1381085b34c171e808eSafe%20&%20Nutritious%20Food.pdf
2. https://en.wikipedia.org/wiki/Food_energy
3. https://www.nutrition.gov/topics/whats-food/carbohydrates

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS102018	BIOCHEMICAL CORRELATIONS IN DISEASE	3	-	3	-	4.5

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Inborn errors of metabolism, Nutritional deficiency and Lifestyle diseases, Hormonal imbalance and autoimmune disease, diseases caused due to mis-folded proteins and Infectious diseases, and hands on experience on diagnostic tests for different diseases.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand diseases resulting from different metabolisms.

CO2. Identify diseases due to deficiency of nutrients and life style.

CO3. Understand diseases resulting from Hormonal imbalance and immune response.

CO4. Understand diseases caused due to misfolded proteins and the mechanism of diseases.

CO5. Analyze various biochemical parameters for the identification of diseases, and work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	3	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	-	**3**	-	-	**3**	-	-	-	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INBORN ERRORS OF METABOLISM (08 Periods)

Alkaptonuria, Phenylketonuria, Maple syrup urine disease (MSUD), Albinism, Glycogen storage diseases, SCID, Clotting disorders

Module 2: NUTRITIONAL DEFICIENCY AND LIFE STYLE DISEASES (10 Periods)

Diseases caused due to deficiency of Vitamins: Kwashiorkor, Marasmus, Beri-Beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Wilson's disease. Life style diseases: Obesity, Atherosclerosis, Non-Insulin dependent diabetes mellitus (Type II diabetes).

Module 3: HORMONAL IMBALANCE AND AUTOIMMUNE DISEASE (09 Periods)

Outline of hormone action and imbalances leading to disease - Hyper and hypothyroidism. Diabetes Mellitus-I (IDDM). Concepts in immune recognition - self and non-self-discrimination, organ specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, myasthenia gravis.

Module 4: DISEASES CAUSED DUE TO MISFOLDED PROTEINS (08 Periods)

Alzheimer's, Huntington's disease, Sickle cell anaemia, Thalessemia.

Module 5: INFECTIOUS DISEASES (10 Periods)

Viral infection (polio, measles, mumps, HIV, Bacterial infections (tetanus, tuberculosis, typhoid), Vaccines against diseases, General strategies in the design and development of vaccines.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 10 experiments shall be conducted)

1. Estimation of Blood Glucose
2. Red blood cell (RBC) count
3. Estimation of Cholesterol
4. Erythrocyte sedimentation rate (ESR)
5. Hemoglobin Estimation
6. Measurement of Blood pressure
7. Obesity parameters (BMI and W/H ratio)
8. Packed cell volume (PCV)
9. Estimation of Vitamin 'C'
10. Mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC)
11. Widal test.

RESOURCES

TEXT BOOKS:

1. Devlin, T.M. Textbook of Biochemistry with Clinical Correlations 7th Edition (2022). CBS publishers.
2. Coico, R and Sunshine, G, Immunology: A Short Course (2021) 8th Edition.,., Wiley Blackwell & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
3. Jayaraman, J. Laboratory manual of Biochemistry, 2nd Edition, New Age, 2012.

REFERENCE BOOKS:

1. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore),
2. Berg J. M., Stryer L., Tymoczko J. and Gatto G., Biochemistry, Freeman Publishers, 9thEdition, 2019.
3. Swaminathan R, Hand book of Clinical Biochemistry, World scientific publishing company, 2nd Edition 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=CUI7Ncgq92o
2. https://www.youtube.com/watch?v=-EUCyvoJGhg
3. https://www.youtube.com/watch?v=JHeRegc4idc

WEB RESOURCES:

1. https://www.alz.org/media/documents/alzheimers-dementia-huntingtons-disease-ts.pdf
2. https://archive.nptel.ac.in/courses/104/108/104108055/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS102020	FUNDAMENTALS OF BIOINFORMATICS AND PROTEOMICS	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Bioinformatics, Biological databases, sequence alignments, Introduction to Proteomics and Proteomics and Proteomics tools. Also, hands-on experience on different basic Bioinformatics tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand interdisciplinary nature of bioinformatics, different tools used in Molecular biology.

CO2. Identify databases to be searched for Biomolecules data.

CO3. Analyze protein and nucleic acid sequences with appropriate sequence alignment methods using different tools.

CO4. Understand Proteomics and emerging areas of proteomics

CO5. Analyse Proteomics data using different Proteomics tools. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	3	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	-	**3**	-	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BIOINFORMATICS (10 Periods)

Introduction to Bioinformatics, Inter disciplinary nature of Bioinformatics, bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, PubMed, PDB) and software (Chimera, Ligand Explorer). Generation of large-scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.

Module 2: BIOLOGICAL DATABASE (11 Periods)

Introduction to data types, Classification and Presentation of Data. Quality of data General Introduction of Biological Databases; Nucleic acid databases, NCBI, DDBJ, and EMBL. Protein databases, Primary, Composite, and Secondary. Specialized Genome databases: (SGD, TIGR, and ACeDB). Human Genome database. Structure databases (CATH, SCOP, and PDBsum).

Module 3: SEQUENCE ALIGNMENTS (09 Periods)

Introduction to sequences, alignments and Dynamic Programming, Local alignment and Global alignment, pairwise alignment (BLAST and FASTA Algorithm), multiple sequence alignment – progressive alignment, (Clustal W2, MUSCLE), Alignment Matrices – BLOSUM and PAM, Introduction to Phylogenetic trees.

Module 4: INTRODUCTION TO PROTEOMICS (08 Periods)

Introduction to Proteomics – The Proteome, mining proteomes, Bridging Genomics and Proteomics. Proteomics and the new biology. Emerging areas in the Proteomics.

Module 5: PROTEOMICS AND PROTEOMICS TOOLS (07 Periods)

Introduction to Proteome and Proteomics, Techniques used in Proteomics, Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilization, 2-dimensional gel electrophoresis, Detection of proteins in PAGE, analysis of 2-D gel images.

Total Periods: 45

EXPERIENTIAL LEARNING (Minimum 10 experiments shall be conducted)

1. Introduction to databases and database searching
2. Database searching – Nucleic acid and protein sequence identification
3. Pair wise sequence analysis using BLAST
4. Pair wise sequence analysis using FASTA
5. Multiple sequence alignment using different programs
6. Colour schemes for Multiple sequence alignment using different editors
7. Generation of Phylogenetic trees
8. Molecular display program SPDBV
9. Molecular display program PyMol
10. Analysis of Proteomics data
11. Interpretation Mass spectrometry data

RESOURCES

TEXT BOOKS:

1. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1st edition, Academic Press, San Diego, 1996.
2. Orpita Bosu and S. K. Thukral, Bioinformatics, 1st edition, Oxford University press, 2007.

REFERENCE BOOKS:

1. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999
2. I. F. Tsigelny, Protein Structure Prediction, Bioinformatics approach, 1st edition, International University Line, 2002.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/content//storage/102/106/102106065/MP4/mod01lec01.mp4
2. https://archive.nptel.ac.in/content//storage/102/106/102106065/MP4/mod01lec06.mp4
3. https://archive.nptel.ac.in/courses/102/104/102104056/

WEB RESOURCES:

1. https://www.youtube.com/watch?v=28lMfTQTFas
2. https://www.youtube.com/watch?v=g9PJEDmoWn4

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101023	GENOMICS	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Genomics, Genome sequencing and editing, Gene structure and Genome organization, Metagenomics and Population Genomics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understanding of genomic concepts, technologies, and applications to analyze genomic data for interpreting the genome data
CO2. Analyze genomic sequencing and genome editing techniques to unravel genetic information
CO3. Analyze gene structure and genome organization, gain insights into the intricacies of genetic information
CO4. Apply metagenomics principles and techniques to unravel the diversity, functional potentials, and ecological roles of microbial communities in various environments
CO5. Gain awareness of population genomics methodologies, designed to explore genetic variations, demographic patterns, and evolutionary dynamics within populations

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO GENOMICS (09 Periods)

Overview of Genomics, Fundamentals of genomics, Databases, Genome banks, NCBI, Tools of Genomics, DNA, Overview of the Gene, Gene mutations, Transgenes.

Module 2: GENOME SEQUENCING AND GENE EDITING (09 Periods)

Sanger sequencing, Human genome project, Automated sequencing method, Transposable elements, Introduction to CRISPR-CAS 9 editing, shot gun sequencing, DNA repair, knock in, Knock out, Gene Therapy.

Module 3: GENE STRUCTURE AND GENOME ORGANISATION (09 Periods)

Genome organization, Central dogma, Structure of gene, Phylo genomics, Phyto genomics, Second generation sequencing, Third generation sequencing, comparative genomics, BLAST, FASTA, Repeatable elements, BAC library construction, Genome assembly, Contig assembly, Cot curves, Heterochromatin and Euchromatin,

Module 4: METAGENOMICS (09 Periods)

Introduction to metagenomics, Metagenome assembly, Metagenome Analysis, Microbial and eukaryotic genomes, Gut microflora, Microbes and health.

Module 5: POPULATION GENOMICS (09 Periods)

Microsatellites, SNP- Array genotyping, McDonald-Kreitman test (MK- Test), Linkage and recombination, Spatial and temporal variation, Genetic drift, Characterisation of Genetic variation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Sequence Homology determination by BLAST
2. Unknown protein identification by MASCOT search
3. Assignment on CRISPR- CAS9 editing methodology
4. DNA Cot curve Analysis
5. Assignment on sequence Analysis of sequence deduced by Sanger method and Gilbert - Maxam methodology.

RESOURCES

TEXT BOOKS:

1. T. Strachan, A. Lucassen, Genetics and Genomics in Medicine (2022), 2nd edition, Routledge Taylor and Francis group publishers.
2. S. R. Primrose and R. M. Twyman, Genomics: Applications in Human biology (2003), Wiley-Blackwell publishers.
3. S. Choudhuri and D. B. Carlson, Genomics: Fundamentals and applications (2009), 1st Edition, Routledge Taylor and Francis group publishers.

REFERENCE BOOKS:

1. J. Pevsner, Bioinformatics and Functional genomics (2015), 3rd edition. Wiley-Blackwell publishers.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=_CcoPGjxFQ4
2. https://www.youtube.com/watch?v=O3Gek4BkR-A
3. https://www.youtube.com/watch?v=eyRlGL9oPUg
4. https://www.youtube.com/watch?v=F7DpdOHRDR4

WEB RESOURCES:

1. https://www.digimat.in/nptel/courses/video/102104056/L01.html
2. https://www.cytosurge.com/applications/gene-editing-techniques
3. B. R. Korf and M. B. Irons, Human Genetics and Genomics (2021), 4th edition, John Wiley and sons' publishers.

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101024	EMBRYOLOGY	3	-	-	-	3

Pre-Requisite Human Physiology and Nutrition
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Students will gain a comprehensive understanding of the key stages of embryonic development, from gametogenesis to organogenesis. This course is suitable for students with a basic understanding of biology and is ideal for those interested in medicine, biotechnology, or the wonders of life itself.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamental concepts of gametogenesis, fertilization, and early embryonic development.
CO2. Analyze the processes of gastrulation, neurulation, and organogenesis in different systems.
CO3. Analyze the influence of environmental factors on embryonic development and potential teratogenic effects.
CO4. Identify the ethical implications of assisted reproductive technologies and related research.
CO5. Apply knowledge of embryology to solve problems and critically evaluate scientific data.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO EMBRYOLOGY (09 Periods)

Historical Timeline of Embryology, Basic Principles of Embryology, Male and Female Reproductive Systems, Mitosis vs. Meiosis, Introduction to Gametogenesis

Module 2: GAMETOGENESIS AND FERTILIZATION (09 Periods)

Spermatogenesis: Sperm Production, Oogenesis: Egg Development, Hormonal Regulation of Gametogenesis, Sperm Cell Structure and Function, Egg Cell Structure and Function, Fertilization Process and Consequences

Module 3: EARLY EMBRYONIC DEVELOPMENT (09 Periods)

Cleavage and Blastocyst Formation, Implantation and Early Development, Extraembryonic Membranes and Their Functions, Environmental Factors and Embryonic Development

Module 4: ORGANOGENESIS (09 Periods)

Gastrulation and Formation of Germ Layers, Neurulation and Development of the Nervous System, Organogenesis of Major Systems (Cardiovascular, Respiratory, Digestive) Signaling Molecules and Morphogenesis

Module 5: APPLICATIONS AND ETHICS OF EMBRYOLOGY (09 Periods)

Stem Cell Research and Applications, Assisted Reproductive Technologies (ARTs), Ethical Dilemmas in Embryology

Total Periods: 45

EXPERIENTIAL LEARNING

1. Construct models of cells, embryos, and organs using clay, playdough, or even 3D printing
2. Incubate fertilized chicken eggs and observe the external changes daily.
3. Grow and observe microbial cultures, exploring basic cellular processes like cell division and differentiation
4. Plant seeds and monitor their growth, comparing it to animal embryonic development.

RESOURCES

TEXT BOOKS:

1. "Essential Concepts in Embryology" by Gilbert Scott F.
2. "Human Embryology" by Sadler T.W.
3. "Larsen's Human Embryology" by Larsen W.J.

REFERENCE BOOKS:

1. "The Promise of Stem Cell Therapy" by Scientific American
2. "The Impact of Assisted Reproductive Technologies on Society" by The New England Journal of Medicine

VIDEO LECTURES:

1. "The Science of IVF" by TED-Ed
2. "The Ethics of IVF" by TEDx Talks
3. "3D Printing Organs: The Future of Medicine?" by TED-Ed
4. "The Ethics of Bioprinting" by The Future of Humanity Institute

WEB RESOURCES:

1. The Visible Embryo: http://www.visembryo.com/ - Interactive 3D models of human development.
2. Human Developmental Anatomy Center:https://hdbratlas.org/ - Images and descriptions of human embryonic development.

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS102021	**ENDOCRINOLOGY**	3	-	3	-	4.5

Pre-Requisite Human Physiology and Nutrition

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course delves into the anatomy, physiology, and biochemistry of major endocrine glands (pituitary, thyroid, parathyroid, adrenals, pancreas, gonads), and their diverse hormonal messengers. Learn how these hormones orchestrate essential functions like growth, metabolism, reproduction, and stress response, and how their imbalance can lead to various endocrine disorders

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Identify the major endocrine glands and their locations and describe the main hormones produced by each gland and their general effects.

CO2. Identify common disorders of the pituitary (e.g., acromegaly) and thyroid (e.g., hyperthyroidism)

CO3. Understand the functions of adrenal hormones (cortisol, aldosterone) and pancreatic hormones (insulin, glucagon).

CO4. Analyze the anatomy and physiology of the gonads and their role in hormone production

CO5. Apply diagnostic and treatment strategies to complex endocrine cases.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ENDOCRINOLOGY (09 Periods)

The endocrine system overview: Major endocrine glands and their locations, General functions of different hormone systems, principles of hormone action and regulation, Mechanisms of hormonal regulation: Receptor types and signaling pathways, second messenger systems, feedback loops and hormonal secretion

Module 2: THE PITUITARY AND THYROID GLANDS (09 Periods)

Pituitary gland: Anatomy and physiology of the anterior and posterior pituitary, Pituitary hormones (e.g., growth hormone, prolactin, TSH, ACTH) and their functions, Pituitary disorders (e.g., acromegaly, Cushing's syndrome, diabetes insipidus)

Thyroid gland: Anatomy and physiology of the thyroid gland, Thyroid hormones (T3, T4) and their actions on metabolism, Regulation of thyroid hormone secretion, Thyroid disorders (e.g., hyperthyroidism, hypothyroidism, thyroiditis)

Module 3: THE ADRENAL GLANDS AND PANCREAS (09 Periods)

Adrenal glands: Anatomy and physiology of the adrenal cortex and medulla, Adrenal hormones (cortisol, aldosterone, epinephrine, norepinephrine) and their functions, Regulation of adrenal hormone secretion, Adrenal disorders (e.g., Cushing's syndrome, Addison's disease, pheochromocytoma)

Pancreas: Anatomy and physiology of the endocrine pancreas, Pancreatic hormones (insulin, glucagon, somatostatin) and their roles in glucose metabolism, Regulation of insulin and glucagon secretion, Diabetes mellitus (type 1, type 2, gestational) and its pathophysiology

Module 4: THE GONADS AND BONE METABOLISM (09 Periods)

Gonads: Anatomy and physiology of the testes and ovaries, Sex hormones (testosterone, estrogen, progesterone) and their diverse functions, Regulation of sex hormone secretion, Reproductive disorders (e.g., polycystic ovary syndrome, erectile dysfunction, infertility)

Bone metabolism: Roles of hormones (parathyroid hormone, vitamin D) and other factors in bone formation and resorption, Calcium and phosphorus homeostasis

Module 5: INTEGRATION AND APPLICATION (09 Periods)

Clinical case studies and presentations, Current advancements and research in endocrinology; emerging therapies, diagnostic tools, and ongoing research relevant to various endocrine conditions, Ethical considerations in endocrinology practice, public health and advocacy

Total Periods: 45

EXPERIENTIAL LEARNING

1. Examine histological sections of various endocrine glands (pituitary, thyroid, adrenal, pancreas, gonads) to identify key anatomical features and cell types.
2. Practice analyzing simulated blood samples for hormone levels using techniques like ELISA or immunoassay kits. Interpret results and discuss their clinical significance.
3. Learn and practice using a glucometer to measure blood glucose levels.
4. Analyze urine samples for potential indicators of endocrine disorders, such as presence of glucose or ketones.
5. Observe histological sections of healthy and osteoporotic bone tissue to understand structural differences and assess bone health markers.

RESOURCES

TEXT BOOKS:

1. Larsen, Kronenberg, Melmed, Polonsky Williams, Textbook of Endocrinology (14th Edition)
2. Brunton, Chabner, Knollmann, Goodman& Gilman's The Pharmacological Basis of Therapeutics (14th Edition)
3. David G. Gardner, Dolores Shoback, Comprehensive Clinical Endocrinology (6th Edition)

REFERENCE BOOKS:

1. Endocrinology: Adult and Pediatric (8th Edition) by Jameson and De Groot
2. "The Endocrine System: An Overview" by National Institutes of Health (NIH)

VIDEO LECTURES:

1. Khan Academy: Endocrine System
2. Crash Course: Hormones
3. TED Talk: "The Symphony of Hormones" by Robert Lustig

WEB RESOURCES:

1. The Endocrine Society: Image of The Endocrine Society logo: https://www.endocrine.org/
2. National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK): Image of National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) logo: https://www.niddk.nih.gov/)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS102022	**NEUROBIOLOGY**	3	-	3	-	4.5

Pre-Requisite Human Physiology and Nutrition
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Students delve into the fascinating world of neuroscience in this comprehensive course exploring the structure, function, and development of the nervous system. From individual neurons to complex brain circuits, students will unravel the mysteries of how our brains generate thought, feeling, and action.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Identify and describe the major anatomical structures of the central and peripheral nervous systems.
CO2. Analyze the pathways involved in processing sensory information from the periphery to the brain.
CO3. Differentiate between different types of memory (e.g., short-term, working memory, long-term) and their neural substrates.
CO4. Analyze the challenges and ethical considerations surrounding technologies impacting the brain (e.g., brain-computer interfaces).
CO5. Evaluate current research advancements and emerging therapeutic strategies in neurobiology.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	-	-	**-**	**-**	-	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO NEUROBIOLOGY (09 Periods)

Structure and organization of the nervous system: Central Nervous System (CNS), Peripheral Nervous System (PNS), and major brain regions. Cellular basis of nervous system: neurons, glial cells, and their functions. Basics of neuronal communication: action potentials, synapses, neurotransmitters and signal integration.

Module 2: SENSORY AND MOTOR SYSTEMS (09 Periods)

Vision, audition, and other sensory systems: How we perceive and process sensory information. Motor control and movement coordination: From basic reflexes to complex actions. Integration of sensory and motor information: Circuits involved in perception and behavior.

Module 3: LEARNING, MEMORY, AND EMOTIONS (09 Periods)

Cellular and molecular mechanisms of learning and memory: Long-term potentiation, synaptic plasticity, and memory consolidation. Different types of memory: Short-term, working memory, and long-term memory systems. Neural basis of emotions: Fear, pleasure, and the limbic system.

Module 4: HIGHER COGNITIVE FUNCTIONS (09 Periods)

Language, communication, and speech production: Neural networks involved in language processing. Consciousness and decision-making: Exploring the complex nature of awareness. Sleep and its role in brain function: Sleep stages and their impact on learning and memory.

Module 5: NEUROLOGICAL DISORDERS (09 Periods)

Neurodegenerative diseases: Alzheimer's, Parkinson's, and Huntington's diseases.
Stroke, epilepsy, and other neurological conditions: Causes, symptoms, and treatment options.
Current research and future directions in neurobiology: Brain-computer interfaces, gene therapy, and other emerging technologies.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Observe prepared slides of different brain regions to identify key structures and cell types.
2. Analyze a simulated case study of a patient with a neurological disorder and discuss the potential underlying neural dysfunction
3. Design and conduct simple experiments to explore different sensory modalities (e.g., visual illusions, taste perception tests).
4. Analyze facial expressions or physiological responses (e.g., heart rate) to various stimuli and discuss the neural basis of emotions.
5. Analyze case studies of patients with different neurological disorders and discuss the potential areas of the brain affected.

RESOURCES

TEXT BOOKS:

1. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, Principles of Neural Science (6th Edition).
2. Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony S. Lamantia, Lawrence White Neuroscience (6th Edition).

REFERENCE BOOKS:

1. G. F. Streitdter (2016), Neurobiology: A functional approach, Oxford University press.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ezy2WJdRXgw
2. https://www.youtube.com/watch?v=cNaFnRKwpFk
3. https://www.youtube.com/watch?v=rcQUjbS8mGI
4. https://www.youtube.com/watch?v=CurW-sIQPxU

WEB RESOURCES:

1. Society for Neuroscience: https://www.sfn.org/:
2. Dana Foundation: https://www.dana.org/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101025	BASIC REAGENTS AND REACTION MECHANISM	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on nomenclature, classification, properties and applications of halogen, hydroxyl, carbonyl, carboxylic acid and its derivatives and active methylene compounds using various reagents and reaction mechanism.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the nomenclature, classification and reactivity of halogen compounds.

CO2. Explain the preparation, degradation of alcohol and identify the alcohol and phenols.

CO3. Describe synthesis, reactivity and reactions of carbonyl compounds.

CO4. Explain nomenclature, classification, preparation, physical and chemical properties of carboxylic acid and its derivatives.

CO5. Understand the preparation and synthetic applications of active methylene compounds.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	-	1
Course Correlation Mapping	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-	-	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: HALOGEN COMPOUNDS (07 Periods)

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aryl alkyl, allyl, vinyl, benzyl halides.

SN^1 and SN^2 – reaction mechanism with optically active alkyl halide 2-bromobutane. Relative reactivity of alkyl, allyl, vinyl, benzyl and aryl halides towards nucleophilic substitution reaction.

Module 2: ALCOHOLS AND PHENOLS (10 Periods)

Alcohols: Nomenclature and classification, preparation with hydroboration reaction and Grignard synthesis. Physical properties-Hydrogen bonding (intermolecular and intramolecular). Effect of hydrogen bonding on boiling point and solubility in water. Chemical properties (with mechanism) - Dehydration of alcohols, Oxidation of alcohols by CrO_3, $KMnO_4$. Identification of alcohols- by oxidation with KMnO4, Luca's reagent.

Phenols: Preparation from diazonium salt and from cumene. Chemical Properties (with mechanism) - Bromination, Kolbe-Schmidt reaction, Riemer-Tiemann reaction, azocoupling. Identification of Phenol with neutral $FeCl_3$**.**

Module 3: CARBONYL COMPOUNDS (10 Periods)

Nomenclature of aliphatic and aromatic carbonyl compounds, Synthesis of aldehydes from acid chlorides, synthesis of ketones from nitriles. Physical properties, Reactivity of carbonyl group in aldehydes and ketones-Nucleophilic addition reaction with-$NaHSO_3$, HCN, RMgX, NH_2OH, $PhNHNH_2$, 2,4 DNPH, Aldol reaction, Cannizzaro's reaction, Perkin reaction, Benzoin condensation. Reduction reactions-Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with $LiAlH_4$ and $NaBH_4$.

Analysis of aldehydes and ketones with 2,4-DNPH test, Tollen's test, Fehling test, Schiff's test, Haloform test (with equation).

Module 4: CARBOXYLIC ACIDS AND DERIVATIVES (10 Periods)

Nomenclature, classification of carboxylic acids. Methods of preparation by Hydrolysis of nitriles, amides and esters (by acids and bases), Carbonation of Grignard reagents, Kolbe reaction. Physical properties-Hydrogen bonding, dimeric association. Chemical properties- Reactions involving H, OH and COOH groups-salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, halogenation by Hell-Volhard-Zelinsky reaction.

Module 5: ACTIVE METHYLENE COMPOUNDS (08 Periods)

Acetoacetic ester: keto-enol tautomerism, preparation by Claisen condensation, Acid hydrolysis. Synthetic application-Preparation of monocarboxylic acids and Dicarboxylic acids, Reaction with urea

Malonic ester: preparation. Synthetic applications-Preparation of monocarboxylic acids (propionic acid and n-butyric acid), Dicarboxylic acids (succinic acid and adipic acid), α, β-unsaturated carboxylic acids (crotonic acid), Reaction with urea.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a PPT on Modern utilization of halogens
2. prepare a document on commercial applications of alcohols and phenols
3. Give a talk on chemical properties of Carbonyl Compounds
4. Submit a document on the role of carboxylic acid in human health and in foods.
5. Discuss the importance of active methylene compounds.

RESOURCES

TEXT BOOKS:

1. I. L. Finar, A Text Book of Organic chemistry, Vol I., 4th edition, Pearson publications, 2015.
2. Bahl and Arun Bahl, A Text Book of Organic Chemistry, Chand publications-India, 1997.

REFERENCE BOOKS:

1. P. Sykes, A guidebook to mechanism in organic chemistry, Longman scientific & technical, 6th Edition, John Wiley & sons, Inc, New York, 1985.
2. V. K. Ahluwalia, Organic Reactions and Their Mechanisms, Springer publications, New York, 2023.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/106/104106077/
2. https://archive.nptel.ac.in/courses/104/105/104105038/
3. https://archive.nptel.ac.in/courses/104/103/104103111/

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/104/101/104101005/
2. https://archive.nptel.ac.in/courses/104/103/104103023/
3. https://archive.nptel.ac.in/courses/104/105/104105071/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS102023	BASICS OF SPECTROSCOPY	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Spectroscopy, Electronic Spectroscopy, Infrared Spectroscopy, NMR Spectroscopy, Mass spectrometry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the nature of bonding in coordination compounds.
CO2. Know the importance and application of coordination compounds in industry and in medicine
CO3. Study the active roles played by metal ions and coordination compounds in biological systems

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	2
Course Correlation Mapping	**3**	**-**	**-**	**-**	-	-	-	-	**-**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO SPECTROSCOPY (09 Periods)

Interaction of low energy radiation with matter, Electromagnetic spectrum, quantization of energy, Electronic, vibrational and rotational energy levels, and transitions in atoms and molecules. Absorption and emission spectra. Boltzmann distribution (formula only). Relative population of translational, rotational, vibrational and electronic energy levels at different temperatures. Transition probabilities, selection rules, line widths, resolution and signal to noise ratio

Module 2: ELECTRONIC SPECTROSCOPY (09 Periods)

Absorption laws, calculations involving Beer – Lambert's law, verification and its limitations. Instrumentation of photo colorimeter and spectrophotometer, block diagrams with description of components, theory, types of electronic transitions, chromophores and auxochromes, absorption bands and intensity, factors governing absorption maximum and Intensity. Atomic absorption spectroscopy and Flame photometry – principles, instrumentation and applications.

