MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102

MBU
MOHAN BABU
UNIVERSITY
DREAM. BELIEVE. ACHIEVE

SCHOOL OF LIBERAL ARTS AND SCIENCES

B.Sc. – Biotechnology

CURRICULUM AND SYLLABUS

(For 2022-23 Admitted Students)

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. – Biotechnology

PROGRAM EDUCATIONAL OBJECTIVES

After few years of graduation, the graduates of B.Sc.Biotechnology,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. Biotechnology,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 B.Sc. Biotechnology program, students will be able to:

PSO1. Understand fundamentals of Biotechnology and apply their practical skills in the production of different industrial products as well in the preparation of Genetically modified organisms and vaccines. Also, design and develop drugs, analyze genomes and proteomes via Bioinformatics tools

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. Use appropriate techniques to culture the microbes, identify the pathogenic microbes responsible for disease condition and useful microbes in the production of different products.

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. – Biotechnology (3 Year Degree)

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min.- Max.)
1	SCHOOL CORE	28-34
2	PROGRAM CORE	54-72
3	PROGRAM ELECTIVE	27-45
4	UNIVERSITY ELECTIVE	9-12
	TOTAL CREDITS	**Min. 120**

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

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min.- Max.)
1	SCHOOL CORE	28-36
2	PROGRAM CORE	66-81
3	PROGRAM ELECTIVE	39-60
4	UNIVERSITY ELECTIVE	9-12
	TOTAL CREDITS	**Min. 160**

SCHOOL CORE

(28-34 Credits for 3 years Program); (28-36 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 Main Basket (Min. 20 Credits to be earned)							
22BS101401	Environmental Studies	2	-	-	-	2	-
22BS101036	Mind and Behavior	3	-	-	-	3	-
22LG101401	Personality Development	2	-	-	-	2	-
22BS101002	Introduction to Biology	3	-	-	-	3	-
22BS101003	Biodiversity monitoring and management	3	-	-	-	3	-
22CM101401	Principles of Business Economics and Accountancy	3	-	-	-	3	-
22MG101401	Essentials of Leadership	2	-	-	-	2	-
22MG101402	Organizational Behaviour	2	-	-	-	2	-
22MG101403	Project Management	2	-	-	-	2	-
22CS102402	Basic computers and Information Sciences	3	-	2	-	4	-
22DF105001	Biomedical Waste Management	-	1	2	-	2	-
22EC111001	Internship	-	-	-	-	4	-
22EC108001	Capstone Project	-	-	-	-	10	-
Language Basket (Min. 8 Credits to be earned)							
22LG102405	General English	2	-	2	-	3	-
22LG102401	English for Professionals	-	1	2	4	3	-
22LG101403	German Language	2	-	-	-	2	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22LG101404	French Language	2	-	-	-	2	-
22LG101402	Telugu	2	-	-	-	2	-
22LG101403	Hindi	2	-	-	-	2	-
22LG101404	Sanskrit	2	-	-	-	2	-
Mandatory Non-Credit Courses (Min. 6 Credits to be earned) Earned Credits will not be considered for CGPA							
22LG107601	Professional Ethics and Human Values	2	-	-	-	2	-
22CE107602	Disaster Mitigation and Management	2	-	-	-	2	-
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NCC/NSS Activities	-	-	-	-	2	-
22MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107601	Intellectual Property Rights	2	-	-	-	2	-
22EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-

PROGRAM CORE

(54-72 Credits for 3 years Program - *Min. 18 Credits from each Major*);

(66-81 Credits for 4 years Program - *Min. 20 Credits 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 – Biotechnology (18-24 Credits)							
22BS102006	Biomolecules	3	-	3	-	4.5	-
22BS101009	Cell Biology	3	-	-	-	3	-
22BS101010	Introduction to Metabolism	3	-	-	-	3	Biomolecules
22BS102010	Enzymology	3	-	3	-	4.5	Biomolecules
22BS102007	Biophysical techniques	3	-	3	-	4.5	Biomolecules
22BS102011	Molecular Biology	3	-	-	3	4.5	Biomolecules
22BS102012	Immunology	3	-	-	3	4.5	-
Major 2 - Microbiology (18-24 Credits)							
22BS102025	Principles of Microbiology	3	-	3	-	4.5	-
22BS102026	Microbial physiology and metabolism	3	-	3	-	4.5	-
22BS101033	Basic concepts of Microbial genetics	3	-	-	-	3	Principles of Microbiology
22BS101034	Microbes in sustainable agriculture and development	3	-	-	-	3	Principles of Microbiology
22BS102027	Microbial Biotechnology	3	-	3	-	4.5	Microbes in sustainable agriculture and development
22BS102028	Agri- Food Microbiology	3	-	3	-	4.5	

Major 3 – Chemistry (18-24 Credits)							
22BS101011	General Chemistry	3	-	-	-	3	-
22BS102013	Inorganic and Physical Chemistry	3	-	3	-	4.5	-
22BS102014	Basic Organic Chemistry	3	-	3	-	4.5	-
22BS102015	Advanced Chemistry-1	3	-	3	-	4.5	-
22BS102016	Advanced Chemistry-2	3	-	3	-	4.5	Advanced Chemistry-1
22BS101012	Chemistry of Advanced Materials	3	-	-	-	3	-
22BS101013	Phase Equilibria and Kinetics	3	-	-	-	3	-
22BS101014	Basics of Polymer Chemistry	3	-	-	-	3	-
22BS101015	Coordination Chemistry	3	-	-	-	3	-

PROGRAM ELECTIVE

(27- 45 Credits for 3 years Program - *Min. 09 Credits from each Major*);

(39 - 60 Credits for 4 years Program - *Min. 12 Credits 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 – Biotechnology (9-15 Credits)							
22BS101022	Food and Nutrition	3	-	-	-	3	-
22BS101023	Genomics	3	-	-	-	3	-
22BS102039	Industrial Biotechnology	3	-	3	-	4.5	Biomolecules
22BS102001	Introduction to Bioinformatics	3	-	3	-	4.5	-
22BS101008	Endocrinology	3	-	-	-	3	-
22BS102036	Recombinant DNA technology	3	-	3	-	4.5	Molecular Biology
22BS102037	Plant Biotechnology	3	-	3	-	4.5	Recombinant DNA Technology
22BS102038	Animal Biotechnology	3	-	3	-	4.5	Recombinant DNA Technology
Major 2 – Microbiology (9-15 Credits)							
22BS102029	Phycology and Mycology	3	-	3	-	4.5	Principles of Microbiology
22BS102032	Medical Bacteriology	3	-	3	-	4.5	Principles of Microbiology
22BS102034	Medical Microbiology	3	-	3	-	4.5	Medical Bacteriology
22BS102035	Microbial Quality Control in Food and Pharmaceutical Industries	3	-	3	-	4.5	Bioreactors and Industrial Microbiology
Major 3 - Chemistry (9-15 Credits)							
22BS101025	Basic Reagents and Reaction Mechanism	3	-	-	-	3	-
22BS102023	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	
22BS101028	Thermodynamics	3	-	-	-	3	-
22BS101029	Organic Functional Groups	3	-	-	-	2	-
22BS101030	Chemistry of Materials	3	-	-	-	3	-
22BS101031	Electrochemistry	2	-	-	-	2	-
22BS102024	Fundamentals of Analytical Chemistry	3	-	3	-	4.5	-