Module 3: INFRARED SPECTROSCOPY (09 Periods)

Principle, types of stretching and bending vibrations, vibrational frequencies, IR instrumentation, block diagram, source, monochromator, cell sampling techniques, detector and recorders, identification of organic molecules from characteristic absorption bands. Raman spectroscopy, Raleigh and Raman scattering, stoke's and antistoke's line, instrumentation, block diagram, differences between IR and Raman spectroscopy, mutual exclusion principle, applications, structural diagnosis.

Module 4: NMR SPECTROSCOPY (09 Periods)

Principle of nuclear magnetic resonance, basic instrumentation, equivalent and non-equivalent protons, shielding mechanism, chemical shift, number of signals, spin-spin coupling and coupling constants, splitting of signals, deuterium labeling. Applications of NMR to simple organic compounds.

Module 5: MASS SPECTROMETRY (09 Periods)

Basic principles of mass spectrum, molecular peak, base peak, isotopic peak, metastable peak and their uses, fragmentation – nitrogen rule. Instrumentation, determination of molecular formulae with example, mass spectrum of simple organic compounds, identification – alcohols, aldehydes, aromatic hydrocarbons

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES: Minimum 10 exercises have to be done

1. Analyze the simple organic molecules with the help of IR spectrum
2. Analyze the simple organic molecules with the help of NMR spectrum
3. Analyze the simple organic molecules with the help of Mass spectrum
4. Apply malty spectral study in analyzing simple organic compounds

RESOURCES

TEXT BOOKS:

1. Y R Sharma, Elementary Organic Spectroscopy**,** S. Chand Publishing, New Delhi, 2007

REFERENCE BOOKS:

1. A.K. Srivastava and P.C. Jain, Chemical Analysis: An Instrumental Approach for B.Sc. Hons. and M.Sc. Classes, S. Chand and company Ltd., Ram Nagar, New Delhi.
2. R. Gopalan, Analytical chemistry, S. Chand and Co., New Delhi

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/106/104106122/
2. https://archive.nptel.ac.in/courses/104/106/104106048/
3. https://archive.nptel.ac.in/courses/103/108/103108139/
4. https://archive.nptel.ac.in/courses/104/101/104101117/

WEB RESOURCES:

1. https://www.su.se/polopoly_fs/1.521101.1602178917!/menu/standard/file/Introduction%20to%20Spectroscopy.pdf
2. https://www.usp.br/massa/2014/qfl2144/pdf/MassSpectrometry.pdf
3. https://www.lehigh.edu/~kjs0/carey-13.PDF

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101028	THERMODYNAMICS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on First Law of Thermodynamics and its Applications, Thermos chemistry, Second Law of Thermodynamics and its Applications, Thermodynamics of Equilibrium Processes, Third Law of thermodynamics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the concepts of thermodynamics and to apply it to physical and chemical systems.
CO2 Understand the measurements of heat reaction, bond energy, heat of transition.
CO3 Understand the second law of thermodynamics and its applications.
CO4 Understand thermodynamics of equilibrium processes and third law of thermodynamics.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	2	-	-	3
CO2	3	2	-	-	-	-	-	-	2	-	-	3
CO3	3	2	-	-	-	-	-	-	2	-	-	3
CO4	3	-	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**-**	**-**	-	-	-	-	**2**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FIRST LAW OF THERMODYNAMICS AND ITS APPLICATIONS (10 Periods)

First law of thermodynamics: Exact differentials, state functions E and H. Concept of ideal gas: Gas laws, Kinetic theory of gases – postulates and derivation. Deviation from ideal behavior, Van der Wall's equation of state - derivation. Applications of the laws of thermodynamics to ideal gases: Heat capacity, relation between CP and CV. Isothermal process: Change in internal energy, work done, W (rev) and W (irrev). Adiabatic process: work done, and entropy changes. Application of the laws of thermodynamics to real (van der Walls) gases: Isothermal process- Work done, change in internal energy, heat absorbed. Adiabatic process: Work done- Joule- Thomson effect- Joule- Thomson coefficient and its significance, inversion temperatures. Variation of enthalpy change of reaction with temperature (Kirchoff's equation).

Module 2: THERMO CHEMISTRY (08 Periods)

Measurements of thermal changes. Heats of reaction. Calculation of change in internal energy from the enthalpy change, standard states and standard heats of formation, Heat of combustion; integral heat of solution and dilution, heat of neutralization, heat of hydration; heat of transition, Bond energy and heat of reaction.

Module 3: SECOND LAW OF THERMODYNAMICS AND ITS APPLICATIONS (08 Periods)

Second law of thermodynamics- Limitations of first law and the need for the second law. Formulation of the second law of thermodynamics on the basis of Cannot cycle. Thermodynamic principle of the working of refrigerator. Criteria of spontaneity. Changes in S, G and A as criteria for spontaneous process, dS, dG and dA – exact differentials. Evaluation of DG and DS for the mixing, Maxwell's equations and thermodynamic equation of state. Gibbs-Helmholtz equation

Module 4: THERMODYNAMICS OF EQUILIBRIUM PROCESSES (09 Periods)

Law of mass action. Various forms of equilibrium constants. Relationships between KP and KC; properties of equilibrium constants. Vant Hoff isotherm. Derivation of thermodynamic equilibrium constant, and its relationship with free energy changes under standard conditions. Vant Hoff isochore. Le-Chatelier-Braun principle: Formation of ammonia. Application of law of mass action and Le-Chatelier-Braun principle to homogeneous gaseous reactions: dissociation of nitrogen tetroxide and ammonia.

Module 5: THIRD LAW OF THERMODYNAMICS (09 Periods)

Nernst heat theorem- Planck and Lewis Randall formulation of third law. Absolute entropy of solids, liquids and gases. Evaluation of the standard entropy of oxygen, on the basis of heat capacity. Exceptions to third law of thermodynamics.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Application of thermodynamic laws in day-to-day life.
2. Determination of calorific value using Bomb calorimeter.
3. Trouton's rule and its significance.
4. Formation of HI, dissociation of PCl5.
5. Calculation of absolute entropies of a system.

RESOURCES

TEXT BOOKS:

1. B.R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin chand and Co. 33rd edition, 1992.
2. P.W. Atkins, Physical Chemistry, 7thedition, Oxford university press, 2001.

REFERENCE BOOKS:

1. Gilbert. W. Castellan, Physical Chemistry, Narosa publishing house, third edition 1985.
2. Irving M. Klotz and Robert M. Rosenberg, Chemical Thermodynamics, John Wiley and sons, Inc. 1994.
3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan limited, New York, 1966.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/112/106/112106314/
2. https://archive.nptel.ac.in/courses/103/104/103104151/
3. https://archive.nptel.ac.in/courses/104/106/104106107/
4. https://archive.nptel.ac.in/courses/112/105/112105220/
5. https://archive.nptel.ac.in/courses/102/106/102106026/

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/102/106/102106026/
2. https://www.sfu.ca/~mbahrami/ENSC%20388/Notes/Intro%20and%20Basic%20Concepts.pdf
3. https://m-media.resosir.com/media/study_material/notes/1._TDS_Th_E_F5peMCd.pdf
4. https://mrcet.com/downloads/digital_notes/ME/II%20year/Thermodynamics%20Digital%20Notes.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101029	ORGANIC FUNCTIONAL GROUPS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on preparation, and properties of Aliphatic halides, aromatic halides, Hydroxy derivatives, Ethers, Epoxides, Aldehydes and Ketones

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the properties, preparation and applications of Aliphatic halides, aromatic halides, Hydroxy derivatives, Ethers, Epoxides, Aldehydes and Ketones.

CO2. Study advanced chemical reactions of carbonyl compounds

CO3. Understand the properties of Aldehydes and Ketones

CO4. Study advanced chemical reactions of carbonyl compounds

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	1	-	-	3
CO2	3	1	-	-	-	-	-	-	1	-	-	3
CO3	3	1	-	-	-	-	-	-	1	-	-	3
CO4	3	1	-	-	-	-	-	-	1	-	-	3
Course Correlation Mapping	**3**	**1**	**-**	**-**	-	-	-	-	**1**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ALIPHATIC AND AROMATIC HALIDES (10 Periods)

Nomenclature and classification, Preparation of aliphatic and aromatic halides: Free radical mechanism, addition and Substitution reactions. Reactions: Nucleophilic substitutions, SN1, SN2 and SNAr mechanisms, stereochemistry and reactivity, effects of structure, substrate, solvent, nucleophile and leaving groups.

Module 2: HYDROXY DERIVATIVES (08 Periods)

Aliphatic alcohols: Preparation by hydroboration, oxidation, Reduction of carbonyl compounds, epoxidation, and Grignard synthesis. Reactions with reference to C-OH bond cleavage and O-H bond cleavage, iodoform test.

Phenols: Nomenclature, physical properties, hydrogen bonding. Preparation: Industrial source, preparation from diazonium salts and sulphonic acids. Reactions: acidity, ether formation, ester formation, mechanism of ring substitution, nitration, sulphonation, halogenation, Friedel-Craft's reaction, nitrosation, coupling reactions, Kolbe's reaction and Riemer-Tiemann reaction

Module 3: ETHERS AND EPOXIDES (08 Periods)

Nomenclature and classification, Preparation by Williamson's synthesis and alkoxy mercuration-demercuration methods, Reactions: cleavage by acids, Preparation and reactions of epoxides.

Module 4: ALDEHYDES AND KETONES (09 Periods)

Nomenclature and classification, Preparation of aldehydes and ketones, Reactivity of carbonyl groups, acidity of alpha hydrogen, Reactions: Mechanism of enolization reactions, nucleophilic addition, oxidation and reduction reactions, addition reactions with Grignard reagents, cyanide, and bisulphate, preparation of derivatives of ammonia and alcohols, Cannizaro reaction and Aldol condensation.

Module 5: ADVANCED REACTIONS OF CARBONYAL COMPOUNDS (09 Periods)

Mechanism of aldol, Perkin, Knoevenagel reactions and benzoin condensation, Claisen, Wittig, Cannizaro and Reformatsky reactions. Mechanism of reductions with $NaBH_4$, LiAlH4, Wolf-kishner and MPV reaction. Mechanism of haloform and Michael addition.

Basic principles of photochemistry, Jablonski diagram, photochemical reactions of carbonyl compounds: Norrish type I and II reactions.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Competition between elimination and substitution reactions, application of Hoffmann and Saytzeff rules
2. preparation and properties of catechol, resorcinol and phloroglucinol
3. Properties of simple and mixed ethers.
4. Electrophilic substitution reactions of aromatic aldehydes and ketones

RESOURCES

TEXT BOOKS:

1. R. T. Morrison, R. N. Boyd, Organic Chemistry, 6th Edition, Printice-Hall of India Limited, New Delhi, 1992.
2. B. Y. Paula, Organic Chemistry, 3rd Edition, Pearson Education, Inc. (Singapore), New Delhi, reprint, 2002

REFERENCE BOOKS:

1. Jerry March, Advanced Organic Chemistry, 4th Edition, John Wiley and Sons, New York, 1992.
2. Francis A. Carey, Organic Chemistry, 3rd edition, Tata-McGraw Hill Publications, New Delhi, 1999.
3. S. H. Pine, Organic Chemistry, 5th Edition, McGraw Hill International Edition, Chemistry Series, New York, 1987.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=gJwMsAMGzfY
2. https://www.youtube.com/playlist?list=PLitHn3L0kE4ywlUCbvLGvjhqGAGxViDg8

WEB RESOURCES:

1. https://www.sciencedirect.com/topics/chemistry/carbonyl-compound
2. https://pubmed.ncbi.nlm.nih.gov/4045924/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101030	CHEMISTRY OF MATERIALS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Structures of solids, Preparative methods and characterization, Electrical and optical properties. Magnetic properties, Special materials.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the structural concepts of concepts of solids.
CO2. Prepare and characterize the solid material.
CO3. Study the electrical, optical and magnetic properties of solid material.
CO4. Familiar with the special materials.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	-	-	-	-	-	-	-	3
CO3	3	1	-	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2
Course Correlation Mapping	**3**	**1**	**-**	**-**	-	-	-	-	**-**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: STRUCTURES OF SOLIDS (09 Periods)

Introduction to solids – crystalline and amorphous. Unit cell, Bravais lattices and X-ray structure determination (NaCl and KCl only) – powder and single crystal- methods and applications-identification of the cubic lattice and indexing of the X-ray diffraction lines. Radius ratio rules – coordination number. Packing arrangement -different structure types in solids – rock salt, zinc blende, wurtzite, fluorite and antifluorite, spinel and inverse-spinel and perovskite structures

Module 2: PREPARATIVE METHODS AND CHARACTERIZATION (09 Periods)

Solid state reactions – ceramic method, sol-gel, hydrothermal, high pressure, zone efining, CVD, Czochralski and Bridgman and Stock Barger methods.

Module 3: ELECTRICAL AND OPTICAL PROPERTIES (09 Periods)

Defects in solid state – point defects – Frenkel and Schottky defects and non-stoichiometric defects. Conductors – variation of conductivity with temperature – semiconductors – p and n types, pn- junction, photoconduction, photo voltaic cell and photo galvanic cell – solar energy conversion, organic semiconductors. Introduction and application of Piezoelectric, pyro-electric and ferroelectrics, Photoluminescence.

Module 4: MAGNETIC PROPERTIES (09 Periods)

Magnetic properties – classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferri magnetic – magnetic susceptibility. Variation with temperature – Curie-Wiess law, Curie temperature and Neel temperature. Permanent and temporary magnets.

Module 5: SPECIAL MATERIALS (09 Periods)

Superconductivity – introduction, Meissner effect – mention of Bardeen, Cooper and Schrieffer theory and Cooper pairs – examples of superconducting oxides, Chevrel phases – Applications of superconducting materials. Ionic conductors – sodium-b alumina, sodium-sulphur battery. Intercalation – layered compounds – graphitic compounds. Special applications of solid-state materials. High energy battery- lithium batteries.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Synthesis of Biodegradable Plastics from Renewable Resources
2. Advancement of material research today
3. Material research is highly attractive field now.
4. Significance of material science for industrial use

RESOURCES

TEXT BOOKS:

1. Solid State Chemistry-An Introduction by Lesley Smart and Elaine Moore, Chapman Hall, London, 1992
2. M. G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001.

REFERENCE BOOKS:

1. H. P. Meyers, Introductory Solid-State Physics, Viva Books Private Limited, 1998.
2. A. R. West, Solid State Chemistry and its applications, John-Wiley and sons, 1987.
3. P. K. Palanisamy, Materials Science, SciTech Publications, Chennai, 2003.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/104/104104011/
2. https://www.youtube.com/watch?v=LmLYwREkj7Y
3. https://www.youtube.com/watch?v=TQ1zu4bgxO8

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/104/103/104103019/
2. https://www.nde-ed.org/Physics/Materials/Structure/solidstate.xhtml
3. https://www.ucl.ac.uk/quantum-spins/sites/quantum-spins/files/EOPM-Part1.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101031	ELECTROCHEMISTRY	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Equilibrium Electrochemistry, Electrochemical Reactions, quantitative aspects of electrochemistry, ions in solution, electrical properties of atoms and molecules.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the inter conversion of chemical and electrical energy and to link thermodynamics with electrochemistry.

CO2. Apply the concepts of electrochemistry.

CO3. Study the quantitative aspects of electrochemistry.

CO4. Understand the electrical properties of atoms and molecules.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	3
CO2	3	1	-	-	-	-	-	-	-	-	-	3
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**1**	**-**	**-**	-	-	-	-	**-**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: EQUILIBRIUM ELECTROCHEMISTRY (10 Periods)

Electrode potential- Single and standard electrode potentials. Reference electrodes: (i) Primary reference electrode: Standard hydrogen electrode (ii) Secondary reference electrode: Saturated calomel electrode. Determination of standard electrode potentials of zinc and copper electrodes. Calculation of cell EMF from single electrode potentials. Definition and applications of electromotive series.

Different types of electrodes- (i) Metal-Metal ion electrodes (ii) Amalgam electrodes (iii) Gas electrodes (iv) Metal insoluble salt electrodes (v) Oxidation –reduction electrodes

Electromotive force-Definition. Measurement using potentiometer. Construction and working of Weston saturated and unsaturated standard cells Conventions regarding sign of EMF.

Module 2: ELECTROCHEMICAL REACTIONS (09 Periods)

Thermodynamics of electrochemical reactions - Derivation of Nernst equation and its use in calculating EMF of cells at different activities of the individual electrodes. Relationship between EMF and (i) free energy changes (ii) enthalpies changes (iii) entropy changes occurring in electrochemical reactions. Equilibrium constants for electrochemical reactions.

Applications of EMF -Calculation of (i) Valency of ions in doubtful cases (ii) free energy, enthalpy and entropy changes in electrochemical reactions, (iii)solubility product of sparingly soluble salt pH and its determination using hydrogen, quinhydrone and glass electrodes; Potentiometric acid-base, redox and precipitation titrations.

Module 3: QUANTITATIVE ASPECTS OFELECTROCHEMISTRY (09 Periods)

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass electrodes.

Module 4: IONS IN SOLUTION (09 Periods)

Specific conductance, equivalent conductance. Variation of equivalent conductance with dilution. Migration of ions, Kohlrausch's law. Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorf's method. Application of conductivity measurements- conductometric titrations.

Module 5: ELECTRICAL PROPERTIES OF ATOMS AND MOLECULES (08 Periods)

Basic ideas of electrostatics, Electrostatics of dielectric media. Clausius-Mosotti equation and Lorenz-Laurentz equation (no derivation), Dipole moment and molecular polarizabilities and their measurements

Total Periods: 45

EXPERIENTIAL LEARNING

1. Commercial cells: Dry cell, lead storage, alkali (Na-S) and H_2-O_2 fuel cells
2. Arrhenius theory of electrolytic dissociation. Evidences in favor of the theory Limitations
3. Conductometric titrations
4. Electrochemical theory of corrosion

RESOURCES

TEXT BOOKS:

1. B.R. Puri and L.R. Sharma, Principles of physical chemistry, Shoban Lal Nagin Chand and Co. 33rd edition, 1992.
2. S.H. Maron and J.B. Lando, Fundamentals of physical chemistry, Macmillan limited, New York, 1966.

REFERENCE BOOKS:

1. P.W. Atkins, Physical chemistry, Oxford university press, 1978.
2. S.K. Dogra and S. Dogra, Physical chemistry through problems, new age international,4th edition 1996.
3. K. L. Kapoor, A textbook of Physical chemistry, (volume-2 and 3) Macmillan, India Ltd, 1994.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/104/106/104106137/
2. https://www.youtube.com/watch?v=p2OBuNLSQLY
3. https://www.youtube.com/watch?v=uvVp57gIj98

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/104/106/104106129/
2. http://www.sfu.ca/~aroudgar/Tutorials/OLD/Electrochemistry-09-2004/Lecture_5-7.pdf
3. https://www.sciencedirect.com/topics/materials-science/electrochemical-reaction

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS102024	FUNDAMENTALS OF ANALYTICAL CHEMISTRY	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Quantitative analysis, Treatment of analytical data, Chromatography, Spectrophotometry and Atomic and molecular spectroscopy**.**

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the types of volumetric analysis and steps involved in gravimetric analysis.

CO2. Familiar with the types of analytical errors and can able to minimize them

CO3. Analyze and solve problems associated with water, and address the societal, health and safety issues related to quality of water

CO4. Apply chromatography techniques for separation of compounds.

CO5. Demonstrate the basic knowledge of instrumental methods and their applications in the structural analysis of materials

CO6. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes									Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	-	-	3
CO2	3	2	-	-	-	-	-	-	1	-	-	3
CO3	2	3	-	-	1	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	-	-	-	-	-	-	-	1	-	-	3
CO6	1	2	-	-	-	-	3	2	1	-	-	1
Course Correlation Mapping	**3**	**2**	**-**	**-**	**1**	**-**	**3**	**2**	**1**	**-**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: QUANTITATIVE ANALYSIS (09 Periods)

Principles of volumetric analysis, concentration terms, preparing solutions-Standard solution, primary standards and secondary standards.

Principles of volumetric analysis: Theories of acid-base, redox, complexometric, iodometric and precipitation titrations - choice of indicators for these titrations.

Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration, and washing of precipitate, drying and ignition.

Module 2: TREATMENT OF ANALYTICAL DATA (09 Periods)

Description and use of common laboratory apparatus; Types of errors-Relative and absolute, significant figures and its importance, accuracy- methods of expressing accuracy, errors-Determinate and indeterminate and minimization of errors, precision-methods of expressing precision, standard deviation and confidence interval.

Module 3: WATER ANALYSIS AND SOLVENT EXTRACTION (09 Periods)

Water Analysis: Determination of dissolved solids, total hardness of water, turbidity, alkalinity, Dissolved oxygen, COD, determination of chloride using Mohr's method.

Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction; Waste water treatment by solvent extraction.

Module 4: COLUMN CHROMATOGRAPHY AND LIQUID CHROMATOGRAPHY (08 Periods)

Column chromatography: Principle, Experimental procedure, stationary and mobile phases, development of the chromatogram, applications, Reverse phase column chromatography.

Liquid Chromatography: HPLC, Basic principles, instrumentation–block diagram and applications. Difference between column and HPLC.

Module 5: INTRODUCTION TO SPECTROSCOPY (10 Periods)

Introduction to spectroscopy–types of energy present in molecules, types of spectra, UV-Vis spectroscopy – principle, types of electronic transitions, chromophore, auxochrome, Bathochromic shift, Hypsochromic shift, Instrumentation of UV-Vis spectrophotometer, applications; Infrared spectroscopy – principle, types of vibrational modes, group frequencies, Instrumentation of IR spectrophotometer, applications; Mass spectrometry (MS) – Principle, Instrumentation and Applications; principle and applications of physicochemical methods (SEM, TEM, X-ray diffraction).

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES: Minimum 10 exercises have to be done

1. Determination of hardness of ground water sample
2. Determination of alkalinity of Water sample
3. Estimation of Dissolved Oxygen in water by Winkler's method
4. Estimation of residual chlorine in drinking water
5. Estimation of Iron (II) using standard Potassium dichromate solution.
6. Verification of Beer lambert's law.

7. Separation of given mixture of amino acids using ascending paper chromatography
8. Separation of a given dye mixture (methyl orange and methylene blue) using TLC (using alumina as adsorbent).
9. Separation of triglycerides using TLC.
10. Separation of food dyes using Column Chromatography.
11. Identification of compounds using IR spectrum.
12. Determination of Calcium in Limestone.

RESOURCES

TEXT BOOKS:

1 F. James Holler, Stanley R Crouch, Donald M. West and Douglas A. Skoog, Fundamentals of Analytical Chemistry, Cengage Publications, 9th edition.

2 John Mendham, Textbook of Vogel's Quantitative Chemical Analysis, Pearson Education Asia, 6th edition.

REFERENCE BOOKS:

1 Gary D. Christian, Purnendu K. Dasgupta and Kevin A. Schug, Analytical Chemistry, Wiley Publications, 7th edition.

2 S.S. Dara and D.D. Mishra, Textbook of Environmental Chemistry and Pollution Control, S Chand& Co Ltd, Revised edition.

VIDEO LECTURES:

1. https://shorturl.at/adkzM
2. https://shorturl.at/esJW1
3. https://www.youtube.com/watch?v=eYYCWGRTmcg
4. https://www.youtube.com/watch?v=ZN7euA1fS4Y
5. https://archive.nptel.ac.in/courses/104/106/104106122/

WEB RESOURCES:

1. https://in.okfn.org/files/2013/07/An-Introductory-Course-of-Quantitative-Chemical-Analysis.pdf
2. https://bionmr.unl.edu/courses/chem221/lectures/chapter-00-01.ppt
3. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/water-analysis
4. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/column-chromatography
5. https://www.google.co.in/books/edition/Handbook_of_Spectroscopy/RkgGVFlck6QC?hl=en&gbpv=1&dq=spectroscopy&printsec=frontcover

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EC101701	AI IN HEALTHCARE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamental concepts of AI in Healthcare sector.

CO2. Analyse the present state and future of AI in Healthcare specialties for different scenarios.

CO3. Apply design concepts and metrics for AI in Healthcare.

CO4. Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.

CO5. Develop AI applications through AI techniques for healthcare

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	-	-	-	-	-	-
CO2	2	3	-	-	2	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-
CO4	2	-	-	2	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	-
Course Correlation Mapping	**2**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE (08 Periods)

Introduction to AI in Healthcare, Benefits & Risks, AI in the health sector, AI versus human intelligence, The future of AI in health sector, AI & Neural networks.

Module 2: THE PRESENT STATE & FUTURE OF AI IN HEALTHCARE SPECIALTIES (10 Periods)

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

Module 3: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE (08 Periods)

IBM Watson, The role of Google & Deep mind in AI in Healthcare, Baidu, Facebook & AI in Healthcare, Microsoft & AI in Healthcare.

Module 4: FUTURE OF HEALTHCARE IN AI (10 Periods)

Evidence-based medicine, personalized medicine, Connected medicine, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantable, Digital Health and Therapeutics, Incentivized Wellness, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals.

Module 5: APPLICATIONS OF AI IN HEALTHCARE (09 Periods)

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study 2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study 3: Delivering A Scalable and Engaging Digital Therapy.

Case Study 4: Improving Course Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy.

Case Study 5: Big Data, Big Impact, Big Ethics: Diagnosing Disease Risk from Patient Data.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Analyze how the artificial intelligence is used to predict the disease result and Prognosis Assessment of a patient.
2. How does drug discovery happen and how does AI is helping in drug discovery and Labs.
3. Justify that artificial intelligence provides engineering solutions for early detection and Diagnosis of diseases.
4. Demonstrate the prediction of bladder volume of a patient.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Dr. Parag Mahajan, Artificial Intelligence in Healthcare, Med Manthra Publications, First Edition 2019.
2. Arjun Panesar, Machine Learning and AI for Healthcare Big Data for Improved Health, A press Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril, National Academy of Medicine Publication, First Edition 2019.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=-aHBwTQQyNU
2. https://intellipaat.com/blog/artificial-intelligence-in-healthcare/

WEB RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/
2. https://www.ibm.com/topics/artificial-intelligence-healthcare
3. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CM101701	BANKING AND INSURANCE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to Banking; Bank-Customer Relationship; Electronic Payment System and Business Models; Introduction to Risk and Insurance; Insurance Overview.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the importance of Banking and functions of the Reserve Bank of India and its role in the country's sustainable development.

CO2. Demonstrate the role, relationships, and operations between Banker and Customer.

CO3. Demonstrate the Online Banking system, various types of Electronic Payments, and Business models.

CO4. Demonstrate the concept of risk and principles, functions, and, types of Insurance companies.