UNIVERSITY ELECTIVE (9-12 CREDITS)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22ME101702	Human Resource Management	3	-	-	-	3	-
22ME101703	Management Science	3	-	-	-	3	-
22ME101704	Managing Innovation and Entrepreneurship	3	-	-	-	3	-
22LG101701	Business Communication and Career Skills	3	-	-	-	3	-
22MG101701	Entrepreneurship for Micro, Small and Medium Enterprises	3	-	-	-	3	-
22SS101704	Indian History	3	-	-	-	3	-
22SS101706	Women Empowerment	3	-	-	-	3	-
22CE101703	Planning for Sustainable Development	3	-	-	-	3	-
22CM101701	Banking and Insurance	3	-	-	-	3	-
22CM101702	Cost Accounting and Financial Management	3	-	-	-	3	-
22SS101702	Gender and Environment	3	-	-	-	3	-
22SS101703	Indian Economy	3	-	-	-	3	-
22SS101705	Indian Tradition and Culture	3	-	-	-	3	-
22SS101701	Constitution of India	3	-	-	-	3	-
22ME101701	Global Strategy and Technology	3	-	-	-	3	-
22EE101704	Green Technologies	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 list.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG102405	**GENERAL ENGLISH**	2	-	2	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with selected literary works of eminent writers, exercises on speaking, reading comprehensions for skimming and scanning, vocabulary, grammar, pronunciation, and conversation practice.

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

CO1. Demonstrate knowledge of literary works of various pieces of eminent writers.

CO2. Adapt general and technical vocabulary in communication.

CO3. Apply grammatically correct English in writing.

CO4. Analyse texts using reading techniques.

CO5. Apply different communication styles in various situations.

CO-PO-PSO 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' short story by R.K. Narayan. ***(06 Periods)***

A Snake in the Grass – A Short Story, Reading Comprehension, Grammar, Vocabulary, Pronunciation, and Conversation Practice.

Module 2: 'On saying Please 'short essay by A. G. Gardiner ***(06 Periods)***
On Saying Please – A Short Essay, Reading Comprehension, Grammar Vocabulary, Pronunciation, and Conversation Practice.

Module 3: 'If You Forget Me 'poem by Pablo Neruda ***(06 Periods)***
If you Forget Me - A Poem, Reading Comprehension, Grammar, Pronunciation, and Conversation Practice.

Module 4: 'After the Sunset' short story by Bhoopal ***(06 Periods)***
After the Sunset – A Short Story, Reading Comprehension, Grammar, Pronunciation, and Conversation Practice.

Module 5: 'Man's Peril 'essay by Bertrand Russel ***(06 Periods)***
Man's Peril - An Essay, Reading Comprehension, Vocabulary, Grammar, Pronunciation, and Conversation Practice.

Total Periods: 30

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 programmes 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. How do you feel that the role of science and technology in nation-building?

Above all will be detailed in CHO.

RESOURCES

TEXTBOOKS:

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

REFERENCE BOOKS:

1. https://www.researchgate.net/publication/331773456_RK_Narayan's_A_Snake_in_the_Grass_and_Stephen_Leacock's_With_the_Photographer_-_A_Comparative_Study

2. https://smartenglishnotes.com/2020/07/17/on-saying-please-summary-analysis-and-questions-and-answers/

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=WnOOKO0CdaM
2. https://www.youtube.com/watch?v=H6Nlz8qmcFc
3. https://www.youtube.com/watch?v=-lTliZO85YM
4. https://www.youtube.com/watch?v=048YjXwgHWE
5. https://www.youtube.com/watch?v=XLLQm7Grmcc

WEB RESOURCES:

1. https://www.researchgate.net/publication/331773456_RK_Narayan's_A_Snake_in_the_Grass_and_Stephen_Leacock's_With_the_Photographer_-_A_Comparative_Study
2. https://smartenglishnotes.com/2020/07/17/on-saying-please-summary-analysis-and-questions-and-answers/
3. http://www.emcp.com/product_catalog/school/litLink/Grade09/U09-04forgetme/
4. https://englishlanguage-lit.blogspot.com/2021/05/after-sunset-short-story-by-bhoopal.html
5. https://www.taylorfrancis.com/chapters/mono/10.4324/9781003090359-31/man-peril-bertrand-russell?context=ubx&refId=1d767e2d-ceb1-4537-9de5-6417eab47d1e

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG101402	**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-PSO 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
22LG101404	**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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS101002	**INTRODUCTION TO 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, Entamoebahistolytica*), Helminthes (*Fasciotopsis buski, Taenia solium, Ascaris, Wucharia bancrafti*)

Module 3 BASIC MOLECULAR BIOLOGY ***(11 Periods)***

DNA as genetic material, Structure of DNA, Cental 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 solarenergy, photosynthetic reaction centres, Hill reaction, PS I & PS II, Photophosphorylation - cyclic & noncyclic;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		L	T	P	S	C
22LG101401	**PERSONALITY DEVELOPMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality developments.

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

CO1. Demonstrate knowledge of leadership qualities by examining and applying personality traits through Positive self esteem, Open Communication and Self-Righteousness.

CO2. Analyze the limitations of Attitudes by applying and demonstrating communication traits through decision Making, Ethics and Self Actualization.

CO3. Apply appropriate Analyzing techniques for comprehending different personalities by examining Positive and Negative Characteristic Traits and demonstrating through Leadership Styles, Mentoring and Behaviour Modification.

CO4. Apply appropriate techniques in Solving Problems by examining and demonstrating Time Management, Stress Management and Anger Management.

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1: PERSONALITIES AND LEADERSHIP QUALITIES ***(06 Periods)***

Introduction: Different Personalities **-** Personality Analysis **-** Freudian Analysis **–** Vedantic Concept: Swamy Vivekananda **-** Personality Begets - Types- Leadership Qualities – Decision Making **-** Case Studies: Personalities, - Exercises.

Module 2: SELF ESTEEM AND SELF DEVELOPMENT ***(06 Periods)***

Know Yourself: Self Image - Positive Self Esteem -Turn Failure into Success - Be Sensitive to Feedback - Build Self Confidence – Self Actualization - Set Goals - Action Plans - Accountability – Behavior Modification – Mentoring - Learning- Counseling – Challenge yourself with Aptitude Tests and Internships, - Exercises.

Module 3 **ATTITUDE** ***(06 Periods)***

Importance – Difference between Behavior and Attitude - Changing Negative Attitude- Impact of Attitudes on others - Unproductive Attitudes –Assess your Behaviour - Exercises.

Module 4 **COMMUNICATION RELATIONSHIP** ***(06 Periods)***

Introduction – Positive and Negative Characteristic Traits - Grapevine Communication – Open Communication; Team Player - Leadership styles – Performance Expectations - Electronic Communication; Text Messaging – Voicemail – e-Mail, - Exercises.

Module 5 **CRITICAL WORK SKILLS AND ETHICS** ***(06 Periods)***

Time Management - Balancing Life and Work - Stress Management - Anger Management - Making Decisions and Solving Problems - Developing Creativity - Ethics and Self-Righteousness – Being Judgemental in the Real World - Striving for Integrity, - Exercises.

Total Periods: 30

EXPERIENTIAL LEARNING

1. List out the positive traits in you on the charts and explain in detail.
2. Discuss different famous personalities and their leadership styles.
3. What do you know about values and beliefs discuss elaborately.
4. Illustrate the morals that you follow in your that you practice in your life.
5. Interpret the role of different personalities in *Bhagavad Gita.*

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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS101401	**ENVIRONMENTAL STUDIES**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onmultidisciplinary nature of environmental studies, scope and importance of environmental education, ecosystems, ecology, renewable and non-renewable energy resources. Biodiversity and its conservation. Environmental pollution and its control measures, global environmental issues and Acts. Green Chemistry and its tools.

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-PSO 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: ENERGY SOURCES ***(06 Periods)***

Renewable energy Resources:Solar energy - solar cells, wind energy, tidal energy.
Non-renewable energy resources:Natural gas, coal gas, biogas.

Module 2: WATER POLLUTION ***(06 Periods)***

Potable water, Sources of water, impurities in water and their consequences, Eutrophication, Effect of Hardness of water, Municipal and Industrial wastewater management.

Module 3: ENVIRONMENTAL POLLUTION AND ITS CONTROL MEASURES ***(06 Periods)***

Definition, causes, effects and control measures of: Air, Water (thermal and marine pollution), Land pollution, Radiation pollution and Nuclear hazard, Noise pollution, Overgrazing, effects of modern agriculture – fertilizer and pesticides.