CO5. Understand the principles of insurance and its functions.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	2	-	-	1
CO2	3	-	-	-	-	2	-	-	1
CO3	3	-	-	-	-	2	-	-	1
CO4	3	-	-	-	-	2	-	-	1
CO5	3	-	-	-	-	2	-	-	1
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BANKING (09 Periods)

Meaning - Importance of banking- Functions of banking - Reserve Bank of India: Functions – Role of RBI in sustainable development.

Module 2: BANK-CUSTOMER RELATIONSHIP (09 Periods)

Debtor-creditor relationship, deposit products or services, payment, and collection of cheques. Accounts – Types of accounts, the procedure for opening and closing an account - Loans and Advances- principles of lending.

Module 3: ELECTRONIC PAYMENT SYSTEM&BUSINESS MODELS (09 Periods)

Introduction to Online Banking - types of e-payment system, e-cash, NEFT, RTGS, Credit cards, Electronic Wallet and Debit cards. **Business models**- B2B, B2C, C2C, and B2G.

Module 4: INTRODUCTION TO RISK AND INSURANCE (09 Periods)

Insurance: Definition, Insurance as risk mitigation mechanism, elements of insurance. Concept of risk, risk Vs uncertainty.

Module 5: INSURANCE OVERVIEW (09 Periods)

Principles of insurance - insurance types - LIC & GIC – insurance functions, IRDA - Insurance Players in India.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Make a PowerPoint presentation on the banking system in India.
2. Submit a report on the working of insurance companies.
3. Prepare a report on the functions of RBI & IRDA in India.
4. Submit a report on electronic banking facilities provided by Indian banks.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Ranganadha Chary, A.V. and Paul, R.R., Banking and Financial system, Kalyani Publisher, New Delhi, 3rdedition, 2016.
2. Sharma, R.K., Shashi K. Gupta and Jagwant Singh, Banking and Insurance, Kalyani Publishers, New Delhi, 17th edition, 2014

REFERENCES BOOKS:

1. Indian Institute of Banking & Finance, Digital Banking, Taxman Publications Pvt. Ltd., 2016 edition, 2016.
2. Jyotsna Sethi and Nishwan Bhatia, Elements of Banking and Insurance, PHI Learning Pvt. Ltd., 2nd edition, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=a1_p8zhbAfE
2. https://www.youtube.com/watch?v=bxNw9VB5Y_0

WEB RESOURCES:

1. https://unacademy.com/content/railway-exam/study material/economics/importance-of-banking-sector-in-the-country/
2. https://www.geeksforgeeks.org/ life-insurance-meaning-elements-and-types-of-life-insurance-policies/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25DS101701	**BIOINFORMATICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course focus on Biological Data Acquisition, Databases, Data Processing, Methods of Analysis, Applications of Bio-informatics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand basic biological data acquisition in bioinformatics.

CO2. Identify the proper databases for the information search by choosing the biological databases and also submission and retrieval of data from databases.

CO3. Analyze the results of bioinformatics data using text and sequence-based searching techniques.

CO4. Analyze the secondary and tertiary structures of proteins by applying different alignment programs

CO5. Design biological databases by using contextual knowledge on bioinformatics.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-
CO5	3	2	3	3	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BIOLOGICAL DATA ACQUISITION (09 Periods)

Biological information, Retrieval methods for DNA sequence, protein sequence and protein structure information

Module 2: DATABASES (09 Periods)

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary and secondary sequence databases, protein sequence and structure databases.

Module 3: DATA PROCESSING (09 Periods)

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local and global. Distance metrics. Similarity and homology. Scoring matrices, PAM and BLOSUM

Module 4: METHODS OF ANALYSIS (09 Periods)

Dynamic programming algorithms, Needleman-Wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA and BLAST; Multiple Sequence Alignment and software tools for pair wise and multiple sequence alignment, CLUSTAL program, Prediction of Tertiary structure of proteins.

Module 5: APPLICATIONS (09 Periods)

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis, Genomics, Proteomics, Genome analysis – Genome annotation, DNA Microarray, computer aided drug design (CADD).

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Calculate the dynamic programming matrix and one or more optimal alignment(s) for the sequences GAATTC and GATTA, scoring +2 for a match, −1 for a mismatch and with a linear gap penalty of d = 2.
2. Determine whether the RNA string GGACCACCAGG should be folded into two substructures.
3. Discuss how to carry out the multiple sequence alignment of the following three sequences: TTTTAAAA, AAAACCCC, CCCCTTTT.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Lesk, A. K., Introduction to Bioinformatics, Oxford University Press, 4th Edition, 2013
2. Dan Gusfield, Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology, Cambridge University Press, 1997.

REFERENCE BOOKS:

1. Baldi, P. and Brunak, S., Bioinformatics: The Machine Learning Approach, MIT Press, 2nd Edition, 2001.
2. Mount, D.W., Bioinformatics Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.
3. Tindall, J., Beginning Perl for Bioinformatics: An introduction to Perl for Biologists, O'Reilly Media, 1st Edition, 2001.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=liNblw4x50E
2. https://www.youtube.com/watch?v=eZfyWdHnzR0

WEB RESOURCES:

1. https://www.britannica.com/science/bioinformatics
2. https://www.ebi.ac.uk/training/online/courses/bioinformatics-terrified/what-bioinformatics/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101701	BIOLOGY FOR ENGINEERS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to living organisms, Proteins, Nucleic acids and enzymes, Genetics and Molecular biology, Recombinant DNA technology, Human physiology and applied biology.

COURSE OUTCOMES: After successful completion of the course, students will be able to

CO1. Identify difference between cells, Cellular components and their functions.

CO2. Understand Proteins, Nucleic acids structure and function and also Mechanism of enzyme action.

CO3. Identify Central dogma of Molecular biology and processes of Molecular Biology.

CO4. Understand Recombinant DNA technology and its importance in creating new Animals and Plants.

CO5. Understand basics and Mechanism of different Physiological process including nerve function and applications of biological sciences.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: LIVING ORGANISMS (09 Periods)
Comparison of biological organisms with manmade systems, Classification of living organisms, Cellular basis of life, differences between prokaryotes and eukaryotes, classification on the basis of carbon and energy sources, molecular taxonomy

Module 2: PROTEINS, NUCLEIC ACIDS AND ENZYMES (10 periods)
Biomolecules, structure, function and Classification of proteins, structure, function and Classification of and Nucleic acids, Enzymes, Enzyme nomenclature, Classification of Enzymes and Mechanism of Enzyme action, Industrial applications of enzymes, Fermentation and its industrial applications

Module 3: GENETICS AND MOLECULAR BIOLOGY (11 Periods)
Mendel's laws, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation.

Module 4: RECOMBINANT DNA TECHNOLOGY (08 Periods)
Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips.

Module 5: HUMAN PHYSIOLOGY AND APPLIED BIOLOGY (07 Periods)
Fundamentals of Human physiology, neurons, synaptic and neuromuscular junctions, Introduction to EEG, DNA fingerprinting, DNA Micro array and Genomics.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Identify the Cell and Cellular organelle spotters and write the functions of spotters identified
2. Prepare a table of Enzymes and their importance.
3. Assignments on Central dogma of Molecular biology
4. Identify different organs in the organ system diagrams.
5. Assignments on photosynthesis.
6. Quiz related to organ system and functions.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rajiv Singal, Gaurav Agarwal, Biology for Engineers, CBS, 2019.
2. S. Sing and T. Allen, Biology for Engineers, Vayu Education of India, 2014.

REFERENCE BOOKS:

1. B. Alberts, A. Johnson et al., The molecular biology of the cell, Garland Science, 6th edition, 2014
2. A. T. Johnson, Biology for Engineers, CRC press, 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=N0Y386SVGN8
2. https://www.youtube.com/watch?v=1Pzk-UqilW4
3. https://www.youtube.com/watch?v=208pMhKoQeo

WEB RESOURCES:

1. Structure and function of Proteins: https://nptel.ac.in/courses/104102016/16
2. Enzyme catalysis: https://nptel.ac.in/courses/103103026/module3/lec35/4.html
3. Biochips: https://nptel.ac.in/courses/112104029/3

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25LG101701	BUSINESS COMMUNICATION AND CAREER SKILLS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Nature and Scope of Communication, Corporate Communication, Writing Business Messages & Documents, Careers & Résumés, and Interviews.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of professional communication by analyzing and applying the styles and strategies of business communication in Communication Networks, Interpersonal, and Informal communication.

CO2. Analyze the limitations of communication by applying and demonstrating corporate and cross-cultural communication strategies effectively in a business context and Crisis Management situations.

CO3. Apply appropriate strategies and techniques in writing business messages, business letters, and résumé for effective professional communication and career building.

CO4. Demonstrate appropriate communication techniques and answering strategies by analyzing the expectations during presentations and interviews.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	-	2	-	-	-	3	-
CO2	1	2	-	2	-	-	-	3	-
CO3	1	-	-	2	-	-	-	3	-
CO4	1	2	-	2	-	-	-	3	-
Course Correlation Mapping	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NATURE AND SCOPE OF COMMUNICATION (09 Periods)

Introduction – Communication Basics – Functions of Communication – Communication Networks – Interpersonal Communication – Informal Communication – Communication Barriers – Roles of a Manager.

Module 2: CORPORATE COMMUNICATION (09 Periods)

Introduction – Corporate Communication – Cross-Cultural Communication; Concept & Styles – Corporate Communication Strategy – Corporate Citizenship – Crisis Communication: Case Study.

Module 3: WRITING BUSINESS MESSAGES & DOCUMENTS (09 Periods)

Introduction – Importance of Written Business Communication – Types of Business Messages – Five Main Stages of Writing Business Messages – Business Letter Writing – Kinds of Business Letters – Common Components of Business Letters – Strategies for Writing the Body of a Letter.

Module 4: CAREERS AND RÉSUMÉS (09 Periods)

Introduction – Career Building – Résumé Formats: Traditional, Electronic and Video Résumé – Sending Résumés – Follow-up Letters – Business Presentations and Speeches: Planning – Structuring – Organizing – Delivery.

Module 5: INTERVIEWS (09 Periods)

Introduction – General Preparation for an Interview – Success in an Interview – Important Non-verbal Aspects – Types of Interviews – Styles of Interviewing – Types of Interviewing – Online Recruitment Process.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. People often get confused in identifying or using English vocabulary on most occasions. Prepare a list of confusing words and find methods to overcome the difficulties in using those words to uplift the career of professionals.
2. Organizations and institutions use modern technology in communicating with their colleagues, clients, and stakeholders. Make a PowerPoint presentation on the modern communication system of any organization and its role in the success of the organization and its career.
3. As a student in the modern technological world, organizing or attending webinars is inevitable. Analyze the pros and cons of video conferencing by organizing webinars and preparing a report.
4. Form a team and act as a team leader. Prepare a performance appraisal report of the team using visual aids to support the presentation.
5. Make a detailed study on social networking and its impact on modern business and career.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Meenakshi Raman, Prakash Singh, Business Communication, Oxford University Press, New Delhi, 2nd edition, 2012.
2. Neera Jain, Sharma Mukherji, Effective Business Communication, Tata Mc Graw–Hill

REFERENCE BOOKS:

1. Courtland L. Bovee et al., Business Communication Today, Pearson, New Delhi, 2011.
2. Krizan, Effective Business Communication, Cengage Learning, New Delhi, 2010.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/110105052
2. https://edurev.in/courses/14522_Business-Communication-The-Ultimate-Guide

WEB RESOURCES:

1. http://www.career.vt.edu/interviewing/TelephoneInterviews.html
2. http://job-search-search.com/interviewing/behavioral_interviews
3. https://goo.gl/laEHOY (dealing with complaints)
4. http://www.adm.uwaterloo.ca/infocecs/CRC/manual/resumes.html
5. https://goo.gl/FEMGXS
6. http://www.resumania.com/arcindex.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE101701	CIVIL ENGINEERING AND THE SOCIETY	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to civil engineering, aesthetics of historic and modern civil engineering structures, unpredictable nature and the civil engineering; civil engineering solutions for the problems of traffic, pollution, water and waste management; building sustainable smart cities.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze principles of civil engineering to basic civil engineering problems following ethics and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze aesthetics of historic and modern civil engineering structures to solve complex civil engineering problems using tools and techniques by following ethics and latest trends considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze unpredictable nature and the role of civil engineering to solve complex civil engineering problems using tools and techniques by following ethics and considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze civil engineering solutions for the problems of traffic, pollution, water and waste management to solve complex problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO5. Analyze the building principles of sustainable smart cities to solve complex problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	3	2	-	1	1
CO2	3	3	-	2	2	2	-	1	1
CO3	3	3	-	2	2	2	-	1	-
CO4	3	3	-	2	2	2	-	1	-
CO5	3	3	-	2	2	2	-	1	-
Course Correlation Mapping	**3**	**3**	**-**	**2**	**2**	**2**	**-**	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO CIVIL ENGINEERING (07 Periods)

Philosophy of civil engineering, Disciplines of civil engineering, Evolution of construction and civil engineering in the world; Civil engineer - Duties and responsibilities, Role of Civil engineer in the society; Civil engineering materials and their applications, Latest advancements in civil engineering.

Module 2: AESTHETICS OF HISTORIC AND MODERN CIVIL ENGINEERING STRUCTURES (09 Periods)

Aesthetics in civil engineering structures; Aesthetic principles and techniques - Analysis of materials, textures and colors in aesthetic design, Integration of aesthetics with structural engineering principles; Historic civil engineering structures - Case studies of iconic historic structures (e.g. Colosseum, Taj Mahal, Eiffel Tower); Modern civil engineering structures - Exploration of contemporary iconic structures (e.g. Burj Khalifa, Sydney Opera House, Golden Gate Bridge); Integration of aesthetics and functionality - Ethical considerations in balancing aesthetics, functionality and sustainability; Future trends in aesthetic engineering.

Module 3: UNPREDICTABLE NATURE AND THE CIVIL ENGINEERING (09 Periods)

Unpredictable nature, Examples of unpredictable natural disasters - Earthquakes, Floods, Landslides, Hurricanes, Tsunamis, Impacts of unpredictable natural events on infrastructure; Role of civil engineering; Resilience in civil engineering - Strategies for building resilient structures, Risk assessment and analysis, Incorporating safety factors, Using robust construction materials, Implementing redundancy and backup systems, Sustainable design practices; Case studies of successful resilient designs.

Module 4: CIVIL ENGINEERING SOLUTIONS FOR THE PROBLEMS OF TRAFFIC, POLLUTION, WATER AND WASTE MANAGEMENT (11 Periods)

Introduction to urban challenges and sustainable development; Traffic management solutions - Causes and impacts of traffic congestion, Intelligent transportation systems; Pollution control and environmental engineering, Sources and types of urban pollution, Air quality monitoring and control strategies, Water pollution control, Noise pollution management, Sustainable construction practices to reduce pollution; Water resource management, Water demand and supply management in urban areas, Rainwater harvesting techniques, Water conservation and wastewater treatment technologies; Waste management strategies, Solid waste generation and disposal challenges, Waste-to-energy conversion technologies, Case studies of successful waste management initiatives; Integration and synergies among Solutions, Multi-disciplinary approach for holistic solutions.

Module 5: BUILDING SUSTAINABLE SMART CITIES (09 Periods)

Smart city; Elements of smart city infrastructure – Buildings, Mobility, Energy, Water, Waste management, Health and digital layers; Need for an integrated approach; Role of science, technology and innovation in the implementation of smart infrastructure; Smart infrastructure design principles and policies; Case studies: Gujarat International Finance Tech-City in India.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Group discussion on compatibility of modern construction materials compared to that of traditional civil engineering materials
2. Poster presentation on historic and modern civil engineering structures.
3. Submit a case study report on Life Cycle Analysis (LCA) of any one of the historic civil engineering structures.
4. Submit a case study report on the theme of severity of the natural disasters on the Civil engineering structures.
5. Debate on challenges, limitations and solutions for design and implementation of smart city.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. David Muir Wood., Civil Engineering: A Very Short Introduction, Oxford University Press, 1st Edition, 2012.
2. Roger Scruton, The Aesthetics of Architecture, Princeton University Press, 2nd Edition, 2013.

REFERENCE BOOKS:

1. Anubha Kaushik and C. P. Kaushik, Perspectives in Environmental Studies, New Age International (P) Ltd Publications, 6th Edition, 2018.
2. Sang Lee (Editor), Aesthetics of Sustainable Architecture, 010 publishers, 1st Edition, 2013.
3. Marc Kushner, The Future of Architecture in 100 Buildings, Simon and Schuster, 1st Edition, 2015.
4. Nicholas J. Garber and Lester A. Hoel, Traffic and Highway Engineering, Nelson Engineering, 1st Edition, 2008.
5. Stephen M. Wheeler and Timothy Beatley, Sustainable Urban Development, Reader Routledge Urban Reader Series, 3rd Edition, 2014.
6. Larry W. Mays, Water Resources Engineering, Wiley India Private Limited, 3rd Edition, 2011.
7. Hans Straub, A History of Civil Engineering: An Outline from Ancient to Modern Times, The MIT Press, 4th Edition, 1964.
8. Brian Vanden Brink, Iconic: Perspectives on the Man-Made World, Down East Books, Illustrated Edition, 2012.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/123/105/123105001/
2. https://onlinecourses.nptel.ac.in/noc22_ce42/preview
3. https://onlinecourses.nptel.ac.in/noc19_ce31/preview
4. https://onlinecourses.nptel.ac.in/noc20_ce07/preview

WEB RESOURCES:

1. https://bregroup.com/insights/aesthetics-in-architecture-how-beauty-and-design-are-inspiring-each-other/
2. https://keckwood.com/news-updates/how-civil-engineers-help-during-disaster-recovery/#:~:text=Civil%20engineers%20provide%20humanitarian%20and,shortages%20to%20hard%2Dhit%20communities
3. https://smartcities.gov.in/
4. https://www.twi-global.com/technical-knowledge/faqs/what-is-civil-engineering
5. https://www.ice.org.uk/engineering-resources/knowledge-resources/water-and-waste-water-management

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101701	CONSTITUTION OF INDIA	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides and in-depth knowledge about Constitution of India's Preamble and its Philosophy; Union Legislature; Federalism in India; Judiciary and Public Services; Nation Building. The students can gain first-hand information and knowledge about these dynamics and accordingly act based on these sources in their professional and routine activities.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge in the Parliamentary proceedings, Election Commission, Public Services and Foreign Policy of India.

CO2. Apply the reasoning informed by the various aspects of the Constitution and its provisions to assess societal issues and the consequent responsibilities relevant to the professional engineering practice.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	-	-	-	2	-	-	-	-
CO2	2	-	-	-	-	3	-	-	-
Course Correlation Mapping	**2**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PREAMBLE AND ITS PHILOSOPHY (09 Periods)

Introduction to Indian Constitution; Evolution of Indian Constitution; preamble and its philosophy

Module 2: UNION LEGISLATURE (09 Periods)

The Parliament, Parliamentary Structure, Process of Legislation; President of India – Powers and Functions; Prime Minister and Council of Ministers; Constitution Amendment Procedure.

Module 3: FEDERALISM IN INDIA (09 Periods)

Centre-State Administrative Relationship; Governors – Powers and Functions; State Legislature - Composition and powers; Chief Ministers - Powers and Functions; The Election Commission – Powers and Functions.

Module 4: JUDICIARY AND PUBLIC SERVICES (09 Periods)

The Union Judiciary - Supreme Court and High Court; Fundamental Rights and Duties All India Services - Central Civil Services -State Services - Local Services.

Module 5: INTERNATIONAL PARTICIPATION (09 Periods)

Foreign Policy of India; International Institutions Influence: UNO, WTO, WHO, SAARC, International Summits: BRICS, NSS, UNEP – India's Role in International Negotiations; Environmentalism in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Review newspapers and submit a report on critical analysis of Indian Civil Servants exercise of powers, in the awake of constitutionally assigned authority.
2. Visit your village Panchayat office or Municipality office and generate a report on your observations about maintained Constitutional symbolism.
3. Watch few videos on recent Indian Independence Day and Republic Day celebrations as marked in New Delhi and present a detailed report, by considering the following aspects:
   a) Comparatively analyze the speeches of the President of India and Prime Minister of India as delivered on these two occasions.
   b) Compare this two events relevance in terms of Indian Armed Forces presence.
   c) Observe, compare and analyse 'flag code' relevance as marked in these two events.
4. Watch a few videos on recent 'proceedings' of any state Legislative Assembly session and submit a detailed report.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Briji Kishore Sharma, Introduction to the Constitution of India, Prentice Hall of India, 2005.

REFERENCE BOOKS:

1. Mahendra Pal Singh, V. N. Shukla's, Constitution of India, Eastern Book Company, 2011.
2. Pandey J. N., Constitutional Law of India, Central Law Agency, 1998.

VIDEO LECTURES:

1. Doctrine of Basic Structure: https://www.youtube.com/watch?v=cvUf9ZeEe8Y
2. Significance of the Constitution: https://www.youtube.com/watch?v=vr1Dc_-ZKbQ

WEB RESOURCES:

1. The Constitution of India: https://www.youtube.com/watch?v=of2SoO8i8mM
2. Protection of Constitutional Democracy: https://www.youtube.com/watch?v=smJ99cdPrns

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CM101702	COST ACCOUNTING AND FINANCIAL MANAGEMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Cost accounting; cost sheet & preparation of cost sheet; standard costing & variance analysis; financial management & ratio analysis; introduction to investment**.**

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the concepts of Cost Accounting and Management Accounting and the elements of costing.

CO2. Determine the Cost of Production for pricing decisions.

CO3. Apply the Standard Costing and Variance techniques for the control of the cost of production

CO4. Analyze the Profitability and financial condition of an organization using Ratios.

CO5. Apply Capital Budgeting techniques for making investment decisions in an organization.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	2	-	1	-	-	-
CO2	3	-	-	2	-	1	-	-	-
CO3	3	-	-	2	-	1	-	-	-
CO4	3	-	-	2	-	1	-	-	-
CO5	3	-	-	2	-	1	-	-	-
Course Correlation Mapping	**3**	**-**	**-**	**2**	**-**	**1**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: COST ACCOUNTING (09 Periods)

Meaning of Cost and Cost Accounting, Objectives, Scope, Advantages, and Disadvantages – Cost Accounting Vs Management Accounting – Elements of Costing – Installation of costing system – Material Control, Labor Control, Overhead Control.

Module 2: COST SHEET & PREPARATION OF COST SHEET (09 Periods)

Analysis of Cost – Preparation of cost sheet, estimate, tender, and quotation (Simple problems) – Importance of Costing while pricing the products

Module 3: STANDARD COSTING & VARIANCE ANALYSIS (09 Periods)

Introduction to Standard Costing & Variances – Variance Analysis: Material variances, Labor variances (Simple Problems).

Module 4: FINANCIAL MANAGEMENT & RATIO ANALYSIS (09 Periods)

Meaning, Objectives - Nature and Scope, Importance of FM – Ratio Analysis**:** Types of Ratios: Solvency Ratios, Liquidity Ratios, Turnover Ratios, and Profitability Ratios - Financial Statement Analysis through Ratios (Simple Problems).

Module 5: INTRODUCTION TO INVESTMENT (09 Periods)

Investment - Meaning and Definition- concept of risk and returns - Capital budgeting techniques – Security Analysis and Portfolio Management (Basic concepts).

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Prepare a report on the role of cost accountants in the growth of a company.
2. To visit the manufacturing unit to observe how they used various techniques for analyzing the financial health of a company.
3. Prepare a report on factors influencing the form of business organization.
4. Prepare the cost sheet with practical examples of any two manufacturing companies.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. S.P. Jain and K.L. Narang: Cost Accounting, Kalyani Publishers, Ludhiana, 10th edition, 2016.
2. I.M. Pandey, Financial Management, Vikas Publishing House Pvt. Ltd., 14th edition, 2016.

REFERENCE BOOKS:

1. The Institute of Company Secretaries of India, Cost and Management Study Material, New Delhi.
2. CA Saravana Prasath, Cost Accounting and Financial management, Wolters Kluwer India Pvt. Ltd., New Delhi, 2018.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ESqO8sFgQa0&list=PLLhSIFfDZcUVE2kzOhEubO9rkvUOAgZbz
2. https://www.youtube.com/watch?v=tzasFmP1CpAhttps://www.youtube.com/watch?v=tzasFmP1CpA

WEB RESOURCES:

1. https://www.tutorialspoint.com/accounting_basics/management_versus_cost_accounting.htm
2. https://www.netsuite.com/portal/resource/articles/financial-management/financial-management.shtml

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CB101701	CYBER LAWS AND SECURITY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Crimes and Indian IT Act; Cyber Offenses; Tools and Methods used in Cyber Crime; Phishing ad Identity Theft; Indian and Global Perspective on Cyber Crimes and Cyber Security; Organizational Implications on Cyber Security; IPR Issues; Cyber

Crime and Terrorism; Cyber Crime Illustrations

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Cyber security, Cybercrimes and its related laws in Indian and Global Act.

CO2. Analyze the legal perspectives and laws related to cybercrimes in Indian context.

CO3. Apply security and privacy methods in development of modern applications and in organizations to protect people and to prevent cybercrimes.

CO4. Solve Cyber security issues using privacy policies and Use antivirus tools to minimize the impact of cyber threats.

CO5. Apply security standards for the implementation of Cyber Security and laws.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO CYBER CRIMES AND OFFENSES (09 Periods)

Cyber Crimes: Introduction, Definition, Origin, Cybercrime and information security, Cyber criminals, Classifications of cybercrimes, The legal perspectives and Indian perspective, Cybercrime and Indian ITA 2000, Global perspective on cybercrimes.

Cyber Offenses: Introduction, Criminals planning on attacks, social engineering, Cyber stalking, Cyber Cafe and crimes, Botnets.

Module 2: TOOLS AND METHODS USED IN CYBER CRIME AND PHISHING AND IDENTITY THEFT (09 Periods)

Introduction, Proxy servers and Anonymizers, Phishing, Password cracking, Key loggers and Spywares, Virus, Worms and Ransomware, Trojan horses and Backdoors, Steganography, DoS and DDoS attacks.

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Module 3: CYBER CRIMES AND CYBER SECURITY-LEGAL PERSPECTIVES (08 Periods)

Introduction, Cyber laws in Indian context, The Indian IT act, Challenges to Indian law and Cybercrime scenario in India, Consequences of not addressing the weakness in IT act, Digital signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber law, Technology and Students in India scenario.

Module 4: CYBER SECURITY-ORGANIZATIONAL IMPLICATIONS (10 Periods)

Introduction, Web threats for organizations – evils and perils, Security and privacy implications from cloud computing, Social Media Marketing-Security risks and Perils for organizations, social computing and associated challenges for organizations, Protecting people's privacy in organization, Organizational guidelines for internet usage, Safe computing and Usage policy, Incident handling and best practices.

Module 5: CYBER CRIME AND TERRORISMAND ILLUSTRATIONS (09 Periods)

Cyber Crime & Terrorism: Introduction, Intellectual property in the cyber space, The ethical dimension of cybercrimes, The psychology, Mindset and skills of hackers and cyber criminals, Sociology of cyber criminals, Information warfare.

Cyber Crime Illustrations: Indian banks lose millions of rupees, Justice vs. Justice, Parliament attack, The Indian case of online gambling, Bank and credit card related frauds, Purchasing goods and services scam, Nigerian 419 scam.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. The Cyber Security Risks on social media – Learn from Case Studies: https://www.rswebsols.com/tutorials/internet/cyber-security-risks-social-media
2. SIX automates key cybersecurity tasks to actively protect itself against social media threats: https://www.hootsuite.com/resources/six-group-case-study
3. Important Cyber Law Case Studies: https://www.cyberralegalservices.com/detail-casestudies.php

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Nina Gobole, Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India, 2011.

REFERENCE BOOKS:

1. Prashant Mali, Cyber Law and Cyber Crimes, Snow White Publications Pvt. Ltd., 2013.

2. Alfred Basta and et al, Cyber Security and Cyber Laws, Cengage Learning India 2018

VIDEO LECTURES:

1. Learn Cyber Security | Cyber Security Training:

   https://www.youtube.com/watch?v=PlHnamdwGmw

2. Cyber Security for Beginners: https://www.youtube.com/watch?v=4RE4d23tDFw

WEB RESOURCES:

1. https://study.com/academy/course/computer-science-110-introduction-to-cybersecurity.html

2. https://www.pandasecurity.com/en/mediacenter/panda-security/types-of-cybercrime/

3. https://mediasmarts.ca/digital-media-literacy/digital-issues/cyber-security/cyber-security-spam-scams-frauds-identity-theft

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE101701	ELECTRICAL SAFETY AND SAFETY MANAGEMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course deals with the various aspects of potential risk due to electrical shock; safety precautions to be followed while working in hazardous zones; safe practices while handling various electrical equipment and during maintenance; and relevant electrical safety standards and Indian rules and acts.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the Indian electricity rules, regulations and various standards to be maintained for the safety of life and equipment.

CO2. Understand the potential effects of electrical shock and safety measures to protect against such risk.

CO3. Understand the safety aspects and safe practices to be followed while installing residential, commercial, and agricultural appliances.

CO4. Identify various hazardous working zones and take necessary precautionary measures while working in such areas.

CO5. Follow safety measures during installation, testing and commissioning, and maintenance of electrical equipment/plant.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	1	1	3	-	-	1
CO2	3	-	-	1	2	-	-	-	1
CO3	3	-	-	1	2	-	-	-	1
CO4	3	-	-	2	2	2	-	-	1
CO5	3	-	-	-	2	2	-	-	1
Course Correlation Mapping	**3**	-	-	**1**	**2**	**3**	-	-	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INDIAN ELECTRICITY RULES AND ACTS, AND THEIR SIGNIFICANCE (10 Periods)

OSHA standards of electrical safety, Basic electrical safety rules as per OSHA; Objectives and scope of IE acts and IE rules, Ground clearance and Section Clearances, Clearance in transmission and distribution lines, Significance of Equipment Earthing, Earthing of equipment bodies, structures and non-current carrying metallic parts, Earthing of system neutral; Rules regarding first aid and firefighting facility, Electrical safety general requirements as per IE rules.

Module 2: INTRODUCTION TO ELECTRICAL SAFETY AND SAFETY MANAGEMENT (10 Periods)

Electric Safety: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, Protection against electrical hazards and types, Effect of current on the human body, Principles of electrical safety and approach to prevent accidents.

Electric shocks and its prevention: Primary and secondary electrical shocks, possibilities of getting an electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, Safety precautions in LV installations and electric plant.

Module 3: ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL, AND AGRICULTURAL INSTALLATIONS (08 Periods)

Introduction—Wiring and fitting; Domestic appliances—water tap giving a shock, shock from wet wall, fan firing shock; multi-storied building, Temporary installations, Agricultural pump installation; Do's and Don'ts for safety in the use of domestic electrical appliances; Principles of safety management in electrical plants, safety auditing, and economic aspects.

Module 4: ELECTRICAL SAFETY IN HAZARDOUS AREAS (07 Periods)

Hazardous zones—class 0, 1 and 2; Sparks, flashovers and corona discharge in electrical plants; equipment for hazardous locations; scope for live line work, principles of live line maintenance, special tools for live line maintenance, safety instructions for working on HV lines/apparatus.

Module 5: SAFETY DURING INSTALLATION TESTING AND MAINTENANCE (10 Periods)

Safety during installations: Preliminary preparations, preconditions for the start of installation work and safe sequence, safety aspects during installations of Transformers and Rotating machines.

Safety during testing: Purpose of commissioning checks and tests, equipment tests, high voltage energization tests, performance and acceptance tests, and safety aspects during commissioning.

Safety during maintenance: Operators' safety, Types of safety maintenance, Safety procedures, safety precautions during maintenance, and planning of maintenance.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Study and submit a report on various electrical safety standards followed in abroad countries.
2. Visit a nearby industry and submit a report on various safety measures followed in the industry.
3. Study and submit a report on standard practices followed during the maintenance/commissioning of the electrical apparatus in any industry.
4. Collect information about various safety/alert sign boards and the relative measures for a particular situation.
5. Should practice preliminary first aid assistance such as Cardiopulmonary resuscitation (CPR) and shall demonstrate.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rao, Prof. H.L. Saluja, Electrical Safety, Fire Safety Engineering and Safety Management, Khanna Publishers. New Delhi, 2nd Edition, 2018 Reprint.

REFERENCE BOOKS:

1. Cadick, John, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel, Electrical safety Handbook, McGraw-Hill Education, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=g-ofq7i_u48

WEB RESOURCES:

1. https://cercind.gov.in/Act-with-amendment.pdf
2. https://www.edapp.com/blog/electrical-safety-training-topics/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25MG101701	ENTREPRENEURSHIP FOR MICRO, SMALL AND MEDIUM ENTERPRISES	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To understand the setting up and management of MSMEs and initiatives of Government and other institutions support for growth and development of MSMEs

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic of SME and challenges of MSMEs

CO2. Explain the opportunities to Set-Up SSI/SME Units and role of rural & women entrepreneurship.

CO3. Illustrate roles of various institutions supporting MSMEs.

CO4. Understand Management of MSME, NPA & sickness units

CO5. Evaluate role of Government in Promoting Entrepreneurship

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	2	-	-	-	-	-	-
CO2	1	1	2	-	2		1	-	-
CO3	2	2	1	-	-	1	-	-	-
CO4	3	1	2	-	-	-	-	-	2
CO5	2	2	1	-	-	-	-	-	1
Course Correlation Mapping	**2**	**2**	**2**	**-**	**2**	**1**	1	-	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION2 (07 Periods)

Concept & Definition, Role of Business in the modern Indian Economy SMEs in India, Employment and export opportunities in MSMEs. Issues and challenges of MSMEs

Module 2: MSME SETTING (09 Periods)

Identifying the Business opportunity, Business opportunities in various sectors, formalities for setting up an enterprise - Location of Enterprise – steps in setting up an enterprise – Environmental aspects in setting up, Incentives and subsidies.

Module 3: MSMES SUPPORTING INSTITUTIONS (09 Periods)

Forms of Financial support, long term and short-term financial support, Sources of Financial support, Development Financial Institutions, Investment Institutions, Central level institutions, State level institutions, other agencies, Commercial Bank – Appraisal of Bank for loans

Module 4: MANAGEMENT OF MSME (10 Periods)

Management of Product Line; Communication with clients – Credit Monitoring System - Management of NPAs - Restructuring, Revival and Rehabilitation of MSME, Problems of entrepreneurs – sickness in SMI – Reasons and remedies –– Evaluating entrepreneurial performance

Module 5: ENTREPRENEURSHIP PROMOTION (10 Periods)

MSME policy in India, Agencies for Policy Formulation and Implementation: District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB)

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Present a case study on MSMEs Business Strategies.
2. Collect the data about nearby MSMEs and Present their structures in a PPT
3. Discuss in the group MSMEs opportunities in terms of Orientation and Develop mentation.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Vasant Desai, Small Scale Industries and Entrepreneurship, Himalaya Publishing House, 2003.
2. Poornima M Charanthimath, Entrepreneurship Development Small Business Enterprises, Pearson, 2006.

REFERENCE BOOKS:

1. Suman Kalyan Chaudhury, Micro Small and Medium Enterprises in India Hardcover, Raj Publications, 2013.
2. Aneet Monika Agarwal, Small and medium enterprises in transitional economies, challenges and opportunities, DEEP and DEEP Publications
3. Paul Burns & Jim Dew Hunt, Small Business Entrepreneurship, Palgrave Macmillan publishers, 2010.

VIDEO LECTURES:

1. https://sdgs.un.org/topics/capacity-development/msmes
2. https://blog.tatanexarc.com/msme/msme-schemes-in-india-for-new-entrepreneurs-and-start-ups/

WEB RESOURCES:

1. ncert.nic.in/textbook/pdf/kebs109.pdf
2. https://www.jetir.org/papers/JETIR1805251.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE101702	ENVIRONMENTAL POLLUTION AND CONTROL	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on fundamentals of air pollution, dispersion of pollutants, effects and control of air pollution, water pollution, soil pollution and control, and municipal solid waste management.
COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze air and noise pollution using appropriate tools and techniques to solve complex environmental issues following relevant standards considering society, environment and sustainability besides communicating effectively in graphical form.
CO2. Analyze air and noise pollution control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
CO3. Analyze water pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
CO4. Analyze soil pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
CO5. Analyze solid waste and its management measures using appropriate tools and techniques to solve solid waste disposal issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	-	2	3	2	-	1	-
CO2	2	3	-	2	3	2	-	1	1
CO3	2	3	-	2	3	2	-	1	1
CO4	2	3	-	2	3	2	-	1	1
CO5	2	3	-	2	3	2	-	1	1
Course Correlation Mapping	**2**	**3**	**-**	**2**	**3**	**2**	**-**	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: AIR AND NOISE POLLUTION (08 Periods)

Air Pollution: Scope, Significance, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, material and vegetation; Global effects of air pollution; Air pollution meteorology - Lapse rate, Inversion, Plume pattern; Dispersion of air pollutants - Dispersion models and applications; Ambient air quality standards.
Noise Pollution: Sound pressure, Power and intensity, Impacts of noise, permissible limits of noise pollution, measurement of noise, Noise standards.

Module 2: AIR AND NOISE POLLUTION CONTROL (10 Periods)

Self-cleansing properties of the environment, Dilution method, Control at source, Process changes and equipment modifications, Control of particulates – Types of equipment, Design and operation - Settling chambers, Centrifugal separators, Bag house filters, Wet scrubbers, Electrostatic precipitators; Control of gaseous pollutants – Adsorption, Absorption, Condensation, Combustion; Control of air pollution from automobiles, Control of noise pollution, Case studies, Latest developments in the air and noise pollution control.

Module 3: WATER POLLUTION AND CONTROL (10 Periods)

Water pollution – Sources, Causes, Effects; Surface and groundwater quality – Physical, Chemical, Biological; Drinking water quality standards, Water purification – Processes, engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Wastewater – Sources, Causes, Effects, Treatment process and disposal – Primary, Secondary, Tertiary; Case studies, Latest developments in the water pollution control.

Module 4: SOIL POLLUTION AND CONTROL (08 Periods)

Soil pollutants, Sources of soil pollution, Causes, Effects and control of soil pollution, Diseases caused by soil pollution, Methods to minimize soil pollution, Effective measures to control soil pollution, Soil quality standards, Case studies, Latest developments in the soil pollution control.

Module 5: MUNICIPAL SOLID WASTE MANAGEMENT (09 Periods)

Municipal solid waste – Types, Composition and characteristics; Methods of collection and transportation; Methods of disposal – Open dumping, Sanitary landfill, Composting and Incineration; Utilization - 6R Concept, Recovery and recycling and Energy Recovery; Latest developments in solid waste management.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Explain plume patterns due to air pollution and meteorology effects and draw a neat sketch of plume pattern from any chimney that you have observed in recent times.

2. Compare the different air pollution control equipment used in India and draw a neat sketch line diagram of equipment you have seen in any of your industrial visit.

3. Submit a study report on Coagulation, Flocculation, Sedimentation, Filtration and Disinfection in your own words after watching a YouTube video on water treatment.

4. Enumerate the effective measures to control soil pollution with any two case studies.

5. Submit a report on case studies on the use of 6Rs concept of Municipal Solid Waste Management.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Peavy, H. S, Rowe, D. R., and Tchobanoglous, G., Environmental Engineering, McGraw Hill Inc., 1985.
2. C. S. Rao, Environmental Pollution Control Engineering, New Age International Pvt. Ltd., 2nd Edition, 2007.
3. Ibrahim A. Mirsa, Soil Pollution: Origin, Monitoring & Remediation, Springer, UK, 2nd Edition, 2008.

REFERENCE BOOKS:

1. M. N. Rao and H. V. N. Rao, Air Pollution, Tata McGraw–Hill Education Pvt. Ltd., 19th Edition, 2010.
2. Daniel Vallero, Fundamentals of Air Pollution, Academic Press (Elsevier), 5th Edition, 2014.
3. S. M. Khopkar, Environmental Pollution Monitoring and Control, New Age International Pvt. Ltd., 2nd Edition, 2007.
4. V. M. Domkundwar, Environmental Engineering, Dhanpat Rai & Co. Pvt. Ltd., New Delhi, 2014.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/123/105/123105001/
2. https://archive.nptel.ac.in/courses/105/107/105107213/
3. https://archive.nptel.ac.in/courses/103/107/103107084/

WEB RESOURCES:

1. https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200501211601643 5Ranvijay-Pratap-Singh-Environmental-Pollution.pdf
2. https://www.deshbandhucollege.ac.in/pdf/resources/1585622878_HIST_(HONS.)_II_Env-Pollution.pdf
3. https://www.jica.go.jp/jica-ri/IFIC_and_JBICI-Studies/english/publications/reports/study/topical/health/pdf/health_08.pdf
4. https://www.iitr.ac.in/wfw/web_ua_water_for_welfare/education/proceeding_of_short-term_training/diploma/Environmental_Sciences_May_24-28_2007/Lecture_notes/Env_Pollution-rb.pdf
5. https://anits.edu.in/online_tutorials/es/Unit%203.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EC101702	**ESSENTIALS OF VLSI**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course contains the topics that make student realize the need for Testing. The various types of testing along with Fault Modeling. Test methods for evaluation and test generation algorithms, Delay Tests, IDDQ Tests for testing the circuits, Ad-Hoc DFT Methods, Scan Based Designs, Built-In Self-Test.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the importance of Testing, fault models and related theorems.

CO2. Analyze various test methods as applicable to digital circuits.

CO3. Appraise the various combinational and sequential circuit test generation algorithms for functional verification of digital circuits

CO4. Assess delay test algorithms and IDDQ test algorithms for at-speed testing of CMOS Integrated Circuits.

CO5. Recognize the concepts and architectures for Built-In Self-Test to satisfy industry specifications.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-
CO4	3	3	2	2	2	3	-	-	-
CO5	3	-	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO VLSI (09 Periods)

Levels of Abstraction, VLSI Design Flow, MOS Transistor - Characteristics, I_{DS} – V_{DS} Relation, NMOS and CMOS Logic – Logic Gates Design, NMOS and CMOS Fabrication Process.

Module 2: CMOS CIRCUIT DESIGN PROCESS (10 Periods)

MOS Layers, Stick Diagrams, NMOS and CMOS Design Styles, Lambda based Design Rules, NMOS and CMOS Layouts for Inverter and Universal Gates, Sheet Resistance, Capacitance and Delay Calculations, Effects of Scaling.

Module 3: SUBSYSTEM DESIGN (11 Periods)

Adders – Manchester Carry Chain Adder, Carry Look Ahead Adder, Carry Select Adder, Carry Skip adder, Barrel Shifter, Multiplier – Array Multiplier, Booth Multiplier.

Module 4: PROGRAMMABLE HARDWARE (06 Periods)

Design Styles, Programmable Interconnects, Field Programmable Gate Arrays, Complex Programmable Logic Devices, Cell based Design Methodology.

Module 5: DESIGN FOR TESTABILITY (09 Periods)

Ad-Hoc DFT Methods, Full Scan Design, Partial Scan Design, Random Logic BIST – Test-per-Clock and Test-per-Scan BIST Systems; Boundary Scan Standard – TAP Controller and Port.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Develop and Illustrate D – algorithm for Sequential Circuits.
2. Illustrate the applicability of existing testing algorithms for circuits with multiple stuck-at-faults.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Michael L. Bushnell, Vishwani D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Kluwer Academic Publishers, Springer US, New York, 2006.

REFERENCE BOOKS:

1. Miron Abramovici, Melvin A. Breur, Arthur D. Friedman, Digital Systems Testing and Testable Design, Wiley, Jaico Publishing House, 1st Edition, 2001.
2. Alfred L. Crouch, Design for Test for Digital ICs & Embedded Core Systems, Pearson Education, 1st Reprint Edition, 2007.
3. Robert J. Feugate, Jr., Steven M. Mclntyre, Introduction to VLSI Testing, Prentice Hall, 1st Illustrated Edition, 1998.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/117105137
2. https://nptel.ac.in/courses/117103125
3. https://nptel.ac.in/courses/106103016
4. https://archive.nptel.ac.in/courses/106/103/106103116/

WEB RESOURCES:

1. https://www.electronics-tutorial.net/vlsi-design-for-testability/IC-Testing.html
2. https://alexromanov.github.io/2022/08/14/what-is-testability/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CB101702	INTRODUCTION TO ETHICAL HACKING	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on ethical hacking overview, role of security and penetration testers, foot printing, reconnaissance and scanning networks, enumeration and vulnerability analysis, system hacking, network protection systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand and recognize role of security and penetration testers to protect the system from malware attacks.

CO2. Apply the foot printing tools to find the vulnerabilities in the system.

CO3. Analyze vulnerabilities to find the system security loopholes or flaws in networked systems within a given range of IP

CO4. Apply the web attackers tools to assess the website's security

CO5. Identify the possible incidents and threats, alert administrators, and prevent potential attacks using IDS

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-
CO5	3	2	3	2	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (10 Periods)

Ethical Hacking Overview, Role of Security and Penetration Testers. Penetration, Testing Methodologies, Laws of the Land, Overview of TCP/IP, The Application Layer, The Transport Layer, The Internet Layer, IP Addressing, Network and Computer Attacks, Malware, Protecting Against Malware Attacks, Intruder Attacks, Addressing Physical Security.

Module 2: FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS (09 Periods)

Foot printing Concepts, Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email, Competitive Intelligence, Foot printing through Social Engineering, Foot printing Tools, Network Scanning Concepts, Port-Scanning Tools, Scanning Techniques, Scanning Beyond IDS and Firewall

Module 3: ENUMERATION AND VULNERABILITY ANALYSIS (09 Periods)

Enumeration Concepts, NetBIOS Enumeration, SNMP, LDAP, NTP, SMTP and DNS Enumeration, Vulnerability Assessment Concepts, Desktop and Server OS Vulnerabilities, Windows OS Vulnerabilities, Tools for Identifying Vulnerabilities in Windows, Linux OS Vulnerabilities, Vulnerabilities of Embedded Oss.

Module 4: SYSTEM HACKING (10 Periods)

Hacking Web Servers, Web Application Components, Vulnerabilities, Tools for Web Attackers and Security Testers Hacking Wireless Networks, Components of a Wireless Network, Wardriving, Wireless Hacking, Tools of the Trade.

Module 5: NETWORK PROTECTION SYSTEMS (07 Periods)

Access Control Lists, Cisco Adaptive Security Appliance Firewall, Configuration and Risk Analysis Tools for Firewalls and Routers, Intrusion Detection and Prevention Systems, Network, Based and Host-Based IDSs and IPSs, Web Filtering, Security Incident Response Teams, Honeypots.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. List out various ways used to Protect Yourself from Hackers.
2. Demonstrate how do White Hackers work?
3. Demonstrate The bug bounty program.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2. Patrick Engebretson, The Basics of Hacking and Penetration Testing, SYNGRESS, Elsevier, 2013.

REFERENCE BOOKS:

1. Dafydd Stuttard and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Wiley, 2nd Edition, 2011.
2. Justin Seitz, Black Hat Python: Python Programming for Hackers and Pentesters, 2nd Edition, 2014.

VIDEO LECTURES:

1. https://www.coursera.org/learn/ethical-hacking-essentials-ehe
2. https://www.udacity.com/course/ethical-hacker-nanodegree--nd350

WEB RESOURCES:

1. https://github.com/PacktPublishing/Python-Ethical-Hacking
2. https://www.youtube.com/watch?v=x3IwvPvDpKE

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25BS101703	FORENSIC SCIENCE	3	-		-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Forensic Science, Tools and Techniques in Forensic Science, Forensic Photography, Crime Scene Management, Crime Scene Management Laws and Forensic Science.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts of Forensic science.

CO2. Apply various tools and techniques in forensic science for crime investigation.

CO3. Understand Forensic Photography fundamentals.

CO4. Perform Crime scene investigation, scene reconstruction and prepare reports.

CO5. Understand Legal aspects of Forensic Science.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	-	-	-
CO5	3	3	2	2	2	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (09 Periods)

Introduction, Need, Scope, Concepts and Significance of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Organizational set-up of a Forensic Science Laboratory. Investigative strategies. Expert testimony and eye-witness report.

Module 2: TOOLS AND TECHNIQUES IN FORENSIC SCIENCE (09 Periods)

Basic principles of microscopy, spectroscopy, chromatography, Electrophoresis, Enzyme Linked Immunosorbent Assay (ELISA), Radio Immuno Assay (RIA). Measuring and optical instruments. Research methodologies; Formation of research design on a specific problem. Central tendency and Dispersion. Test of significance. Analysis of variance, Correlation and Regression.

Module 3: FORENSIC PHOTOGRAPHY (08 Periods)

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.

Module 4: CRIME SCENE MANAGEMENT (11 Periods)

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences, Chain of custody and Reconstruction of scene of crime. Report writing.

Module 5: LAW AND FORENSIC SCIENCE (08 Periods)

Legal aspects of Forensic Science: Forensic Science in the Criminal Justice System, The Criminal Investigation Process, Production of Evidence: The Subpoena, The Rules of Evidence, Authentication of Evidence: The Chain of Custody, The Admissibility of Evidence, Laboratory Reports, Examples of Analysis and Reports, Expert Testimony, Getting into Court, Testifying, Being a Witness and an Expert, Considerations for Testimony.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENCIAL LEARNING

1. Study of Computer Forensics and different tools used for forensic investigation
2. Identify and list the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Houck M.M and Siegel J.A, Fundamentals of Forensic Science, Elsevier, 2nd edition, 2010.
2. Sharma B.R, Forensic Science in Criminal Investigation and Trials, Universal Publishing Co., New Delhi, 2003.

REFERENCE BOOKS:

1. Nanda B.B and Tewari, R.K, Forensic Science in India- A vision for the Twenty First Century, Select Publisher, New Delhi, 2001.
2. James, S.H and Nordby, J.J, Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
3. Saferstein, Criminalistics, An Introduction of Forensic Science, Prentice Hall Inc, USA, 2007.
4. Barry, A.J. Fisher, Techniques of Crime Scene Investigation, CRC Press, New York, 7th edition, 2003.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106178
2. https://www.youtube.com/watch?v=X5fo1H7bc0g

WEB RESOURCES:

1. https://www.nist.gov/forensic-science
2. https://www.coursera.org/learn/forensic-science

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101702	**GENDER AND ENVIRONMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Gender and the environment relationship, Gendered Roles in the Family & Community, Gender and sustainable development, Gender in environmental justice, Gender & Environmental Security.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the knowledge of gender & environmental connections by analyzing key issues and topics within global environmental politics in environmental decision-making.

CO2. Demonstrate knowledge of the concepts of gender and sustainable development through debates and policy documents.

CO3. Analyze the concept of environmental security and justice by identifying the sources of insecurity.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	-	-	-	3	3	-	-	-	-	-
CO2	3	-	-	-	-	2	3	1	-	2	-	-
CO3	3	1	-	-	-	3	3	-	-	-	-	2
Course Correlation Mapping	**3**	**1**	**-**	**-**	**-**	**3**	**3**	**1**	**-**	**2**	**-**	**2**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: GENDER AND ENVIRONMENT RELATIONSHIP ***(09 Periods)***

Introduction – Gender and Environment – Development of gender roles – Society, gender & environment – Understanding environmental politics – Gender-environment connections–Eco-feminism – Cultural eco-feminism – Social eco-feminism – Feminist political ecology

Module 2: GENDERED ROLES IN THE FAMILY & COMMUNITY ***(09 Periods)***

Organization of the household – Domestic division of labour – Food: growing, harvesting, shopping, preparing, and cooking

Gender & Power – Planning – Politics – NGO – Gendering of environmental protest – Environmental decision-making

Module 3: GENDER AND SUSTAINABLE DEVELOPMENT ***(09 Periods)***

Concept of sustainability & its achievement – Concept of sustainable development – Ecological Modernization – Gender & sustainability debates – Gender & sustainable development debates - Gender in policy documents – Gender, poverty & equity in sustainable development

Module 4: GENDER IN ENVIRONMENTAL JUSTICE ***(09 Periods)***

Normative Concerns (Fairness, Inequality & Justice) –Making sense of Environmental justice – Ecological debt, Transnational harm, & human rights – Ecological justice – Gender &Environmental Justice – Gender, Vulnerability & risk – Women in environmental justice movements – Knowledge & participation – Gender, sustainability & justice as guiding concepts.

Module 5: GENDER AND ENVIRONMENTAL SECURITY ***(09 Periods)***

Connections between security & the environment – **Gender, environment & security:** Sustainability as security – poverty & insecurity – Insecurity as injustice – Competing ways of thinking security – Reflecting on sources of insecurity – **Case Study** – Food Security -**Case Study** – The impacts of natural disasters

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a poster presentation on the impact of globalization on family structure and society.
2. Prepare a presentation on the family setup of different countries and their peculiar customs.
3. Prepare poster presentation on "Ancient hominines walked like humans but climbed like apes."
4. Find out the problems of present society and being part of future generations how you may help to strengthen environmental security.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Nicole Detraz, *Gender and the Environment,* Polity Press, Cambridge, UK. 2017
2. Susan Buckingham- Hatfield, *Gender and Environment*, Rutledge, London. 2000

REFERENCE BOOKS:

1. Promillakapur ed., *Empowering Indian Women*, Publication Division, Government of India, New Delhi. 2000.
2. Ronnie Vernooy, Ed., *Social and Gender Analysis Natural Resource Management: Learning Studies and Lessons from Asia,* Sage, New Delhi. 2006
3. Swarup Hemlata and Rajput, Pam, *Gender Dimensions of Environmental and Development Debate: The Indian Experience,* In Sturat S. Nagel, (ed). *India's Development and Public Policy*. Ashgate, Burlington. 2000

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101703	INDIAN ECONOMY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction; Elementary Economic Analysis; Economic Planning; Time Value of Money; Value Analysis/Value Engineering.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts of economics, economic analysis, economic planning and strata.

CO2. Demonstrate knowledge in capital budgeting, evaluation of engineering projects, depreciation policy and familiarize with the concepts of value analysis vs value engineering.

CO3. Analyze and apply financial information for the evaluation of finance.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	2	-	-	-
CO2	3	-	-	-	-	2	-	-	2
CO3	3	-	-	-	-	2	-	-	2
Course Correlation Mapping	3	-	-	-	-	2	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (09 Periods)

Economics-Flow in an Economy, Law of Supply and Demand; Micro and Macro Economics; Relationship between Science, Engineering, Technology and Economic Development; Concept of Engineering Economics-Types of Efficiency, Definition and Scope of Engineering Economics.

Module 2: ELEMENTARY ECONOMIC ANALYSIS (09 Periods)

Economic Analysis – Meaning, Significance, Simple Economic Analysis; Material Selection for a Product, Substitution of Raw Material; Design Selection for a Product; Material Selection-Process Planning, Process Modification.

Module 3: ECONOMIC PLANNING (09 Periods)

Introduction - Need for Planning in India, Five-year plans (1951-2012), NITI Aayog (from 2014 onwards); Inclusive Growth-Meaning, Significance, Need for inclusive growth in India, Strategy for more inclusive growth, Challenges and Prospects; Employment and Inclusive Growth in India, Role of engineers in sustaining inclusive growth.

Module 4: TIME VALUE OF MONEY (12 Periods)

Concepts and Application; Capital Budgeting-Traditional and Modern Methods; Simple and Compound Interest, Cash Flow Diagram, Principle of Economic Equivalence; Evaluation of Engineering Projects - Present Worth Method, Future Worth Method, Annual Worth Method, Internal Rate of Return Method, Cost-benefit Analysis in Public Projects; Depreciation Policy-Depreciation of Capital Assets, Causes of Depreciation, Straight Line Method and Declining Balance Method.

Module 5: VALUE ANALYSIS/VALUE ENGINEERING (06 Periods)

Introduction-Value Analysis, Value Engineering, Functions, Aims; Value Analysis vs Value Engineering; Value Engineering Procedure- Advantages, Application Areas.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a poster presentation on the impact of globalization on family structure and society.
2. Prepare a presentation on family setups of different countries and their peculiar customs if any.
3. Prepare a poster presentation on "Ancient hominin walked like a human but climbed like an ape."
4. Find out the problems of present society and being part of future generations and how you may help to strengthen environmental security.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Panneerselvam. R., Engineering Economics, PHI Learning Private Limited, New Delhi, 2nd edition, 2013.
2. Jain. T. R., V. K. Ohri, O. P. Khanna., Economics for Engineers, VK Publication, 1st edition, 2015.

REFERENCE BOOKS:

1. DuttRudar & Sundhram K. P. M., Indian Economy, S. Chand, New Delhi, 62nd revised edition, 2010.
2. Misra, S. K. & V. K. Puri., Indian Economy: Its Development Experience, Himalaya Publishing House, Mumbai, 32nd edition, 2010.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101704	**INDIAN HISTORY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction; Ancient India; Classical and Medieval era; Modern India; India after independence.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate contextual knowledge in the evolution of ancient and medieval Indian History and acquire an awareness of societal and cultural transformation.

CO2. Analyze the situations before and after Independence and assess the societal reforms implemented in India after Independence.

CO3. Practice culture transformations and appreciate its influence to adapt themselves in global scenarios.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	-	-	-	-	1	-	-	-
CO2	1	2	-	-	-	1	-	-	-
CO3	1	1	-	-	-	2	-	-	-
Course Correlation Mapping	2	1	-	-	-	2	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INDIAN HISTORY (08 Periods)

Elements of Indian History; History Sources: Archaeology, Numismatics, Epigraphy & Archival research; Methods used in History; History & historiography; Sociological concepts-structure, system, organization, social institutions, Culture and social stratification (caste, class, gender, power), State& Civil Society.

Module 2: ANCIENT INDIA (09 Periods)

Mohenjo-Daro civilization; Harappa civilization; Mauryan Empire.

Module 3: CLASSICAL & MEDIEVAL ERA (12 Periods)

Classic Era (200 BC - 1200 AD); Hindu - Islamic Era (1200 - 1800 AD).

Module 4: MODERN INDIA (06 Periods)

Age of Colonialism (17th - 19th centuries); First war of Indian Independence; Freedom Struggle (1857-1947)

Module 5: INDIA AFTER INDEPENDENCE (1947) (10 Periods)

The Evolution of the Constitution and Main Provisions; Consolidation of India as a Nation; Politics in the States; Indian economy; Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and Inclusion, Changing Nature of Work and Organization.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a write-up on how to safeguard ancient monuments.
2. Analyze the most famous historically important place you visited.
3. Prepare a presentation on the ancient Seven Wonders of the World with their significance and how they are destroyed.
4. Prepare a presentation on "Wars of the past not only destroyed people and their livelihood but also the people's tradition and culture."
5. Prepare a poster on "Continents that No Longer Exist" with causes

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. K. Krishna Reddy, Indian History, Tata McGraw-Hill, 21st reprint, 2017.

REFERENCE BOOKS:

1. Guha, Ramachandra, India after Gandhi, Pan Macmillan, 2007.
2. Romila Thapar, Early India**,** Penguin India, New Delhi 2002.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101705	INDIAN TRADITION AND CULTURE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Basic traits of Indian Culture; Humanistic Reforms under Jainism and Buddhism; Culture in the medieval period; Socio Religious reforms in Indian Culture; Reform movements for harmonious relations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of Vedic and Upanishadic culture and society to consider human aspirations, values and theories.

CO2. Understand the contributions of Buddhism and Jainism to Indian culture.

CO3. Examine the cultural conditions and achievements of India under Mouryas and Guptas.

CO4. Analyze social religious reforms and reform movements.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	1	-	-	-
CO2	3	-	-	-	-	1	-	-	2
CO3	2	-	-	-	-	3	-	-	-
CO4	2	-	-	-	-	3	-	-	2
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BASIC TRAITS OF INDIAN CULTURE (08 Periods)

Meaning and definition and various interpretations of culture - Culture and its features - The Vedic and Upanishad culture and society - Human aspirations and values in these societies – Chaturvidha purushardhas, Chaturashrma and Chaturvarna theory.

Module 2: HUMANISTIC REFORMS UNDER JAINISM AND BUDDHISM (09 Periods)

Salient features of Jainism - contributions of Jainism to Indian culture - Contributions of Acharya and Maha Pragya - Buddhism as a humanistic culture - The four noble truths of Buddhism - Contributions of Buddhism to Indian culture.

Module 3: CULTURE IN THE MEDIEVAL PERIOD (09 Periods)

Unifications of India under Mouryas and Guptas and their cultural achievements - Cultural conditions under satavahanas - Contributions to Pallavas and cholas to art and cultural achievements of Vijayanagara rulers

Module 4: SOCIO RELIGIOUS REFORMS IN INDIAN CULTURE (09 Periods)

Western impact on India - Introduction of Western education - social and cultural awakening and social reform movements of Rajaramohan Roy - Dayanandha Saraswathi - Anne Besant (theosophical society).

Module 5: REFORM MOVEMENTS FOR HARMONIOUS RELATIONS (09 Periods)

Vivekananda, Eswarchandra Vidyasagar and Veeresalingam - emancipation of women and struggle against caste - Rise of Indian nationalism - Mahatma Gandhi – Non-violence and satyagraha and eradication of untouchability.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Identify different cultural festivals of Indian States and prepare a write-up on their uniqueness.
2. India has a rich history with numerous architectural wonders. Prepare a report on any three famous architectural wonders in India.
3. Explore the diverse flavors of Indian cuisine and prepare a poster on the different dishes and their distinctiveness.
4. India is a country of Unity in Diversity. Make a PowerPoint presentation on different traditional dresses of various cultural people.

(Note: It’s an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Valluru Prabhakaraiah, Indian Heritage and Culture, Neelkamal Publications Pvt. Ltd. Delhi, 1/e, reprint 2015.

REFERENCE BOOKS:

1. L. P. Sharma, History of Ancient India, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
2. L. P. Sharma, History of Medieval India, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
3. The Cultural Heritage of India Vol-I, II, III, IV, V, The Ramakrishna Mission Institute of Culture, Calcutta

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EC101703	**INSTRUMENTATION IN INDUSTRIES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on measurement of various parameters like displacement, force, torque, acceleration, velocity, density, viscometer, hygrometers, temperature, pressure, level and flow.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Select appropriate displacement, force and torque measuring devices for specific measurement application.

CO2. Identify suitable acceleration, velocity and density measuring devices for specific measurement application.

CO3. Apply suitable viscometer and hygrometer for measurement of viscosity, humidity and moisture for a specific application.

CO4. Select appropriate temperature and pressure transducer for an industrial requirement.

CO5. Identify appropriate level and flow transducer for measurement of level and flow for a specific application.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	3	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	-
CO4	3	2	-	3	-	-	-	-	-
CO5	3	2	-	3	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DISPLACEMENT, FORCE & TORQUE MEASUREMENT (08 Periods)

Displacement Measurement: Introduction, Strain gauge, LVDT, Capacitive Gauges and applications.

Force Measurement: Introduction, Analytical Balance, Spring Balance, Load cells.

Torque Measurement: Introduction, Strain gauge, Relative angular twist and applications.

Module 2: ACCELERATION, VELOCITY & DENSITY MEASUREMENT (08 Periods)

Acceleration Measurement: Introduction, LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers and applications.

Velocity Measurement: Introduction, Revolution Counter, Capacitive Tacho, Drag-cup Type, Tacho and Stroboscope and applications.

Density Measurement: Introduction, Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

Module 3: VISOCITY, HUMIDITY & MOISTURE MEASUREMENT (09 Periods)

Viscosity Measurement: Introduction, friction tube viscometer, say bolt's viscometer, rotameter viscometer, Searle's rotating cylinder, cone and plate viscometer.

Humidity Measurement: Introduction, Dry and wet bulb psychrometers, Resistive and capacitive type hygrometers

Moisture Measurement: Introduction, Thermal Conductivity and Capacitive sensors, Applications of moisture measurement, Moisture measurement in solids.

Module 4: TEMPERATURE & PRESSURE MEASUREMENT (10 Periods)

Temperature Measurement: Definitions and standards, RTD, Thermistor, Thermocouples: Laws of thermocouple, Reference junctions' compensation, Radiation fundamentals, Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Applications.

Pressure Measurement: Introduction, manometer and its types, elastic transducers Bourdon tube, diaphragm, bellows, electrical types, resistive, inductive and capacitive, Thermal conductivity gage, Ionization gage, Sound level meter, Microphone, Applications.

Module 5: LEVEL & FLOW MEASUREMENT (10 Periods)

Level Measurement: Introduction, Gauge Glass technique, Float Types – Float–and– tape method, Float–and–shaft method, Magnetic float types. Electrical types – Resistance switch type, Inductive and Capacitance type. Ultrasonic methods. Applications

Flow Measurement: Introduction, Head types – Orifice, Venturi, Flow Nozzle. Rotameter & types. Coriolis flow meter, Gyroscopic flow meter, Liquid bridge mass flow meter, Calorimetric flow meter. Electromagnetic flow meter, Ultrasonic flow meter, Hotwire anemometer type. Applications.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Record temperature from RTD and convert temperature in to voltage.
2. Measure the speed of rotating shaft using stroboscope.
3. Record level of the tank using suitable device.
4. Measure the flow rate of water in boiler plant.
5. Measure the displacement using LVDT.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. K. Sawhney, A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons, New Delhi, 19th Revised Edition, 2013
2. D. Patranabis, Principles of Industrial Instrumentation, TMH, 3rd Edition, 2010.

REFERENCE BOOKS:

1. Ernest Doebelin & Dhanesh Manik, Measurement Systems, McGraw Hill International, 6th Edition, 2011.

VIDEO LECTURES:

1. https://www.vlab.co.in/
2. https://archive.nptel.ac.in/courses/103/103/103103135/
3. https://nptel.ac.in/courses/103103135

WEB RESOURCES:

1. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105064/lec1.pdf
3. https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI101701	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to Artificial Intelligence, designing intelligent agents, solving general purpose problems, Search in complex environments, Represent knowledge, Robotics, Ethics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze and architect intelligent agents using Artificial Intelligence Techniques and principles

CO2. Analyze the usage of Knowledge representation techniques in Artificial Intelligence

CO3. Analyze and interpret the problem, identify suitable solutions using heuristic functions and search algorithms

CO4. Investigate robot hardware and frameworks for intelligent robotic perception.

CO5. Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-
CO4	3	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	1	-	2	-
Course Correlation Mapping	**3**	**3**	**2**	**-**	**-**	**1**	**-**	**2**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE (09 Periods)

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

Module 2: KNOWLEDGE & REASONING (09 Periods)

Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Module 3: PROBLEM SOLVING BY SEARCHING (09 Periods)

Problem solving agents, Search algorithms, Uninformed search strategies, Informed search strategies – Greedy best-first search, A* search; Heuristic functions.

Module 4: SEARCH IN COMPLEX ENVIRONMENTS (09 Periods)

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search.

Module 5: ROBOTICS (09 Periods)

Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Application domains.

Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Design and implement agent programs for Table-driven agents using the agent function of vacuum-cleaner world. The agent cleans the current square if it is dirty, otherwise it moves to the other square.
2. Implement agent programs for Simple reflex agents and Model-based reflex agents using the agent function of vacuum-cleaner world.
3. Solve the travelling sales man problem using Hill Climbing search algorithm

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 4th Edition, 2020.

REFERENCE BOOKS:

1. Stephen Lucci, Danny Kopec, Artificial Intelligence in the 21st Century, Mercury Learning and Information, 3rd Edition,2018
2. Rich, Knight, Nair, Artificial intelligence, Tata McGraw Hill, Third Edition, 2009.
3. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education, 2017.
4. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011.

SOFTWARE/TOOLS:

1. Python
2. pandas, matplotlib

VIDEO LECTURES:

1. https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence
2. http://aima.cs.berkeley.edu/
3. https://ai.google/education/
4. https://www.coursera.org/courses?query=artificial%20intelligence
5. https://www.edureka.co/blog/artificial-intelligence-with-python/

WEB RESOURCES:

1. http://www.airesources.org/
2. https://allthingsai.com/
3. https://designmodo.com/ai-tools-designers/
4. https://www.ulethbridge.ca/teachingcentre/chatgpt-ai-resources

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25DS101702	INTRODUCTION TO DATA SCIENCE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Data Science; Data Collection and Data Pre-Processing, Exploratory Data Analytics, Model Development, and Model Evaluation**.**

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on Data science concepts.

CO2. Perform data collection and pre-processing.

CO3. Perform exploratory data analytics.

CO4. Design and develop data visualization models.

CO5. Evaluate performance of data models.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	-
CO2	2	2	3	-	2	-	-	-	-
CO3	2	2	2	-	2	-	-	-	-
CO4	2	3	2	-	2	-	-	-	-
CO5	3	2	2	-	2	-	-	-	-
Course Correlation Mapping	**3**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High 2: Medium 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (09 Periods)

Introduction to Data Science, Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues.

Module 2: DATA COLLECTION AND DATA PRE-PROCESSING (09 Periods)

Data Collection Strategies, Data Pre-Processing- Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.

Module 3: EXPLORATORY DATA ANALYTICS (09 Periods)

Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics, ANOVA.

Module 4: MODEL DEVELOPMENT (09 Periods)

Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making.

Module 5: MODEL EVALUATION (09 Periods)

Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search.

Total Periods:45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. **Use Case:** A human can express his emotions in any form, such as the face, gestures, speech and text. The detection of text emotions is a content-based classification problem. Detecting a person's emotions is a difficult task, but detecting the emotions using text written by a person is even more difficult as a human can express his emotions in any form. Recognizing this type of emotion from a text written by a person plays an important role in applications such as chatbots, customer support forum, customer reviews etc. So, you have to train a machine learning model that can identify the emotion of a text by presenting the most relevant emoji according to the input text.
2. **Use Case:** Customer Personality Analysis is a detailed analysis of a company's ideal customers. It helps a business to better understand its customers and makes it easier for them to modify products according to the specific needs, behaviours and concerns of different types of customers.
   You have to do an analysis that should help a business to modify its product based on its target customers from different types of customer segments. For example, instead of spending money to market a new product to every customer in the company's database, a company can analyze which customer segment is most likely to buy the product and then market the product only on that particular segment.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Cathy O'Neil and Rachel Schutt, Doing Data Science, O'Reilly, 2015

REFERENCE BOOKS:

1. David Dietrich, Barry Heller, Beibei Yang, Data Science and Big Data Analytics, EMC 2013.
2. Davy cielen, Introducing Data Science, Manning Publications, 2022.
3. Chirag Shah, A Hands-on Introduction to Data Science, Cambridge University Press, 2020

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=JL_grPUnXzY&list=PLeo1K3hjS3us_ELKYSj_Fth2tIEkdKXvV
2. https://www.youtube.com/watch?v=-ETQ97mXXF0

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc19_cs60/preview
2. https://towardsdatascience.com/
3. https://www.w3schools.com/datascience/
4. https://github.com/jakevdp/PythonDataScienceHandbook
5. https://www.kaggle.com

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI101702	INTRODUCTION TO MACHINE LEARNING	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to machine learning, Bayesian concept learning, Supervised learning, Unsupervised learning, Artificial neural networks.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the process of machine learning modelling and evaluation to automatically infer a general description for a given learning problem.

CO2. Analyze the underlying mathematical models within machine learning algorithms and learning tasks.

CO3. Design and implement machine learning solutions for classification, regression, and clustering problems.

CO4. Design and implement efficient neural architectures to model patterns for a given learning problem.

CO5. Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	3	3	3	3	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-
CO5	1	3	3	3	3	3	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MACHINE LEARNING (10 Periods)

Machine Learning: Human learning, Types of human learning, Machine learning, Types of machine learning, Applications of machine learning, Issues in machine learning, Machine learning activities, Types of data, selecting a model, training a model, Model representation and interpretability, evaluating performance of a model, Improving performance of a model.

Module 2: BAYESIAN CONCEPT LEARNING (07 Periods)

Introduction, Importance, Bayes' theorem, Bayes optimal classifier, Naïve Bayes classifier, Applications of Bayes classifier.

Module 3: SUPERVISED LEARNING (10 Periods)

Classification: Classification model, Classification learning steps, K-Nearest Neighbor, Decision Tree, Support vector machines.

Regression: Introduction, Simple linear regression, Improving accuracy of the linear regression model, Multiple linear regression, Assumptions and problems in regression analysis.

Module 4: UNSUPERVISED LEARNING (09 Periods)

Introduction, Unsupervised vs supervised learning, Applications of unsupervised learning, Clustering as a machine learning task, Types of clustering techniques, Partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN.

Module 5: ARTIFICIAL NEURAL NETWORKS (09 Periods)

Artificial neuron, Types of activation functions, Early implementations of ANN, Architectures of neural network, Learning process in ANN, Backpropagation.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Use Naïve Bayes classifier to solve the credit card fraud detection problem.
2. Build a neural network that will read the image of a digit and correctly identify the number.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, 1997.
2. Saikat Dutt, Subramanian Chandramouli, Amit Kumar das, Machine Learning, Pearson, 2019.

REFERENCE BOOKS:

1. Manaranjan Pradhan, U Dinesh Kumar, Machine Learning Using Python, Packet Publishing, 2019.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, O'Reilly, 2nd Edition, 2019.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.
4. Shai Shalev Shwartz, Shai Ben David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106202/
2. https://www.coursera.org/learn/machine-learning
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
4. https://onlinecourses.nptel.ac.in/noc23_cs87/preview
5. https://onlinecourses.nptel.ac.in/noc23_ee87/preview
6. https://www.coursera.org/learn/ntumlone-algorithmicfoundations
7. https://www.coursera.org/specializations/machine-learning-introduction
8. http://ndl.iitkgp.ac.in/document/YkxlRXFvZXJrTDBkVzVVZi9ESjl6eXpRZkxRc2lhOWhlVXBhUVVWaXZlNDNyZUVldU9LdlYvd20wbkQ4MC92UQ
9. https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning

WEB RESOURCES:

1. https://www.ibm.com/topics/machine-learning
2. https://www.simplilearn.com/tutorials/machine-learning-tutorial/what-is-machine-learning
3. https://www.w3schools.com/python/python_ml_getting_started.asp
4. https://developers.google.com/machine-learning/crash-course
5. https://www.greenteapress.com/thinkstats/
6. https://info.deeplearning.ai/machine-learning-yearning-book
7. https://www.kaggle.com/code/kanncaa1/machine-learning-tutorial-for-beginners
8. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CS101701	**INTRODUCTION TO PYTHON PROGRAMMING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is aimed at offering the fundamental concepts of Python scripting language to the students. It starts with the basics of Python programming and deals with lists, dictionaries, functions, exceptions and files. The objective of this course is to enable the students to develop the applications using the concepts of Python.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic terminology used in computer programming to write, compile and debug programs in Python programming language.

CO2. Use appropriate data type for handling user data and write optimized programs using the functions, and statements.

CO3. Manage the exceptions raised during the program execution and avoid abrupt termination of the program execution.

CO4. Process files and solve real world problems using classes and objects in the Python programming environment.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3	3	-	2	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-
CO4	2	3	3	-	2	2	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	2	**2**	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DATA TYPES AND INPUT/OUTPUT (09 Periods)

Internal working of Python, Python character set, Tokens, Python Core Data Types (list, set, tuple, and dictionary), The print () function, Assignment of values to variables, The input () function, The eval () function.

Module 2: OPERATORS AND CONTROL STATEMENTS (09 Periods)

Operators- Arithmetic Operators, Operator precedence and Associativity, Bitwise operator, the compound assignment operator; Decision statements- Boolean operators, Boolean Expressions and Relational operators, Decision making statements; Loop Control Statements-while loop, range () function, for loop; break statement, continue statement.

Module 3: FUNCTIONS AND LISTS (09 Periods)

Functions- Syntax and basics of a function, Use of a function, Parameters and arguments in a function, the local and global scope of a variable, the return statement, Recursive functions, the lambda function; Lists-Creating Lists, Accessing the elements of a List, List slicing, Python in-built functions for lists, List Comprehension, List Methods, passing list to a function, Returning a list to function.

Module 4: TUPLES, SETS AND DICTIONARIES (09 Periods)

Tuples - Creating tuples, tuple() function, Inbuilt functions for tuples, Indexing and Slicing, Operations on tuples, Passing variable length arguments to tuples, Sort tuples, Traverse tuples from a list, The zip () function, The Inverse zip(*) function; Sets - Creating sets, The set in and not in operator, The Python Set Class, Set operations; Dictionaries -Basics of Dictionaries, Creating a Dictionary, Adding and replacing values, Retrieving values, Formatting dictionaries, Deleting items, Comparing two dictionaries, Methods of dictionary class, Traversing dictionaries, Nested dictionaries, Traversing nested dictionaries.

Module 5: V FILES (09 Periods)

File Handling-Opening a file, Writing Text, closing files, writing numbers to a file, Reading Text, reading numbers from a file, appending data, seek () function.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Calculator: Create a basic calculator program that can perform addition, subtraction, multiplication, and division operations. You can enhance it by adding more functionality, such as handling decimal numbers or including additional mathematical operations.
2. Develop recursive functions to solve problems that involve self-referential definitions.
3. Develop program to create dictionaries, add, retrieve and delete items from dictionaries.
4. Word Counter: Design a program that counts the number of words, characters, or lines in a given text file. You can also include additional features like finding the most common words or displaying statistics about the text.
5. Tic-Tac-Toe: Implement a two-player tic-tac-toe game where users take turns marking Xs and Os on a 3x3 grid. Determine the winner or detect a tie by checking the board after each move.
6. Dice Rolling Simulator: Create a program that simulates rolling dice. Allow the user to specify the number of dice to roll and display the results. You can also add features like keeping track of the roll history or calculating the probability of certain outcomes.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXTBOOKS:

1. Ashok Namdev kamthane and Amit Ashok Kamthane, Programming and Problem solving with PYTHON, McGraw Hill Education, 1st Edition, 2016.

REFERENCE BOOKS:

1. Allen Downey, Think Python, Green Tea Press, 1st Edition, 2016.
2. W.J. Chun, Core Python Programming, Prentice Hall, 3rd Edition, 2013.
3. Kenneth A. Lambert, Fundamentals of Python, Cengage, 2nd Edition, 2015.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_cs41/preview
2. https://www.coursera.org/specializations/python
3. https://www.coursera.org/learn/python-for-applied-data-science-ai
4. https://www.youtube.com/watch?v=WGJJIrtnfpk
5. https://www.youtube.com/watch?v=_uQrJ0TkZlc
6. https://www.udemy.com/topic/python/
7. https://freevideolectures.com/course/2512/python-programming

WEB RESOURCES:

1. https://www.w3schools.com/python/
2. https://www.programiz.com/python-programming
3. https://www.geeksforgeeks.org/python-programming-language/
4. https://www.javatpoint.com/python-lists
5. https://www.learnpython.org/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CB101704	INTRODUCTION TO INTERNET OF THINGS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is emphasized on the Architecture of IoT and Summarize the roles of various organizations for IoT, To Develop simple applications using Arduino and Rasberry, Test for errors in the application, Predict the market value, Experiment with embedded boards for creating IoT prototypes, to understand the domain specific IoTs and IoT system management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamental concepts of IoT and physical computing.

CO2. Demonstrate knowledge on variety of embedded boards and IoT Platforms

CO3. Understand the communication protocols in IoT communications.

CO4. Demonstrate knowledge on Domain specific IoT applications.

CO5. Understand the IoT System management and network management protocols.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-
CO5	3	2	2				-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: OVERVIEW OF IOT (09 Periods)

The Internet of Things: An Overview, The Flavour of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, who is Making the Internet of Things?

Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.

Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open-source Vs Close source, Tapping into the community.

Module 2: EMBEDDED DEVICES (09 Periods)

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

Module 3: COMMUNICATION IN THE IOT (09 Periods)

Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols

Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

Module 4: DOMAIN SPECIFIC IOTS (09 Periods)

Introduction: Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

Module 5: IOT AND M2M (09 Periods)

Introduction- M2M, Difference between IoT and M2M, SDN and NFV for IoT

IoT System Management with NETCONF-YANG: Need for IoT Systems Management, Simple network management protocol (SNMP), Network operator requirements, NETCONF, YANG.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. (a) Design and Simulate LED 7-Segment Display interfacing with Arduino.
   (b) Design and Simulate Servo motor interfacing with Arduino.
2. (a) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.
   (b) Design and Simulate Flame Sensor interfacing with Arduino.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley Publications, 2012

2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2014.

REFERENCE BOOKS:

1. Pethuru Raj, Anupama C. Raman, The Internet of Things, Enabling technologies and use cases, CRC Press.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/106105166/L01.html

2. https://www.youtube.com/watch?v=oBZnySDgst8

WEB RESOURCES:

1. https://www.arduino

2. https://www.raspberrypi.org/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25ME101705	MATERIAL SCIENCE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Materials Structure and Constitution of Alloys; Heat treatment of steels; Properties of ferrous materials and its alloys; Properties of non-ferrous materials and its alloys; Properties and applications of Ceramics, Polymers and Composite materials.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Ability to understand and apply the principles of materials science to analyze and design materials for specific applications.

CO2. Analyze the properties of materials and enhance the same through heat-treatment processes.

CO3. Demonstrate the knowledge of ferrous and Non-ferrous materials and its alloys for engineering applications.

CO4. Understand the relationship between materials properties and structure at the atomic and molecular level.

CO5. Demonstrate the knowledge of Ceramics, Polymers, and Composite materials for suitable engineering applications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	-	-	-	-	1	-
CO2	3	3	1	-	-	-	-	1	-
CO3	3	1	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MATERIALS STRUCTURE AND CONSTITUTION OF ALLOYS (09 Periods)

Materials Structure: Space lattice, Unit cells and Metallic crystal structures (SC, BCC, FCC and HCP), Crystal defects: Point, Line, Interstitial and Volume, Primary and secondary Bonding in materials.

Constitution of Alloys: Necessity of Alloying, Gibbs's phase and Hume Rothery rule, Iron Iron-carbide diagram and its microstructural aspects.

Module 2: HEAT TREATMENT OF STEELS (09 Periods)

Annealing, Normalizing, Tempering, Carburization and Hardening-Aus tempering, Martempering, Carburizing, Nitriding, Cyaniding, Carbo-Nitriding, Flame and Induction Hardening, Vacuum and Plasma Hardening, Time-Temperature-Transformation Diagrams and Continuous Cooling Transformation Diagrams.

Module 3: FERROUS MATERIALS AND ALLOYS (09 Periods)

Steels: Structure, properties, classifications and applications of plain steels, Specifications of steels, Structure, properties, classifications and applications of low alloy steels, Hadfield Manganese steels, Stainless steel and Tool steels.

Cast iron: Structure, properties and applications of Gray cast iron, White cast iron, Malleable cast iron, Nodular cast iron and Alloy cast iron.

Module 4: NON-FERROUS MATERIALS AND ALLOYS (09 Periods)

Structure, properties and applications of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Nickel and its alloys, Magnesium and its alloys, Refractory and Precious metals.

Module 5: CERAMICS, POLYMERS AND COMPOSITES MATERIALS (09 Periods)

Ceramics: Classifications, Properties and Applications, Glass-ceramics, Polymers: Classification, Properties and Applications, Polymerization Reaction,

Composites: Classifications, Properties and Applications of Polymer matrix composites, Ceramic matrix composites, Metal matrix composites and Nanocomposites.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Laboratory experiments allow students to apply theoretical concepts and learn how to conduct experiments safely and effectively. Some examples of laboratory experiments include mechanical testing of materials, heat treatment of metals, and microscopy analysis of materials.
2. Materials characterization techniques such as X-ray diffraction, scanning electron microscopy, and transmission electron microscopy can provide valuable insights into the structure and properties of materials. Students can gain hands-on experience with these techniques by conducting experiments and analyzing the results.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. V. Raghavan, Materials Science & Engineering, Prentice Hall of India, 5th edition, 2004.
2. R. Balasubramaniam, Callister's, Materials Science & Engineering, John Wiley and Sons, 2nd edition, 2014.

REFERENCE BOOKS:

1. Sidney H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill, 2nd edition, 1997.
2. George E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 3rd edition, 2013.
3. Kodigre V D, Material Science and Metallurgy, Everest Publishing House, 31st edition, 2011.

VIDEO LECTURES:

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-012-fundamentals-of-materials-science-fall-2005/lecture-notes/
2. https://nptel.ac.in/courses/116/104/116104045/
3. https://www.youtube.com/watch?v=tsX-VYvkiJ8&list=PLJV_OG0NLkV8VRNFk-0AyDZz1pZym6V8j
4. https://www.khanacademy.org/science/materials-science

WEB RESOURCES:

1. https://www.doitpoms.ac.uk/tlplib/teachers.php
2. https://www.springer.com/journal/10853
3. http://dmse.mit.edu/
4. http://dmse.mit.edu/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25LG201701	PERSONALITY DEVELOPMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Self-Management and Planning Career.

CO2. Analyze the functional knowledge in attitudes and thinking strategies.

CO3. Learn and apply soft skills for professional success.

CO4. Function effectively as an individual and as a member in diverse teams.

CO5. Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	3	-	-	-	2	-
CO4	1	1	-	-	-	-	3	3	-
CO5	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**2**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SELF-ESTEEM & SELF-IMPROVEMENT (09 Periods)

Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- Exercises- case studies

Module 2: DEVELOPING POSITIVE ATTITUDES (09 Periods)

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies

Module 3: SELF-MOTIVATION & SELF-MANAGEMENT (09 Periods)

Show Initiative – Be Responsible Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who can Think – Thinking Strategies- Exercises- case studies

Module 4: GETTING ALONG WITH THE SUPERVISOR (09 Periods)

Know your supervisor – Communicating with your Supervisor – Special Communication with your Supervisor – What Should you Expect of Your Supervisor? – What your supervisor expects of you - Moving Ahead Getting Along with your Supervisor- Exercises- case studies

Module 5: WORKPLACE SUCCESS (09 Periods)

First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Exercises- case studies

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities with respect to self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and interpret different experiences on the first day of your job.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXTBOOK:

1. Harold R. Wallace and L. Ann Masters, Personal Development for Life and Work, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)
2. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.

REFERENCE BOOKS:

1. K. Alex, Soft Skills, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge, Organizational Behaviour, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6Y5VWBLi1es
2. https://www.youtube.com/watch?v=H9qA3inVMrA

WEB RESOURCES:

1. https://www.universalclass.com/.../the-process-of-perso...
2. https://www.ncbi.nlm.nih.gov/pubmed/25545842
3. https://www.youtube.com/watch?v=Tuw8hxrFBH8

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE101703	PLANNING FOR SUSTAINABLE DEVELOPMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on sustainable development, environmental impact, sustainable policies, governance, theories and strategies, media and education for sustainability.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Compare sustainable development theories in national and global context to protect the society and environment.

CO2. Analyze the unforeseen environmental impacts on sustainable development to protect the society and environment.

CO3. Analyze policies and governance for sustainable development considering ethics, economics, society and environment.

CO4. Analyze systems and strategies for sustainable development using appropriate tools and techniques considering ethics, economics, society and environment.

CO5. Analyze the role of media and education in sustainable development using appropriate tools and techniques considering ethics, society and environment besides communicating effectively.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	2	-	-	-	-
CO2	3	3	-	-	2	-	-	-	1
CO3	3	3	-	-	2	2	-	-	-
CO4	3	3	-	2	2	2	-	-	-
CO5	3	3	-	2	2	2	-	1	-
Course Correlation Mapping	**3**	**3**	**-**	**2**	**2**	**2**	-	**1**	**1**

Correlation Levels: **3: High; 2: Medium; 1: Low**

COURSE CONTENT

Module 1: SUSTAINABLE DEVELOPMENT (09 Periods)

Definition and concepts of sustainable development, Capitalization of sustainability- National and global context; Sustainable development goals, Emergence and evolution of sustainability and sustainable development, Theories of sustainability, Case studies.

Module 2: ENVIRONMENTAL IMPACT (09 Periods)

Climate change – Science, Knowledge and sustainability; Unforeseen environmental impacts on development, Challenges of sustainable development, Centrality of resources in sustainable development, Case studies.

Module 3: SUSTAINABLE POLICIES AND GOVERNANCE (09 Periods)

Governance - Democracy and Eco–welfare; Global civil society and world civil politics, Civic environmentalism, Policy responses to sustainable development, Economics of sustainability, social responsibility in sustainability, National action, ISO 14001: Environmental management system.

Module 4: SUSTAINABLE SYSTEMS AND STRATAGIES (09 Periods)

Need for system innovation, Transition and co–evolution, Theories and methods for sustainable development, Strategies for eco–innovation, Ecological foot print analysis, Socio ecological indicators – Eco labels; Policy programmes for system innovation, Case studies.

Module 5: MEDIA AND EDUCATION FOR SUSTAINABILITY (09 Periods)

Role of emerging media, Remarkable design and communication art, Activism and the public interest, Education for sustainability, Participation in decision making, Critical thinking and reflection, Case studies.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Submit a study report on the importance and implementation of United Nationals sustainable goals 17 among all the ratified nations.
2. Submit a study report on any one case study that the challenges being faced during the sustainable development goals implementation.
3. Submit a study report on the social responsibility in implementation of sustainability concept.
4. Prepare and submit a report on any two case studies that how the eco labels put on their products shall make the consumers feel satisfaction over the sustainable development.
5. Submit a report on the communication art and activism through media which makes the public interest that helps to contribute towards sustainable development.

RESOURCES

TEXT BOOKS:

1. John Blewitt, Understanding Sustainable Development, Earth Scan Publications Ltd., 2nd Edition, 2008.
2. Jennifer A. Elliot, An Introduction to Sustainable Development, Earth Scan Publications Ltd., 4th Edition, 2006.

REFERENCE BOOKS:

1. Peter Rogers, Kazi F Jalal and John A Boyd, An Introduction to Sustainable Development, Earth Scan Publications Ltd., 2006.
2. Simon Dresner, The Principles of Sustainability, Earth Scan Publications Ltd., 2nd Edition, 2008.
3. Peter Bartelmus, Environment Growth and Development: The Concepts and Strategies of Sustainability, Routledge, 3rd Edition, 2003.
4. Gabriel Moser, Enric Pol, Yvonne Bernard, MiriliaBonnes, Jose Antonio Corraliza and Maria Vittoria Giuliani, People Places and Sustainability, Hogrefe& Huber Publishers, 2nd Edition, 2003.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=a5i9RVyhBtc
2. https://www.youtube.com/watch?v=fH_iIVPTujE
3. https://www.youtube.com/watch?v=c2eNrFK5M8I
4. https://www.youtube.com/watch?v=qfOgdj4Okdw
5. https://www.youtube.com/watch?v=_qLqLJq2954

WEB RESOURCES:

1. https://civil.gecgudlavalleru.ac.in/images/admin/pdf/1594706742_III-II-OE-Planning-for-Sustainable-Development.pdf
2. https://www.academia.edu/26950843/Sustainable_Development_in_Practice_Case_Studies_for_Engineers_and_Scientists
3. https://www.academia.edu/24286208/The_Role_of_the_Professional_Engineer_and_Scientist_in_Sustainable_Development
4. https://byjusexamprep.com/liveData/f/2022/8/sustainable_development_goals_upsc_notes_43.pdf
5. https://sdgs.un.org/sites/default/files/2020-10/course%201_Peter_Tarr%20%20-%20%20Compatibility%20Mode.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EC101705	PRINCIPLES OF COMMUNICATION ENGINEERING	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Fundamentals of Communications; Analog and digital - modulation and Demodulation Techniques; Information theory and coding.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze different Analog and Digital Modulation Schemes to improve bandwidth and power efficiency.

CO2. Analyze Pulse Analog modulation Schemes.

CO3. Understand the concepts of Baseband & Passband Digital Transmission.

CO4. Analyze various error detection and correction codes for reliable transmission.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**1**	**-**	**-**	**-**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ANALOG MODULATION (13 Periods)

Block diagram of Electrical Communication System, Types of Communications, Need for Modulation, Types of Amplitude Modulation- AM, DSBSC, SSBSC, Power and BW requirements, Generation of AM, DSBSC, SSBSC. Detection of AM - Diode detector, Product demodulation for DSBSC & SSBSC. Frequency & Phase Modulations.

Module 2: PULSE MODULATION (07 Periods)

Elements & Advantages of Digital communication systems, PAM, Regeneration of Base band Signal, PWM and PPM, Time Division Multiplexing, Frequency Division Multiplexing.

Module 3: BASE BAND DIGITAL TRANSMISSION (07 Periods)

Pulse Code Modulation- Advantages, Block diagram of PCM, Quantization, effect of Quantization, Quantization error. DM, ADM and Comparison of PCM, DM & ADM.

Module 4: PASS BAND DIGITAL TRANSMISSION (10 Periods)

Digital Binary Schemes-ASK, FSK, PSK, DPSK, QPSK, Modulation and Demodulation - Coherent and Non-coherent techniques.

Module 5: INFORMATION THEORY AND CODING (08 Periods)

Concept of Information, Entropy and Rate of Information, Coding efficiency, Shannon-Fano and Huffman Coding.

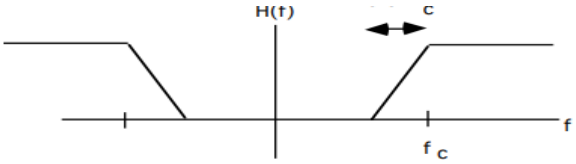
Error Correction and Detection Codes- Linear Block Codes, Cyclic Codes, Convolution Codes.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Suppose that a non-linear device is available for which the output current i0 and the input voltage vi are related by: i_0 (t) = $a_1$vi (t) + a_3v_3 I (t) where a_1 and a_3 are constants. Explain how this device may be used to provide (a) a product modulator (b) an amplitude modulator.
2. A voice signal occupying the frequency band 0.3 - 3.4 KHz is to be modulated onto a carrier wave of frequency 11.6 MHz High pass filters such as the one shown below are available. Design a system to generate the USB wave using DSB modulators and these filters.



3. In a binary PCM system, the output signal to-quantizing noise ratio is to be held to a minimum of 40 dB. Determine the number of required levels, and find the corresponding output signal to quantizing-noise ratio.
4. A bipolar binary signal S_I(t) is a +1V or -1V pulse during the interval (O, T). Additive white noise with power spectral density η/2 = 10^{-5} W /kHz. W/Hz is added to the signal. Determine the maximum bit rate that can be sent with a bit error probability of Pe≤10^{-7}
5. A compact disc (CD) recording system samples each of two stereo signals with a 16-bit

analog-to digital converter (ADC) at 44.1 kb/s.

a) Determine the output signal-to-quantizing-noise ratio for a full-scale sinusoid.
b) The bit Stream of digitized data is augmented by the addition of error-correcting bits, clock extraction bits, and display and control bit fields. These additional bits represent 100 percent overhead. Determine the output bit rate of the CD recording system.
c) The CD can record an hour's worth of music. Determine the number of bits recorded on a CD. For a comparison, a high-grade collegiate dictionary may contain 1500 pages, 2 columns per page, 100 lines per column, 8 words per line, 6 letters per word, and 7 b per letter on average. Determine the number of bits required to describe the dictionary, and estimate the number of comparable books that can be stored on a CD.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. R.P. Singh and S D Sapre, Communication Systems - Analog and Digital, TMH, 2nd edition 2007.
2. Simon Haykin, Communication Systems, John Wiley, 2nd edition 2007.

REFERENCE BOOKS:

1. Herbert Taub & Donald L Schilling, Principles of Communication Systems, Tata McGraw-Hill, 3rd Edition, 2009.
2. Sham Shanmugam, Digital and Analog Communication Systems, Wiley-India edition, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108/104/108104091/
2. https://onlinecourses.nptel.ac.in/noc19_ee47/preview

WEB RESOURCES:

1. https://studiousguy.com/basic-principles-of-communication/
2. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_modulation.htm

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE101702	**RELIABILITY AND SAFETY ENGINEERING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on the fundamentals of reliability and safety engineering. The course emphasizes on various reliability measures used in assessing the performance of the system, evaluating the critical parameters of the network, and the techniques to assess the reliability of the system. The course also deals with safety management and measures in industrial and other hazardous environments.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the various probability and statistics fundamentals into engineering systems to evaluate performance.

CO2. Develop mathematical models for engineering networks/systems to evaluate the critical parameters for the reliability of a network/system.

CO3. analyze the time-dependent/independent characteristics of a repairable system and frequency durations techniques to assess the reliability

CO4. Understand various safety management, policy, and planning strategies for personal and industrial safety.

CO5. Understand various safety and hazard identification techniques and follow appropriate safety measures in industry and society.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	2	-	2	1	1	-	-	-
CO2	3	3	-	2	1	-	-	-	-
CO3	3	2	-	1	1	-	-	-	3
CO4	3	2	-	2	1	1	-	-	-
CO5	3	2	-	2	1	1	-	-	-
Course Correlation Mapping	**3**	**2**	**-**	**2**	**1**	**1**	**-**	**-**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNDAMENTALS OF RELIABILITY ENGINEERING (09 Periods)

Random variables, probability concepts, rules for probabilities of events. Probability density and distribution functions. Binomial distribution - Expected value and standard deviation for binomial distribution. Reliability functions, f(t), F(t), h(t) - Relationship between these functions, Exponential density and distribution functions, expected value and standard deviation of exponential distribution. Measures of reliability - MTTF, MTTR, MTBF. Bathtub curve.

Module 2: NETWORK MODELING AND RELIABILITY EVALUATION (09 Periods)

Basic concepts - Evaluation of network reliability/unreliability, series systems, parallel systems, series - Parallel configuration systems. Redundant systems and its types. Evaluation of network reliability/unreliability using conditional probability method, tie-set and cut-set based approach, complete event tree and reduced event tree methods.

Module 3: MARKOV CHAIN AND MARKOV PROCESSES (09 Periods)

Basic concepts, stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability, Absorbing states. Modelling concepts – State space diagrams, time dependent reliability evaluation of single component repairable model, two component repairable model. Frequency and duration techniques.

Module 4: BASICS OF SAFETY CONCEPTS (08 Periods)

Introduction, goals, need for safety, history of safety movement – the evolution of modern safety concept, general concepts of safety management. Planning for safety- productivity, quality and safety, line and staff functions, budgeting for safety, safety policy.

Module 5: SAFETY TECHNIQUES AND APPLICATIONS (10 Periods)

Introduction to safety techniques, Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of the performance of supervisors on safety. Hazard identification techniques, components of safety audit, types of audit, audit methodology, and process of safety reporting. Applications of industrial Safety, environmental safety, health safety, electrical safety, fire safety.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. The students shall understand various IEEE reliability standards to be followed in the engineering systems for the evaluation of reliability and asses performance.
2. Should collect various engineering components assembled and their network models for evaluations of network reliability indices.
3. The students to visit a nearby power or process industry to know about various types of failures and repair performance of various engineering components and cause of replacements.
4. Should collect information about various safety/alert sign boards and the relative measures for a particular situation.
5. Should understand the standard practices followed during the maintenance/commissioning of the electrical apparatus in any industry following the various safety precautions.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Roy Billinton and Ronald N Allen, Reliability Evaluation of Engineering Systems, 2nd Edition, Springer, New York, 2013.
2. Frank R. Spellman, Nancy E. Whiting, Safety Engineering: Principles and Practices, 3rd Edition, Rowman & Littlefield, 2018.

REFERENCE BOOKS:

1. Charles E. Ebeling, An introduction to reliability and maintainability engineering, 2nd Edition Tata McGraw-Hill Education, 2010.
2. Dan Petersen, Techniques of Safety Management: A Systems Approach, 4th Edition American society of safety engineers, 2003.
3. Ajit Kumar Verma , Srividya Ajit , Durga Rao Karanki, Reliability and Safety Engineering, Springer London, 2016.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105/108/105108128/
2. https://nptel.ac.in/courses/110/105/110105094/
3. https://www.youtube.com/watch?v=uutg8jKrL9w
4. https://www.youtube.com/watch?v=_c-iZ2BAXPw
5. https://www.youtube.com/watch?v=GeMCF3s5EDk
6. https://www.youtube.com/watch?v=xYWyype7cxE

WEB RESOURCES:

1. https://ieeexplore.ieee.org/document/9353567
2. https://www.ualberta.ca/engineering/mechanical-engineering/research/reliability-and-safety.html
3. https://ieeexplore.ieee.org/document/9353567
4. https://www.taylorfrancis.com/books/edit/10.1201/9781003140092/industrial-liability-safety-engineering-dilbagh-panchal-mangey-ram-prasenjit-chatterjee-anish-kumar-sachdeva

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE101704	**REMOTE SENSING, GIS AND GPS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on photogrammetry, remote sensing, geographic information system, GIS spatial analysis. This course also examines remote sensing and GIS applications, global positioning system and its real-time applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze photogrammetry and remote sensing to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment besides communicating effectively in graphical form.

CO2. Analyze GIS to solve complex surveying problems using appropriate tools and techniques following latest developments besides communicating effectively in graphical form.

CO3. Analyze GIS spatial analysis to solve complex surveying problems using appropriate tools and techniques following latest developments besides communicating effectively in graphical form.

CO4. Analyze remote sensing and GIS applications to solve complex civil engineering problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society, environment, sustainability and management principles besides communicating effectively in graphical form.

CO5. Analyze global positioning system to solve complex surveying problems using appropriate tools and techniques considering society and environment besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	2	3	-	2	1	1	-	1	1
CO2	2	3	-	2	1	-	-	1	1
CO3	2	3	-	2	1	-	-	1	1
CO4	2	3	-	2	1	1	-	1	1
CO5	2	3	-	2	1	-	-	1	-
Course Correlation Mapping	**3**	**3**	**-**	**2**	**1**	**1**	**-**	**1**	**1**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: PHOTOGRAMMETRY AND REMOTE SENSING (10 Periods)

Photogrammetry: Principle of photogrammetry, Types of aerial photographs, Planning and execution of photographic flights, Geometry of aerial photographs, Scale of aerial photographs and its determination, Stereoscopy, Ground control, Mosaics, Parallax measurements for height determinations, Latest developments in photogrammetry.

Remote Sensing: Elements of remote sensing, Electromagnetic spectrum, Energy resources, Physics of radiant energy, Energy interactions with earth surface features and atmosphere, Data acquisition platforms Spectral reflectance curves, Resolution; Spectral properties of water bodies, soil and vegetation; Sensors and platforms, Visual interpretation techniques.

Module 2: GEOGRAPHIC INFORMATION SYSTEM (09 Periods)

GIS categories, Components of GIS, Fundamental operations of GIS, Spatial and non-spatial data, Raster data and vector data, File management, Layer based GIS, Feature based GIS, Map projections, Latest developments.

Module 3: GIS SPATIAL ANALYSIS (08 Periods)

Database models, Data storage, Vector data storage, Attribute data storage, Data manipulation and analysis, Integrated analysis of the spatial and attribute data - DTM/DEM, Software's – Arc GIS, QGIS and Global mapper, Latest developments in GIS software.

Module 4: REMOTE SENSING AND GIS APPLICATIONS (09 Periods)

Land use/Land cover classification, Rainfall-runoff studies, Flood and drought impact assessment and monitoring, Drainage morphometry, Watershed management for sustainable development, GIS based precision farming, GIS based natural resources management, Inland water quality survey and management, Regional and urban planning and management, GIS based highway alignment, GIS based traffic congestion analysis, GIS for public health – Case Studies.

Module 5: GLOBAL POSITIONING SYSTEM (09 Periods)

Global Positioning System (GPS) – Fundamental concepts, Components of GPS – Space segment, Control segment, User segment, Reference systems, Satellite orbits; Classification of GPS receivers, GPS observations, GPS measurements and accuracy of GPS, Applications.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Sound composing project: In this assignment, select area and collect the geometry of aerial photographs and analyze the views.
2. Visit any meteorological department and understand about rain gauges and collect, analyse the data
3. Visit Geographical Information Systems Laboratory and understand about GIS and GPS Systems

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Shivam, P. and Shashikanth, T., A Text Book of Basic Concept of Remote Sensing, GPS and GIS, Sankalp Publication, 2020.
2. Anji Reddi, M., A Text Book of Remote Sensing and Geographical Information Systems, B. S. Publications, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Bhatta, B., Remote Sensing and GIS, Oxford University Press, 2nd Edition, 2011.
2. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W., Remote Sensing and Image Interpretation, John Willey and Sons (Asia) Pvt. Ltd., 7th Edition, 2014.
3. Chandra, A. M. and Ghosh, S. K., Remote Sensing and Geographic Information System, Narosa Publishing House, 2nd Edition, 2015.
4. Panigrahi, N., Geographical Information Science, University Press, 2nd Edition, 2013.
5. Peter A. Burragh and Rachael Mc Donnell, Principles of Geographical Information Systems, Oxford University Press, 2nd Edition, 2014.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/105/107/105107206/
2. https://syslab.ceu.edu/videos/geospatial-technologies

WEB RESOURCES:

1. Digital Audio Signal Processing: https://www.udemy.com/course/introduction-to-geospatial-technologies-and-arcgis-interface/
2. Learn Audio Editing - for Beginners: https://www.youtube.com/ watch?v=xGgaV9r_kH8
3. https://storymaps.arcgis.com/stories/47e984aae614442cb80aa40d121b5fe

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE101705	**SMART CITIES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a discussion on smart city and infrastructure, smart governance, smart mobility, smart economy, smart environment, smart buildings, smart energy, smart water, smart living, smart people and case studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the concept of smart cities and its infrastructure for ensuring safety and sustainability using appropriate techniques and management principles in India besides lifelong learning.

CO2. Analyse smart cities to solve problems associated with mobility and governance for the growing population by ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.

CO3. Analyse smart cities to solve problems associated with economy and environment for ensuring safety and sustainability, management using appropriate techniques and standards in India besides lifelong learning.

CO4. Analyse buildings, energy and water resource systems in smart cities to solve problems associated with the growing population for ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.

CO5. Analyse the smart cities to solve complex problems associated with people and living systems for ensuring safety and sustainability, management using appropriate techniques in India besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	-	-	2	1	2	-	1	2
CO2	3	3	-	2	3	2	-	1	2
CO3	3	3	-	2	3	2	-	1	2
CO4	3	3	-	2	3	3	-	-	2
CO5	3	3	-	2	3	2	-	-	2
Course Correlation Mapping	**3**	**3**	**-**	**2**	**2**	**2**	**-**	**1**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SMART CITY AND INFRASTRUCTURE (09 Periods)

Smart city - Concept, Objectives, History, Need; Key trends in smart city development, Government of India – Policy for smart city.

Infrastructure: Smart city infrastructure – Components, Challenges; Managing - Principle stake holders, Infrastructure in India and World, Dimensions of smart cities, Global standards and performance benchmarks, Practice codes, Infrastructure development, Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city, Various types of infrastructure systems, Infrastructure assessment.

Module 2: SMART GOVERNANCE AND SMART MOBILITY (09 Periods)

Smart Governance: Definition, smart governance to citizens, Industries and commerce, Smart governance within government, Emerging trends in smart governance, Future of smart governance, Guidelines and standards for smart governance; IOT and ICT Application – Broadband city, Use of sensors, Intelligent city governance.

Smart Mobility: Intelligent transportation systems, Accessibility, Smart vehicles and fuels, GIS, GPS, Navigation system, public transport, Traffic safety management, Logistics flows in cities, Mobility services, E-ticketing.

Module 3: SMART ECONOMY AND SMART ENVIRONMENT (09 Periods)

Smart Economy: City branding, Market places and crowd funding, Innovation, entrepreneurship – E-business, E-commerce, online integrated business platforms and networks; Local and global interconnectedness, Productivity, Flexibility of labour market.

Smart Environment: Network and environmental monitoring, Energy efficiency, Urban planning and urban refurbishment, Smart buildings and building renovation, Resource management, Environmental protection.

Module 4: SMART BUILDINGS, SMART ENERGY AND SMART WATER (09 Periods)

Smart Buildings: Definition, Sustainable city – A green approach, Housing, Sustainable green building - Solar energy for smart city, Waste water management, solid waste management, 3Rs Policy, Green ratings.

Smart Energy: Current energy demand, Alternate energy sources, Renewable energy, Production, Solar energy, Wind energy, Energy from solid waste, Applications, Challenges in smart energy

Smart Water: Storage and conveyance system of water, Sustainable water and sanitation, Sewage systems, Flood management, Conservation system.

Module 5: SMART LIVING, SMART PEOPLE AND CASE STUDIES (09 Periods)

Smart Living: Definition, Cultural facilities, World-class education, Tourist attractions, World-class hospitals, Latest technologies, Quality housing, Community and urban life management, social cohesion.

Smart People: Definition, Human development index, Level of qualification, Graduate enrolment ratio, Lifelong learning, ICT Skills, Quality of smart people – Flexibility, Creativity to contribute to education, Democratic nature; Personality dimensions – Extroversion, Agreeableness, Consciousness, Emotional Stability, Open to experience.

Case Studies: Helsinki – Finland; Zurich - Switzerland; Oslo - Norway; Amsterdam - The Netherlands; New York - United States; Seoul (World's first Smart City) - South Korea.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a report on smart city infrastructure for south Indian cities.
2. Prepare a review on need for changes in transportation and governing policies in India.
3. Write a report on energy conservation and economy stability in world's first smart city.
4. Write a report on need and technologies to be adopted for green buildings in a smart city.
5. Prepare a case study report on Hyderabad, Telangana.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Li Xian Yi, Smart City on Future Life - Scientific Planning and Construction, Posts and Telecom Press, 2012.
2. Arpan Kumar Kar, Manmohan Prasad Gupta, P. Vigneswara Ilavarasan and Yogesh K. Dwivedi, Advances in Smart Cities, CRC Press, Taylor & Francis Group, Boca Raton, 2017.

REFERENCE BOOKS:

1. Nicos Komninos, The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities), Routledge Taylor & Francis Group, London, 2015.
2. Eleonora Riva Sanseverino, Smart Rules for Smart Cities – Managing Efficient Cities in Euro-Mediterranean Countries, springer for innovation, Springer, Italy, 2014.
3. Smart Cities Mission: A Step Towards Smart India, National Portal of India
4. Anthony M. Townsend, Smart Cities – Big Data, Civic Hackers and The Quest for a New Uthopia, W. W. Norton & Company, Inc., New York, 2013.
5. IoT Technician (Smart City) – MHRD, Govt. of India, 2nd Edition, 2022.

VIDEO LECTURES:

1. City of the Future: Singapore – Full Episode | National Geographic - YouTube
2. Integrated Waste Management for a Smart City - Course (nptel.ac.in)

WEB RESOURCES:

1. Smart Cities (nationalgeographic.org)
2. NPTEL: Civil Engineering - NOC: Sustainable Materials and Green Buildings
3. Smart cities (europa.eu)
4. Top 7 Smart Cities in the World in 2023 (earth.org)

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EC101706	SMART SENSORS FOR ENGINEERING APPLICATIONS	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Basics of sensors, characteristics of sensors and their responses; Smart sensors for Engineering, Science and Health Monitoring Applications; Applications of smart sensors and advancements in sensing Techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Analyse the characteristics of transducers and estimate the response of sensors.

CO2. Understanding the working of various sensors in the context of their specialized domains.
CO3. Apply smart sensors for real time applications.
CO4. Apply the advanced techniques to smart sensors to provide solution to real time applications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: CONCEPTS OF SENSORS (08 Periods)

Introduction to sensors and transducers. Need for sensors in the modern world. Different fields of sensors based on the stimuli, various schematics for active and passive sensors. Static and dynamic characteristics of sensors. **Zero, I and II order sensors:** Response to impulse, step, ramp and sinusoidal inputs. Environmental factors and reliability of sensors.

Module 2: SENSORS IN ENGINEERING (07 Periods)

Physical principles of sensors, Electric Sensors: Resistive, Capacitive, Inductive. Piezoelectric sensor. Photo elastic sensors, Fluid Mechanic sensors.

Module 3: HUMAN AND BIOMIMETIC SENSORS (10 Periods)

Human sensors: vision, Taste and smell, Hearing, Somatic, Biomimetic Sensors, Electrochemical, Thermoelectric sensors, Optic sensors.

Module 4: APPLICATIONS OF SMART SENSORS (11 Periods)

WSN Based Physiological Parameters Monitoring System: Measurement of Human Body Temperature. Intelligent Sensing System for Emotion Recognition: Aim of the Emotion Recognition System, Development of Intelligent Sensing System for Emotion Recognition. WSN Based Smart Power Monitoring System.

Module 5: ADVANCEMENTS IN SENSING TECHNOLOGY (09 Periods)

Ecological Monitoring Using Wireless Sensor Networks: Overview, Challenges, and Opportunities. Development of an Embedded System-Based Gateway for Environmental Monitoring in Wild Fields. Advancements in Structural Health Monitoring.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Build a wireless sensor system for Environmental pollution monitoring.
2. Design a smart temperature measurement system using required accessories.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Patrick F Dunn, Fundamentals of sensors for engineering and science, CRC Press, 2012.
2. Subhas C. Mukhopadhyay, Krishanthi P. Jayasundera, and Anton Fuchs, Smart Sensors, Measurement and Instrumentation, Springer, 2013.

REFERENCE BOOKS:

1. Subhas Chandra Mukhopadhyay, Intelligent Sensing, Instrumentation and Measurements, Springer, Kluwer Academic Publishers, 2013.
2. Henry Bolte, Sensors – A Comprehensive Sensors, John Wiley.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=oRydUfgMdgA
2. https://onlinecourses.nptel.ac.in/noc22_ee36/

WEB RESOURCES:

1. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1199&context=nasapub#:~:text=The%20smart%20materials%20examined%20include,%2C%20magneto%2Doptical%20materials%2C%20and
2. https://www.youtube.com/watch?v=q8UuRkOQ9A0
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8433768/
4. https://www.mdpi.com/1424-8220/21/17/5890

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE101703	SUSTAINABLE ENERGY SYSTEMS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course designed emphasizes the operating principle of a range of non-conventional energy resources, energy harvesting and conversion principles and key performance characteristics. The energy conversion technologies will include energy conversion from, Solar, Wind, Ocean, Biomass, Geothermal and Fuel cells. The course also emphasizes on various types of hybrid energy storage systems with their relative advantages and disadvantages.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamental concepts of renewable energy sources and their endurance for sustainability.

CO2. Understand the various methods of harvesting solar energy, energy conversion principles, and operational aspects and environmental impacts of solar technologies.

CO3. Understand the various methods of harvesting wind energy, conversion principles, operational aspects, and environmental impacts of wind energy systems.

CO4. Understand the various methods of harvesting ocean energy, Biomass energy and geothermal energy, energy conversion technologies, operational aspects, and their impacts on the environment.

CO5. Understand the principle of harvesting energy from fuel cells and the operational aspects of hybrid energy storage systems.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	2	-	-	-	1
CO2	3	-	-	2	2	-	-	-	1
CO3	3	-	-	2	2	-	-	-	1
CO4	3	-	-	2	2	-	-	-	1
CO5	3	-	-	2	2	-	-	-	1
Course Correlation Mapping	**3**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO SUSTAINABLE ENERGY SOURCES (07 Periods)

Impact of conventional sources on Environment—acid rain, ozone layer depletion, Global warming, greenhouse effect and nuclear waste; Limitation of fossil fuels; Renewable energy sources; Renewable sources and their sustainable development.

Module 2: ENERGY FROM SOLAR (10 Periods)

Introduction, solar radiation, Measurement of solar radiation—Pyranometer; Solar energy collectors; Flat plate collectors— Liquid and air (non-porous) types; Focusing type— Parabolic and Point types; Solar photovoltaic system— PV cell and its types, Configuration of solar panel, PV system; Applications: Solar pump, Solar water heater

Module 3: ENERGY FROM WIND (08 Periods)

Introduction, power extraction from the wind, Wind turbines— Horizontal axis wind turbine— Propeller type and Vertical axis wind turbine— Darrieus rotor type; Basic components of wind energy conversion systems, Applications: Energy storage, Water pumping; Environmental impacts.

Module 4: ENERGY FROM OCEAN, BIOMASS AND GEOTHERMAL RESOURCES (12 Periods)

Energy from ocean: Introduction, ocean thermal energy conversion (OTEC): Open and closed cycle power plants; Tidal energy: Schematic diagram of tidal power plant; Advantages and disadvantages.

Energy from Biomass: Introduction, biomass conversion technologies-direct, Thermochemical and Biochemical conversions; Biogas generation—Anaerobic digestion process.

Geothermal energy: Introduction, Geothermal resources, Geothermal power plants— Vapour dominated and liquid dominated; Environmental issues.

Module 5: FUEL CELLS AND HYBRID ENERGY SYSTEMS (08 Periods)

Fuel Cells: Introduction, principle and operation of fuel cell, classification of fuel cells, advantages and disadvantages of fuel cells.

Hybrid energy systems: Need for hybrid systems, configuration and coordination, Block diagram approach of Stand-alone PV-wind system, PV-Diesel and Wind-diesel; energy storage systems — Ultra capacitors, SMES, Battery.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. The students shall visit a solar power plant, understand the operational aspects and should prepare a technical report on the plant visited.

2. The students shall visit a wind farm, understand the operational aspects, and should prepare a technical report on the plant visited.

3. The students shall visit a bio-mass energy conversion plant, understand the operational aspects and should prepare a technical report on the plant visited.

4. The students shall prepare a technical report on the need of a hybrid plant and find new avenues for a new hybrid system.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 2017.
2. G.N. Tiwari and M.K. Ghosal, Renewable energy resources: Basic principles and applications, Alpha Science International Ltd., 2005.

REFERENCE BOOKS:

1. Jhon Twidell and Tony Wier, Renewable Energy Resources, Taylor & Francis, 2nd edition, London and Newyork, 2006.
2. K.M. Mittal, Non-conventional Energy Systems-Principles, Progress and Prospects, Wheeler Publications, 1997.
3. S. Rao, Dr. B.B. Parulekar, Energy Technology, Third edition, Khanna Publications, 2013.
4. R. K. Rajput, A textbook of power system engineering, Laxmi publications (P) Ltd, 2016

VIDEO LECTURES:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/121106014
3. https://youtu.be/mh51mAUexK4
4. https://youtu.be/UW4HYJ36q0Y

WEB RESOURCES:

1. www.mnre.gov.in
2. www.ireda.in

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CS101702	**WEB DESIGN FUNDAMENTALS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to introduce the student to the technologies and facilities of web design: CSS, JavaScript, and jQuery. Students will understand the web design process and use these software technologies together to produce web design projects.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamentals of HTML 5 and the principles of web design.

CO2. Construct basic websites using HTML and Cascading Style Sheets.

CO3. Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.

CO4. Learn how to use HTML5 and other Web technologies to develop interactive and responsive web pages.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3	3	-	-	-	-	-	-
CO2	3	3	-	-	2	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-
CO4	2	3	3	-	-	2	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**2**	**2**	**-**	**-**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (09 Periods)

Elements – Data types - Working with Text - Arranging Text - Displaying Lists - VAR Element - BDO Element - SPAN Element – DIV Element.

Module 2: LINKS AND URLS (09 Periods)

Hyperlinks – URLs - Linking to a Mail System - Creating Tables - Inserting Images in a Web Page – Colors – Form Elements - Multiple-Choice Elements – Multimedia

Module 3: DYNAMIC HTML (09 Periods)

Features of JavaScript - Programming Fundamentals - JavaScript Functions, Events, Image Maps, and Animations – JS Objects - Document Object - Validation, Errors, Debugging, Exception Handling, and Security

Module 4: CASCADING STYLE SHEET (09 Periods)

CSS Syntax - CSS Selectors - Backgrounds and Color Gradients - Fonts and Text Styles - Creating Boxes and Columns - Displaying, Positioning, and Floating an Element - Table Layouts - : Effects, Frames, and Controls in CSS

Module 5: ADVANCED FEATURES OF HTML5 (09 Periods)

Creating Editable Content - Checking Spelling Mistakes - Custom Data Attributes - Client-Side Storage - Drag and Drop Feature - Web Communication –**jQuery -** Fundamentals of jQuery - Callback Functions - jQuery Selectors - jQuery Methods to Access HTML Attributes.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Design a blog layout that includes header, navigation menu, content area, sidebar. Apply appropriate styling to each section.
2. Develop a java script-based quiz that presents MCQs to the user and provides immediate feedback on their answers. Keep track of the score and display the final results at the end.
3. Build a web page that displays and image gallery. Each image should be a clickable link that opens the image in a larger view when clicked.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. DT Editorial Services, HTML 5 Black Book, Dream tech Press, 2nd Edition, 2016.

REFERENCE BOOKS:

1. Jennifer Niederst Robbins, HTML5 Pocket Reference, O'Reilly, 5th Edition, 2018.
2. Ben Frain, Responsive Web Design with HTML5 and CSS3, Packt, 2nd Edition, 2020.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=h_RftxdJTzs
2. https://www.youtube.com/watch?v=dlkWNdnO8ek

WEB RESOURCES:

1. https://www.w3schools.com/html/
2. https://www.w3schools.com/css/
3. https://www.geeksforgeeks.org/web-technology/
4. https://www.smashingmagazine.com/2021/03/complete-guide-accessible-front-end-components/
5. https://css-tricks.com/
6. https://davidwalsh.name/css-optional

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101706	**WOMEN EMPOWERMENT**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Concept & Framework, Status of Women, Women's Right to Work, International Women's Decade, and Women Entrepreneurship.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the knowledge of the characteristics and achievements of empowered women and women's empowerment techniques by analyzing women's legal and political status.

CO2. Apply the knowledge of women's rights by analyzing various societal issues and obstacles in different fields, including science and technology.

CO3. Demonstrate the knowledge of the significance of women's participation in policy debates, National conferences, and common forums for equality and development by identifying and analyzing issues.

CO4. Analyze the concept of women's entrepreneurship, government schemes, and entrepreneurial challenges and opportunities.

CO-PO Mapping Table

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	-	1		1	-	–	–
CO2	3	1	-	-		-	-	–	-
CO3	3	1	-	-		-	-	3	-
CO4	3	1	-	-		-	-	-	-
Course Correlation Mapping	**3**	**1**	**-**	**1**		**1**	**-**	**3**	**–**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: CONCEPT & FRAMEWORK (09 Periods)

Introduction– Empowered Women's Characteristics – Achievements of Women's Empowerment **Concept of Empowerment:** Meaning & Concept – Generalizations about Empowerment – Empowerment Propositions – Choices women can make for empowerment – Women's participation in decision making, development process & in Governance. **Framework for Empowerment** – Five levels of equality – Tenets of Empowerment– Elements – Phases and aspects – Techniques – Categories and Models – Approaches.

Module 2: STATUS OF WOMEN (09 Periods)

Legal Status: Present Scenario – Call for Social Change – Significant Trends – Legal & Schemes – Personal Law – Joint Family – Criminal Law – Shift towards Dowry – Deterrent Punishment – Criminal Law (II Amendment) – Discrimination in Employment.

Political Status: Present Scenario – Political Participation & its Nature Socio–economic Characteristics – Political Mobilization: Mass Media – Campaign Exposure – Group Orientation – Awareness of issues and participation – Progress & Future Thrust.

Module 3: WOMEN'S RIGHT TO WORK (09 Periods)

Introduction – Present Scenario – Changes in Policy & Programme – National Plan of Action– Women's Cells and Bureau – Increase in the work participation rate – Discrimination in the labour market – Women in unorganized sector – Issues and Obstacles– Women in Education – Women in Science & Technology – Case Study: Linking Education to Women's Access to resources.

Module 4: WOMEN'S PARTICIPATORY DEVELOPMENT (09 Periods)

Dynamics of social change – conscious participation – Information Explosion – Organized Articulation – National Conference – Common Forums – Participatory Development – New Issues Identified – Role of other Institutions.

Module 5: WOMEN ENTREPRENEURSHIP (09 Periods)

Introduction – Definition – Concept – Traits of women Entrepreneurs – Role of Women Entrepreneurs in India – Reasons for Women Entrepreneurship – Government schemes & Financial Institutions to develop Women Entrepreneurs – Key policy recommendations – Project Planning – Suggestions and measures to strengthen women entrepreneurship – Growth & Future challenges – Training and Opportunities – Case Study: Training Women as Hand–pump Mechanics– Case Study: Literacy for Empowering Craftswomen

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare poster presentation on "impact of women's self-help groups on their empowerment and socio-economic development."
2. Prepare a comparative analysis chart on the status of women in various countries.
3. Prepare a presentation on women and cultural responsibilities in different societies.
4. Prepare a presentation on the women of the past, present and future in terms of responsibilities and duties.
5. Prepare a presentation on the great women entrepreneurs of India.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Sahay Sushama, Women and Empowerment, Discovery Publishing House, New Delhi, 2013.
2. Nayak Sarojini, Jeevan Nair, Women's Empowerment in India, Pointer Publishers, Jaipur, 2017.

REFERENCE BOOKS:

1. Baluchamy. S, Women's Empowerment of Women, Pointer Publishers, Jaipur, 2010.
2. Khobragade Grishma, Women's Empowerment: Challenges and Strategies Empowering Indian Women, Books clinic Publishing, Chhattisgarh, 2020.

WEB RESOURCES:

1. https://www.economicsdiscussion.net/entrepreneurship/women–entrepreneurs–in–India
2. https://www.businessmanagementideas.com/entrepreneurship–2/women entrepreneurs

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101707	INDIAN KNOWLEDGE SYSTEM IN SCIENCE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course aims to raise awareness among students about the diverse aspects of the Indian Knowledge System in the context of science.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand a sense of rootedness and pride in India, along with an appreciation for its rich, diverse, ancient, and modern culture, knowledge systems, and traditions.

CO2. Demonstrate the rich scientific and technological heritage of the country.

CO3. Analyse the Indian concept of multidisciplinary learning systems, integrating them with modern science.

CO4. Demonstrate the importance of intellectual property rights in safeguarding Indian knowledge.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	2	-
CO4	1	1	-	-	-	-	3	3	-
Course Correlation Mapping	**2**	**2**	**3**	**-**	**3**	**-**	**3**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ANCIENT PHILOSOPHY OF KNOWLEDGE (09 Periods)

Vedas, Vedangas, sutras – Guru Kul Parampara

Module 2: ASTRONOMY IN INDIA (12 Periods)

Astronomy in India: The Beginnings of Indian Astronomy - The Early Historical Period-The Siddhāntic Era - The Kerala School - Aryabhatta - Varahamihira- Bhaskara I – Brahmagupta- Bhaskara II – Brief notes on Astronomical instruments

Module 3: CHEMISTRY IN INDIA (12 Periods)

Early Chemical Techniques, Atomism in Vaiśeṣika - Rishi Kanad- Nagarjuna- Al-Bīrūnī', Vāgbhaṭa- Sushruta- Carak Metallurgy in India - Definition, Metallurgy in Harappan Civilization, Metallurgy of Gold- Copper-Zinc- Bronze - Iron and steel.

Module 4: DEVELOPMENTS IN MATHEMATICS (12 Periods)

Number systems- Geometry- works of Pingala- Baudhayana- Jaina Mahavira-Sridharacharya – Madhava Siddanthas and Calender systems

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the aspects of ancient philosophy of the Vedason the charts and explain in detail.
2. Discuss different astronomical instruments.
3. Describe different metals with respect to civilizations.
4. Imagine you are a mathematician and illustrate different number systems.
5. Assume and interpret different siddhanthas and calendar systems.

RESOURCES

TEXTBOOK:

1. "Indian Knowledge Systems": by ParthaPratim Ray (2024 edition).
2. "Introduction to Indian Knowledge System: Concepts and Applications": by B. Mahadevan and others (various editions available, with a 2022 edition noted).

REFERENCE BOOKS:

1. Concise History of Science in India – Bose, Sen & Subbarayappa- INSA Publications (2009 edition)
2. Encyclopedia of Classical Indian Sciences- Roddam Narasimha, Universities Press, 2007.

VIDEO LECTURES:

1. https://iksindia.org/lectures-and-videos.php
2. https://www.youtube.com/watch?v=D3f3jIcEZho

WEB RESOURCES:

1. https://nep.puchd.ac.in/iks.pdf
2. https://www.millenniumassessment.org/documents/bridging/papers/balasubramian.a.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS101708	**INTRODUCTION TO INDIAN KNOWLEDGE SYSTEMS**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: The course introduces students to key areas of the Indian Knowledge System (IKS), such as research methods, astronomy, literature and arts, agriculture and food, Ayurveda, and architecture.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the various pramanas used in the Indian Knowledge System.

CO2. Analyse fields of IKS related to Astronomy, Arts, Ayurveda, and Architecture.

CO3. Understand the Earth and Atmosphere related specifically to earthquakes, clouds, rainfall, soil, agriculture, and food science

CO4. Explore different fields of study in IKS further with the references and the resources provided during the course.

CO5. Analyse various materials in āyurveda, rasaśāstra, and vāstuvidyā

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	2	1	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-
CO3	2	2	-	3	-	-	-	2	-
CO4	1	1	-	-	-	-	3	3	-
CO5	1	1	-	-	-	-	3	3	-
Course Correlation Mapping	**2**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ASTRONOMY AND MATHEMATICS (10 Periods)

Introduction to various fields in the traditional Indian Knowledge system. Methods and sources - Ancient Indian Observational astronomy. Foundation concepts - nakṣatra, graha, time units, phenomena like meteors, eclipses- Mathematical thinking - numerical and spatial thinking, śulbasūtra, zero, sundials, water clock, time measurement.

Module 2: LANGUAGE, LITERATURE AND ART (10 Periods)

Formation of words in saṃskṛta and some ideas from Pāṇini and Patañjali. Technical words and examples of their usage- Music Vedic chants, sāma, some concepts in ancient treatises like nāradīyaśikṣā, nāṭyaśāstra. Basics of related concepts like dance, meter and rasa in poetry.

Module 3: EARTH AND ATMOSPHERE (05 Periods)

Anomalous phenomena, Earthquakes, clouds, rainfall, soil, agriculture, and food science

Module 4: ARCHITECTURE AND CIVIL ENGINEERING (10 Periods)

Sindhu-Sarasvatī cities, description in purāṇa, arthaśāstra. A glance at select texts like nāradaśilpa, Mayamata, and mānasāra.

Module 5: MATERIAL SCIENCE (10 Periods)

Knowledge and use of various materials in āyurveda, rasaśāstra and vāstuvidyā.

Total Periods: 45

EXPERIENTIAL LEARNING

1 List out the aspects of astronomy and mathematics on the charts and explain in detail.
2. Discuss differenttechnical words and examples of their usage
3. Prepare a poster of anomalous phenomena of Earth and the atmosphere.
4. Demonstrate the role of architecture in the modern world.
5. Illustrate how Materials science can draw upon principles from physics, chemistry, and engineering to understand and manipulate materials.

RESOURCES

TEXTBOOK:

1. Introduction to Indian Knowledge System - A Textbook for UG Students as per NEP 2020 (English, Paperback, Dr. Rohidas Nitonde).
2. "Introduction to Indian Knowledge System: Concepts and Applications": by B. Mahadevan and others (various editions available, with a 2022 edition noted).

REFERENCE BOOKS:

1. Indian Knowledge System Principles and Practices Hardcover –Big Book, 18 December 2024 by Dr. Ajay Kumar Singh.
2. Encyclopedia of Classical Indian Sciences- Roddam Narasimha, Universities Press, 2007.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Gexiwsa7Gc0
2. https://www.youtube.com/watch?v=D3f3jIcEZho

WEB RESOURCES:

1. https://nep.puchd.ac.in/iks.pdf
2. https://www.millenniumassessment.org/documents/bridging/papers/balasubramian.a.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25LG101702	QUANTITATIVE APTITUDE AND VERBAL ABILITY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course explores essential quantitative, verbal, and analytical reasoning skills for competitive exams and placements. It covers arithmetic, algebra, geometry, data interpretation, probability, and logical problem-solving. Verbal modules focus on grammar, vocabulary, reading comprehension, and critical reasoning techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of number systems, percentages, ratios, and averages to solve real-time quantitative problems.

CO2. Apply algebraic techniques, progressions, and geometric concepts to compute and analyze mathematical scenarios.

CO3. Utilize combinatorics, probability, and data interpretation for decision-making under constraints.

CO4. Apply core grammar rules, sentence structures, reading comprehension, and critical reasoning techniques to communicate effectively.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	2	-	-	-	-	-
CO2	3	2	-	2	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-
CO4	3	2	2	2	-	-	-	3	-
Course Correlation Mapping	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NUMBER SYSTEMS, PERCENTAGES, RATIOS & AVERAGES (09 Periods)
Number system, power cycle, remainder cycle, factors, multiples, HCF, LCM, Percentages, fraction-to-decimal conversions, increase/decrease calculations, simple and compound interest, Ratio, proportion, variation, problems on ages, profit and loss vocabulary, partnership, cost/selling price, Averages, weighted averages, mixtures and allegations.

Module 2: ALGEBRA, PROGRESSIONS, GEOMETRY (09 Periods)
Logarithms, rules and simplifications, solving quadratic equations, Arithmetic and geometric progressions, nth term, sum formulas, Geometry and mensuration, triangles, circles, area, perimeter, volume, surface area, Time and work, efficiencies, pipes and cisterns, division of wages, Speed, distance, relative motion, trains, boats and streams, races.

Module 3: COMBINATORICS, PROBABILITY, AND DATA INTERPRETATION (09 Periods)
Permutation and combination, counting principles, factorials, arrangements, selections, Probability concepts, events, rules of probability, real-life applications, Data interpretation from tables, pie charts, bar graphs, Data sufficiency techniques, evaluating adequacy of given data, Basic logical reasoning within quantitative problem-solving.

Module 4: CORE VERBAL GRAMMAR AND SENTENCE STRUCTURE (09 Periods)
Sentence correction, subject-verb agreement, modifiers, parallelism, tenses, comparisons, Articles and prepositions, omission rules, compound structures, interrogatives, Active and passive voice, direct and indirect speech rules, Sentence completion, para-jumbles, context clues, logical connectors, Vocabulary building, synonyms, antonyms, word usage, analogies.

Module 5: READING COMPREHENSION AND CRITICAL REASONING (09 Periods)
Reading comprehension types, speed reading, tone/inference-based questions, Critical reasoning – arguments, assumptions, conclusions, strengthen/weaken/inference, Word roots, prefixes, suffixes, sentence structure clues, Logical structuring of arguments, spotting fallacies, Application of reasoning in RCs, data-based questions, verbal puzzles.

Total Periods: 45

EXPERIENTIAL LEARNING

1) **NUMBER SYSTEMS, PERCENTAGES, RATIOS & AVERAGES**
A trader has 3 varieties of rice 13529 kg, 9617 kg, 7987 kg by weights. Find the minimum number of bags of equal size in which he can store the rice without mixing.
   a) 163
   b) 191
   c) 246
   d) 212

2) **NUMBER SYSTEMS, PERCENTAGES, RATIOS & AVERAGES**
The ratio of the ages of A and B is 3:4. After 5 years, the ratio becomes 4:5. What are their present ages?
   a) 15 and 20
   b) 18 and 24
   c) 30 and 40
   d) 20 and 25

3) **ALGEBRA, PROGRESSIONS, GEOMETRY**

Solve for x:
If $2x + 3 = 7$, then what is the value of x?

a) 1
b) 2
c) 3
d) 4

4) **ALGEBRA, PROGRESSIONS, GEOMETRY**

The perimeter of a rectangle is 36 cm. If the length is 10 cm, what is the width?

a) 8 cm
b) 9 cm
c) 6 cm
d) 7 cm

5) **COMBINATORICS, PROBABILITY, AND DATA INTERPRETATION**

A card is drawn at random from a standard deck of 52 playing cards. What is the probability that it is a red king?

a) 1/13
b) 1/26
c) 1/52
d) 2/13

6) **COMBINATORICS, PROBABILITY, AND DATA INTERPRETATION**

The number of students in five different classes is as follows:
Class A – 40, Class B – 35, Class C – 50, Class D – 45, Class E – 30.
What is the average number of students per class?

a) 38
b) 40
c) 42
d) 45

7) **CORE VERBAL GRAMMAR AND SENTENCE STRUCTURE**

Identify the grammatically correct sentence:

a) He go to the gym every morning.
b) He goes to the gym every morning.
c) He going to the gym every morning.
d) He gone to the gym every morning.

8) **CORE VERBAL GRAMMAR AND SENTENCE STRUCTURE**

Despite the heavy rain, the match _____.

a) has cancel
b) was cancelled
c) will be cancelled
d) continued as scheduled

9) **READING COMPREHENSION AND CRITICAL REASONING**

Passage:

The Earth's climate has changed throughout history. However, the current trend of global warming is particularly alarming because it is occurring at an unprecedented rate. Scientists overwhelmingly agree that human activities, especially the burning of fossil fuels, are the primary cause of this rapid change.

According to the passage, what is the main cause of current global warming?

a) Natural changes in the climate
b) Increase in solar activity
c) Volcanic eruptions
d) Human activities like burning fossil fuels

10) **READING COMPREHENSION AND CRITICAL REASONING**

A new study shows that students who take handwritten notes retain more information than those who type notes. Therefore, schools should ban laptops during lectures to improve student learning.

Which of the following, if true, most seriously weakens the argument?

a) Many students find typing faster than writing by hand.
b) Some students need laptops to access course materials.
c) The study did not account for the difficulty level of the lectures.
d) The students who typed their notes reviewed them more often than those who wrote by hand.

RESOURCES

TEXTBOOK:

1. "R.S. Aggarwal", Quantitative Aptitude for Competitive Examinations, S. Chand Publishing, 2025.
2. "Abhijit Guha", Quantitative Aptitude for Competitive Examinations, 7th edition, Tata McGraw Hill Education, 2021.

REFERENCE BOOKS:

1. "Arun Sharma", How to Prepare for Quantitative Aptitude for CAT, 11th Edition, McGraw Hill Education, 2024.
2. "Nishit Sinha", Quantitative Aptitude for CAT, 5th edition, Pearson Education, 2020.

SOFTWARE/TOOLS:

1. Microsoft Excel or Google Sheets (for solving DI sets)
2. Any Scientific Calculator (if permitted)
3. Online Aptitude Test Platforms like:
   a. India Bix (https://www.indiabix.com)
   b. Lofoya (https://www.lofoya.com)
   c. Test book (https://testbook.com)

VIDEO LECTURES:

1. NPTEL: Aptitude Learning (Verbal & Quant)
2. Un academy: Quantitative Aptitude by Arun Sharma
3. YouTube: Talent Sprint Aptitude Classes
4. YouTube: Study Smart – Full Aptitude Playlist
5. Udemy: Quantitative Aptitude for Competitive Exams

WEB RESOURCES:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://www.geeksforgeeks.org/aptitude/
3. https://www.lofoya.com
4. https://www.placementseason.com/aptitude-questions
5. https://www.campusgate.co.in/p/quantitative-aptitude.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25LG101703	LOGICAL REASONING AND RECRUITMENT ESSENTIALS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course develops essential logical reasoning, analytical skills, and practical communication for competitive exams and placements. It covers data arrangements, coding-decoding, pattern recognition, counting principles, probability, and data interpretation. Learners also acquire skills in logical connectives, syllogisms, time and direction sense, along with group discussions, resume writing, and interview preparation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply concepts of data arrangements, blood relations, ranking, and direction sense to solve spatial and logical reasoning problems.

CO2. Analyze patterns in coding-decoding, series, analogies, odd-one-out, and visual reasoning to improve abstraction and recognition skills.

CO3. Apply principles of combinatorics, probability, data interpretation, logical connectives, syllogistic reasoning, and time-space analysis to construct effective solutions and derive valid conclusions.

CO4. Demonstrate effective communication skills in group discussions, resume writing, and personal interviews through structured activities.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	-	2	-	-	-	-	-
CO2	3	2	3	2	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-
CO4	3	2	-	2	-	-	-	3	-
Course Correlation Mapping	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: DATA ARRANGEMENTS AND BLOOD RELATIONS (08 Periods)

Linear arrangement, circular arrangement, multi-dimensional arrangement, coded and descriptive blood relations, family trees, ranking, and ordering problems. Focus on directional logic, positional comparisons, and attribute-based placement. Enhances spatial reasoning and logical deduction skills.

Module 2: CODING-DECODING, SERIES, ANALOGY, ODD ONE OUT & VISUAL REASONING (08 Periods)

Letter coding, number coding, substitution patterns, alphanumeric series, analogy-based reasoning, identifying odd one out in sequences, visual reasoning including mirror images, paper folding, figure sequences. Builds pattern recognition and abstraction abilities.

Module 3: COUNTING PRINCIPLES, P&C, PROBABILITY, DATA INTERPRETATION & SUFFICIENCY (09 Periods)

Fundamental counting principle, permutation and combination, probability theory and applications, interpreting pie charts, tables, and bar graphs, data sufficiency problems requiring logical assessment of given facts. Develops analytical thinking and quantitative aptitude.

Module 4: LOGICAL CONNECTIVES, SYLLOGISMS, VENN DIAGRAMS, CLOCKS, CALENDARS & DIRECTION (08 Periods)

IF-THEN logic, syllogistic reasoning with Venn diagrams, calendar-based date/day calculations, clock-angle problems, direction sense and cube-based spatial puzzles. Trains logical sequencing and time-space orientation.

Module 5: RECRUITMENT ESSENTIALS – GD, RESUME & INTERVIEW SKILLS (12 Periods)

Basics of group discussion, resume writing guidelines, and key sections, personal interview structure, HR and technical questions, body language tips, mock GD and interview sessions for real-time practice and evaluation. Equips students with communication and interview readiness.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1) **DATA ARRANGEMENTS AND BLOOD RELATIONS**

Six people – A, B, C, D, E, and F – are sitting in a row, facing north.

- B is sitting to the immediate right of D.
- C is at one of the ends.
- A is sitting between E and F.
- D is not at either end.
- E is sitting to the left of A.

Who is sitting in the middle?

Options:

A) A
B) B
C) D
D) F

2) **DATA ARRANGEMENTS AND BLOOD RELATIONS**

Pointing to a man, Mira says, "He is the son of my mother's only daughter."
How is the man related to Mira?

Options:
A) Son
B) Nephew
C) Cousin
D) Brother

3) **CODING-DECODING, SERIES, ANALOGY, ODD ONE OUT & VISUAL REASONING**

In a certain code language, **GAMES** is written as **HZNFT**.
How is **PLANE** written in that code?

Options:
A) QMBOF
B) QMBOD
C) QNCOD
D) OKZMD

4) **CODING-DECODING, SERIES, ANALOGY, ODD ONE OUT & VISUAL REASONING**

Which word does **not** belong to the group?

Options:
A) Apple
B) Mango
C) Banana
D) Carrot

5) **COUNTING PRINCIPLES, P&C, PROBABILITY, DATA INTERPRETATION & SUFFICIENCY**

If the sales of Company A in 2021 were 80 units and in 2022 were 120 units, what was the percentage increase?

Options:
A) 33.3%

B) 50%

C) 40%

D) 60%

6) **COUNTING PRINCIPLES, P&C, PROBABILITY, DATA INTERPRETATION & SUFFICIENCY**

The number of students in five different classes is as follows:
Class A – 40, Class B – 35, Class C – 50, Class D – 45, Class E – 30.
What What is the value of x?
Statement I: $x^2 = 49$
Statement II: x is a negative number

A) Only I is sufficient
B) Only II is sufficient
C) Both I and II together are sufficient
D) Each alone is sufficient

7) **LOGICAL CONNECTIVES, SYLLOGISMS, VENN DIAGRAMS, CLOCKS, CALENDARS**

& DIRECTION

Statements:

1. All engineers are logical.
2. Some logical people are creative.
3. No creative person is careless.

Conclusion:

I. Some engineers are creative.

II. No engineer is careless.

Choose the correct option:

A) Only I follows

B) Only II follows

C) Neither I nor II follows

D) Both I and II follow

8) **LOGICAL CONNECTIVES, SYLLOGISMS, VENN DIAGRAMS, CLOCKS, CALENDARS & DIRECTION**

Ravi starts from his home at 3:00 PM and walks 4 km East, then turns left and walks 3 km. He then turns left again and walks 4 km. What direction is he facing, and what time will it be if each km takes him 15 minutes?

A) Facing North, 3:45 PM
B) Facing West, 4:00 PM
C) Facing South, 4:00 PM
D) Facing West, 3:45 PM

9) **RECRUITMENT ESSENTIALS – GD, RESUME & INTERVIEW SKILLS**

Improves Communication Skills – Students learn to express their thoughts clearly and confidently in a group setting.

Builds Critical Thinking – It enhances analytical skills by encouraging students to think on their feet, structure arguments, and respond to different viewpoints.

Boosts Teamwork & Listening Skills – GD teaches the importance of active listening, respecting others' opinions, and working collaboratively, which are essential in professional environments.

10) **RECRUITMENT ESSENTIALS – GD, RESUME & INTERVIEW SKILLS**

Boosts Confidence – Simulated interviews reduce anxiety and prepare students to face real interviews with ease.

Improves Self-Presentation – Students learn how to present their strengths, goals, and experiences effectively.

Provides Constructive Feedback – Personalized feedback helps identify areas for improvement in communication, attitude, and body language.

RESOURCES

TEXTBOOK:

1. "R.S. Aggarwal", Quantitative Aptitude for Competitive Examinations, S. Chand Publishing, 2025.
2. "Abhijit Guha", Quantitative Aptitude for Competitive Examinations, 7th edition,Tata McGraw Hill Education, 2021.

REFERENCE BOOKS:

1. "Arun Sharma", How to Prepare for Quantitative Aptitude for CAT, 11th Edition, McGraw Hill Education, 2024.
2. "Nishit Sinha", Quantitative Aptitude for CAT, 5th edition, Pearson Education, 2020.

SOFTWARE/TOOLS:

1. Microsoft Excel or Google Sheets (for solving DI sets)
2. Any Scientific Calculator (if permitted)
3. Online Aptitude Test Platforms like:
   a. India Bix (https://www.indiabix.com)
   b. Lofoya (https://www.lofoya.com)
   c. Test book (https://testbook.com)

VIDEO LECTURES:

1. NPTEL: Aptitude Learning (Verbal & Quant)
2. Un academy: Quantitative Aptitude by Arun Sharma
3. YouTube: Talent Sprint Aptitude Classes
4. YouTube: Study Smart – Full Aptitude Playlist
5. Udemy: Quantitative Aptitude for Competitive Exams

WEB RESOURCES:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://www.geeksforgeeks.org/aptitude/
3. https://www.lofoya.com
4. https://www.placementseason.com/aptitude-questions
5. https://www.campusgate.co.in/p/quantitative-aptitude.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EC101707	QUANTUM AI	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course introduces the fundamentals of Quantum Artificial Intelligence (Quantum AI), an emerging field that combines quantum computing with artificial intelligence to develop intelligent systems capable of solving complex problems more efficiently than classical methods. Students will explore core concepts of quantum computation, classical and quantum problem-solving, reversible logic, quantum probability, and quantum-inspired cognitive models.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the foundational concepts of Quantum AI, including its advantages, working principles, challenges, and its relation to classical and quantum computation.

CO2. Analyze classical computation frameworks such as decision problems, P vs NP, and the Church–Turing–Deutsch principle, and apply them to knowledge representation and production systems.

CO3. Apply the concepts of reversible computation and probabilistic models like Bayes's theorem and Naïve Bayes to categorize and process information effectively.

CO4. Evaluate quantum problem-solving methods using heuristic search, quantum tree search, and production systems for cognitive architectures and structured problems like the n-puzzle.

CO5. Explore quantum cognition approaches including quantum probability, decision-making strategies, quantum walk, and quantum neural computation to understand emerging models of intelligent behavior.

CO-PO Mapping Table:

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	–	–	–	–	–	2	2
CO2	3	3	2	–	–	–	–	2	2
CO3	2	3	2	–	–	–	–	–	2
CO4	3	3	3	2	–	–	–	2	2
CO5	3	2	2	2	–	–	–	3	3
Course Correlation Mapping	**3**	**3**	**3**	**2**	–	–	–	**3**	**3**

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT

Module 1: INTRODUCTION (08 Periods)

Definition of quantum AI, Advantages of QAI (Quantum AI), How Quantum AI Works, why is Quantum AI Important, Current Challenges, Future of Quantum AI, Motivation and Goals, Classical computation, Quantum computation.

Module 2: COMPUTATION, PROBLEM SOLVING AND PRODUCTION SYSTEM. (10 Periods)

Cantor's diagonal argument, Decision problems, P and NP, Church–Turing–Deutsch principle, Knowledge Representation, Rules, Logic-based operators, Frames, Categorial representation, Binary vector representation, Deduction systems, Reaction systems, Human problem-solving, Example, Proto logic, Binding problem, Icons, Euclidian geometry of the world.

Module 3: REVERSIBLE ALGORITHMS AND PROBABILITY (08 Periods)

Reversible Computation, Boolean gates, Reversible Boolean gates, Toffoli gate, Circuit, Conditional probability, Bayes's rule, Joint distribution, Naıve Bayes and counting, Counting and categorization.

Module 4: QUANTUM PROBLEM-SOLVING (10 Periods)

Symbols and Quantum Reality, Uninformed Tree Search, Heuristic functions, Invention of heuristic functions, Quality of heuristic, Principles of quantum tree search, Iterative quantum tree search, no constant branching factor, Quantum Production System, 3-puzzle, Extending for any n-puzzle, Pure production system, Cognitive architecture, Representation.

Module 5: QUANTUM COGNITION AND RELATED APPROACHES (09 Periods)

Quantum Probability, Decision Making, Unpacking Effects, Quantum Walk: Random Walk, Quantum insect, Quantum Walk on a graph, Quantum Walk on one dimensional lattice, Quantum Walk and search, Quantum Walk for formula evaluation, Adiabatic Computation, Quantum Neural Computation.

Total Periods: 45

EXPERIENTIAL LEARNING:

1. Build a quantum random number generator
2. Simulate a quantum walk

RESOURCES

TEXT BOOK:

1. Andreas Wichert, principles of quantum artificial intelligence, Copyright © 2014 by World Scientific Publishing Co. Pte. Ltd., ISBN 978-981-4566-74-2.

REFERENCE BOOK:

1. No sons. Yanofsky, Mirco A. Mannucci, "Quantum Computing for Computer Scientists"

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=F3nwNK28LzA&pp=0gcJCf0Ao7VqN5tD
2. https://www.youtube.com/channel/UCgUUiDMmN9AsC2LyQSh_KXw/playlists

WEB RESOURCES:

1. https://www.researchgate.net/publication/262883357_Principles_of_Quantum_Artificial_Intelligence_World_Scientific
2. https://www.worldscientific.com/worldscibooks/10.1142/8980?srsltid=AfmBOop7WiTj56KDDqGnXwRcFMrOlyhVcN5HyIE3S9JO67M_AI45Lwsw
3. https://www.coursera.org/articles/what-is-quantum-ai

UNIVERSITY ELECTVE

Course Code	Course Title	L	T	P	S	C
25CA101702	**SOFTWARE ENGINEERING FOR AI**	3	-	-	-	3

Pre-Requisite Software engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course introduces the principles and practices of software engineering specifically tailored for AI-based systems. It covers the full lifecycle of AI software development, integrating traditional software engineering methods with modern AI and machine learning workflows. Students will learn how to define requirements, design modular and interpretable systems, engineer data pipelines, develop and test AI models, and deploy them responsibly. Emphasis is placed on maintainability, scalability, fairness, and ethical considerations in building AI-driven applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the fundamental differences between conventional software engineering and AI-based systems,

CO2. Apply incremental and exploratory system engineering methodologies, to design AI systems.

CO3. Analyze exploratory programming practices for managing evolving AI software systems.

CO4. Evaluate the design and engineering aspects of machine learning systems and expert systems.

CO5. Design AI-driven practical software using engineering toolboxes, support environments.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	2	–	–	–	–	–	2	2
CO2	3	3	2	2	–	–	–	–	2
CO3	2	3	3	2	–	–	–	2	2
CO4	3	3	2	2	–	–	–	2	2
CO5	3	3	3	2	2	–	–	3	3
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	–	–	**3**	**3**

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT

Module 1: INTRODUCTION TO COMPUTER SOFTWARE FOR AI, AI PROBLEMS AND CONVENTIONAL SE PROBLEMS (10 periods)

Computers and software systems, An introduction to Software engineering, Bridges and buildings versus software systems, the software crisis A need for Al systems What is an AI problem, Ill-defined specifications, correct versus 'good enough' solutions, Context-free problems, SAV methodology, the myth of complete specification, what is verifiable, SAT methodology, testing for reliability, the strengths, the weaknesses

Module 2: INCREMENTAL AND EXPLORATORY METHODOLOGY FOR SYSTEM ENGINEERING (09 periods)

Classical methodology and AI problems, The RUDE cycle, Malleable software, AI muscles on a conventional skeleton Conventional paradigms Automatic programming, Transformational implementation, The "new paradigm" of Blazer, Cheatham and Green, Operational requirements of Kowalski, The POLITE methodology

Module 3: EXPLORATORY PROGRAMMING (09 periods)

Reverse engineering, Reusable software Design knowledge, Stepwise abstraction, The problem of decompiling, Controlled modification, Structured growth Self-adaptive software, The threat of increased software problems

Module 4: MACHINE LEARNING AND EXPERT SYSTEMS (09 periods)

Practical machine learning examples, Multisession inductive programming, Expert Systems: Expert systems as Al software, Engineering expert systems, The lessons of expert systems for engineering Al software

Module 5: AI INTO PRACTICAL SOFTWARE (08 periods)

Support environments, Reduction of effective complexity, moderately stupid assistance, An engineering toolbox, Self-reflective software, Over engineering software, Future Holds

Total Periods: 45

RESOURCES

TEXT BOOK:

1. Derek Partridge, "Artificial Intelligence and Software Engineering", Glenlake Publishing Company, 1998.

REFERENCE BOOKS:

1. "The role of Artificial Intelligence in Software Engineering", K. Nitalksheswara Rao,2020
2. " Farid Meziane &Sunil Vadera, "Artificial Intelligence Applications for Improved Software Engineering Development", Information Science Reference, 2009

VIDEO LECTURES

1. https://www.youtube.com/watch?v=Ccku34DU7k4
2. https://www.youtube.com/watch?v=WNxc85aFFbM
3. https://www.youtube.com/watch?v=KIC-sFz5OT8
4. https://www.youtube.com/playlist?list=PLDS2JMJnJzdkQPdkhcuwcbJpjB84g9ffX

WEB RESOURCES

1. https://www.geeksforgeeks.org/software-engineering/ai-in-software-engineering
2. https://www.coursera.org/learn/team-software-engineering-with-ai
3. https://ckaestne.github.io/seai/S2020/
4. https://www.seerene.com/ai4se
5. https://www.coursera.org/specializations/generative-ai-for-software-developers

UNIVERSITY ELECTVE

Course Code	Course Title	L	T	P	S	C
25CB101703	**ADVANCED ARTIFICIAL INTELLIGENCE**	3	-	-	-	3

Pre-Requisite Artificial intelligence

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course offers an in-depth exploration of advanced concepts and methodologies in Artificial Intelligence (AI), preparing students for real-world applications. Beginning with a comprehensive introduction to the foundations and evolution of AI, the course covers cognitive modelling, expert systems, and intelligent robotics. Students delve into advanced reasoning mechanisms including deductive, inductive, abductive, and common-sense reasoning that are essential for building intelligent systems capable of human-like decision-making.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Summarize the evolution and history of Artificial Intelligence and its major research domains.

CO2. Apply reasoning techniques to real-world and AI problem contexts.

CO3. Apply Game Theory models such as zero-sum and evolutionary games to decision-making problems in AI.

CO4. Apply Bayesian and Gaussian Process models in real-world transfer learning applications.

CO5. Design solution strategies using AI platforms for domain-specific scientific challenges.

CO-PO Mapping Table:

Course Outcome	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	2	–	–	–	–	–	2	2
CO2	3	3	3	2	–	–	–	2	2
CO3	2	3	3	2	2	–	–	–	2
CO4	3	3	2	3	2	–	–	–	2
CO5	3	2	3	3	2	–	2	3	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	–	**2**	**3**	**3**

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE (10 Periods)

Brief History of AI, Basic Content of Artificial Intelligence Research: Cognitive Modeling, Knowledge Representation, Automatic Reasoning, New Generation Artificial Intelligence, Expert System, Natural Language Processing, Intelligent Robot, Distributed Artificial Intelligence, Internet Intelligence Game, AI for Science.

Module 2: CAUSAL REASONING (09 Periods)

Deductive Reasoning, Inductive Reasoning, Abductive Reasoning, Reasoning by Analogy, Non-Monotonic Reasoning, Common Sense Reasoning.

Module 3: GAME THEORY (09 Periods)

History of Game Theory, Basic Concepts of Game Theory, Applications of Game Theory, Representation of Games: Extensive Form, Normal Form, Characteristic Function Form, Alternative Game Representations, Type of Game Theory, Zero-Sum Game, Evolutionary Game Theory, Game Dynamics: MDA Model, Applications.

Module 4: TRANSFER LEARNING (09 Periods)

History, Important Concepts, Similarity Measure, Classifications, Negative Transfer, Inductive Transfer Learning, Transfer Learning, Model-Based Transfer Learning, Bayesian Models. Gaussian Process (GP), Deep Transfer Learning, Heterogeneous Transfer Learning, Multi-task Transfer Learning, Domain Adaptation Transfer Learning.

Module 5: ARTIFICIAL INTELLIGENCE FOR SCIENCE (08 Periods)

Introduction, Knowledge Discovery, Protein Structure Prediction, Drug Development, Genetic Research, Biological Breeding, New Materials, Superconducting Materials, Graphene, Liquid Metal, Climate Change Climate Model, Long-Term Impacts, Solution Strategy, Platform of Artificial Intelligence for Science.

Total Periods: 45

EXPERIENTIAL LEARNING

Real-World Case Study Analysis on

1. AI in healthcare
2. AI in finance or e-commerce (credit scoring, dynamic pricing)

RESOURCES

TEXT BOOK:

1. Zhongzhi SHI, Advanced Artificial intelligence, World Scientific Publishing Co. Pte. Ltd,3rd edition, ISBN 9789811293986 (hardcover) ,3rd edition.

REFERENCE BOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 4th (2020) edition, Pearson publications.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press

VIDEO LECTURES

1. https://www.youtube.com/watch?v=1HpYwa52LeY
2. https://www.youtube.com/watch?v=kOkehUZrjBM
3. https://www.youtube.com/playlist?list=PLxf3-FrL8GzRALeq_9BtdQclN6SF4bTCG

WEB RESOURCES

1. https://people.engr.tamu.edu/guni/csce625/slides/AI.pdf
2. https://dokumen.pub/advanced-artificial-intelligence-3nbsped-9789811293986-9789811293993- 9789811294006.html
3. https://nou.edu.ng/coursewarecontent/CIT%20903%20Advanced%20Artificial%20Intelligence_0.pdf
4. https://home.schoolnutritionandfitness.com/index.jsp/uploaded-files/M2E709/AdvancedArtificialIntelligenceBook.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE101706	**INDIAN KNOWLEDGE SYSTEM IN TOWN PLANNING AND ARCHITECTURE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course explores the profound and time-tested wisdom of the Indian Knowledge System (IKS) as it applies to town planning and architecture. Drawing from ancient texts like the Vastu Shastra, Artha shastra, Manasara, and Silpa Shastra, the course delves into how traditional Indian principles harmonized built environments with nature, climate, cosmology, and societal needs. The course provides a historical and philosophical framework to understand the design of cities, temples, dwellings, water management systems, and public spaces in ancient and medieval India.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of traditional Indian architectural and urban planning systems.

CO2. Interpret ancient design treatises and relate their principles to real-world examples.

CO3. Integration of culture, environment, and functionality in traditional planning.

CO4. Apply IKS principles to modern urban and architectural contexts with sustainability in focus.

CO5. Interpret the concept of ancient stone carving and their significance in architecture.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ANCIENT TEXT AND TOWN PLANNING (09 Periods)

Introduction to ancient text in the context of Town Planning and Governance; terminologies; Indic languages in which the knowledge is embedded; Chronology of development of ancient text and changing principles.

Module 2: PRINCIPLES OF TOWN PLANNING (09 Periods)

Ancient India progressed towards urbanization with cities of various sizes and shapes. Elaboration of basic understanding of the layouts in terms of geometry, formulae and theory based on population, geography, and various communities shall be understood.

Module 3: ANCIENT TOWNS AND PRESENT PLANNING PRACTICES (09 Periods)

Evolution of the cities following the ancient town planning principles in urban centres. Interconnection between ancient knowledge of town planning and present planning practices to establish the relationship between theory and practice.

Module 4: CLAY ARCHITECTURE (09 Periods)

Terracotta and Terracruda, Brick structures and urns from the Indus Valley and Megalithic sites in south India, Sculptures of terracotta and bronze from Harappa, Terracruda or unbaked clay-made objects and rituals.

Module 5: STONE AND GARDEN (09 Periods)

Stone: Memorials, Architectural Remnants and Objects- Types of stone in India: Mathura Sandstone, Deccani Basalt, Rajasthani Marble, Stone carving for architecture and their social significance. Garden: Islam, the garden of paradise and afterlife, Tombs, palace, garden and waterways from the Mughal and Deccani context.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Heritage Walks & On-Site Case Studies (Nearby towns)

2. Hands-on mapping of **temple towns**

3. Students make small prototype using traditional techniques.

4. Students document traditional water harvesting system

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Ali, Daud and Emma Flatt eds, Garden and landscape practices in pre-colonial India: histories from the Deccan, New Delhi: Routledge 2020.
2. Dehejia, Vidya, Chola: Sacred Bronzes of Southern India, London: Royal Academy of Arts 2006.

REFERENCE BOOKS:

1. Goswamy, B. N., and Eberhard Fischer, Pahari Paintings: The Horst Metzger collection in the Museum Rietberg, New Delhi: Niyogi Books 2017.
2. Hardy, Adam, The Temple Architecture of India. Chichester (GB), J. Wiley and Sons 2007.
3. Pandey, Shailaja, Mayamata: An Indian treatise on housing architecture and iconography, Chaukhamba Surbharati Prakashan 2007.
4. Sharma, Sudarshan Kumar, Samarangana Sutradhara, Parimal Publications 2008.
5. Sharma B.L, Vishvakarma - Vastushastram, Parimal Publications 2010.
6. Jugnu, Shri Krishna, Aparajitpraccha, Parimal Publications 2011.
7. Patrick Olivelle, King, governance, and law in ancient India: Kauṭilya's Arthasastra: a new annotated translation, Oxford University Press 2013.
8. Apte, Prabhakar, Samarangana Sutradhara, IGNCA 2023.

VIDEO LECTURES:

1. https://iksindia.org/lectures-and-videos.php
2. https://www.youtube.com/watch?v=4NT9reg4G3s
3. https://onlinecourses.swayam2.ac.in/imb23_mg53/preview
4. https://www.youtube.com/@IKS_Media_MoE/videos

WEB RESOURCES:

1. https://nitkkr.ac.in/ndian-knowledge-systems-iks
2. https://iksindia.org/research-proposal-form.php
3. https://en.wikipedia.org/wiki/Indian_Knowledge_Systems