Module 4: ENVIRONMENTAL AND SOCIAL ISSUES ***(06 Periods)***

Climate changes: global warming, acid rain, ozone layer depletion, nuclear accidents. ***Social Issues:*** Population growth, variation among nations and population explosion. Urban problems related to Water conservation, rain water harvesting and watershed management.

Module 5: GREEN TECHNOLOGY ***(06 Periods)***

Introduction, principles of green chemistry, tools of green chemistry, Green Computing, green construction, Green manufacturing Systems.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Submit a document on your plan of action in maintaining the sustainable environment.
2. Visit the Tirupathi Municipal corporation water treatment plant and submit a report on your observations
3. List any two major environmental issues in Tirupathi and make a report with solutions using your expertise.
4. Submit your ideas on the importance of Environmental Education for technical students.
5. How do unequal urban planning and green space distribution affect temperatures in a city?
6. How are water sources affected by urbanization?

RESOURCES

TEXT BOOKS:

1 Anubha Kaushik and C. P. Kaushik, Perspectives in Environmental Studies, New Age International (P) Ltd. Publications, 6 th 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://study.com/academy/lesson/what-is-environmental-science-definition-and-scope-of-the-field.html

2 https://www.youtube.com/watch?v=Y5B1nWYle40

3 https://www.digimat.in/nptel/courses/video/127105018/L26.html

Web Resources:

1 https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

2 https://www.hzu.edu.in/bed/E%20V%20S.pdf

3 https://cpcb.nic.in/7thEditionPollutionControlLawSeries2021.pdf

4 https://www.clearias.com/environmental-laws-india/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102013	**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, Theories of Bonding in Metals, liquidstate, 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 liquid crystals properties and their applications.

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-blockElements: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-blockElements: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: THEORIES OF BONDING IN METALS ***(08 Periods)***

Metallic properties and its limitations, Valence bond theory, Free electron theory, Explanation of thermal and electrical conductivity of metals, Band theory- formation of bands, explanation of conductors, semiconductors and insulators.

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

LiquidState: 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 andTuli, Advanced physical chemistry,28th Edition, schamd 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
22BS102006	**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 Porphyrinsand 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, Gentiobiose, Polysaccharides- structural (Cellulose and Chitin), Storage Polysaccharides- Starch, Glycogen, Mucopolysaccharides- Hyaluronic acid, Heparan sulfate, Dermatan sulfate, Keratan sulfate, Heparin, Chondroitin sulfate. Glycolipids and Glycoproteins, Bacterial cell wall polysaccharides, Blood group substances

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, Teritiary and Quarternary structures, Protein sequencing methods, Isolation and characterization of Proteins, Denaturation and Renaturation of proteins, Structure of Hemoglobin, Natural peptides- Glutathione.

Module 3: LIPIDS AND FATTY ACIDS ***(9 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, Lipoproteins and their formation, 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, deviations from Watson crick base pairing, Chargaff's rule, Chromatin, Chromosomes, Histones, Polyamines.

Module 5: PORPHYRINS ***(06 Periods)***

Porphyrin types, Porphobilinogen, Heme, Chlorophyll, cytochromes, cyanocobalamin, Identification of Porphyrins, Porphyrias, synthesis of heme, carotenoids, Xanthophylls.

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, Eigth 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
22BS102007	**BIOPHYSICAL TECHNIQUES**	3	-	3	-	4.5

Pre-Requisite -

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:

Learning 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 Hasselbalch 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 ***(07Periods)***

Homogenization techniques - Mortar and Pestle, Potter Elvehjem, Ultra sonication, French press and Microfluidizer. 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 and separation of metal ions using 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, SDS PAGE, Native PAGE, Determination of Molecular weight using SDS PAGE, Isoelectric focussing, Chromato focussing, Capillary Electrophoresis, Immuno Electrophoresis.

Module 5 SPECTROSCOPY AND RADIOISOTOPES ***(10 Periods)***

Laws of Absorption, Absorbance, Transmittance, Colorimeter, U.V- Visible spectroscopy and its applications, Fluroscence, Jabalonski diagram, Stoke's shift and Fluorimetry, Radio activity, Half life period, Radio activity units, safety measures in Radiation laboratories, Different types of radio activity measurements, GM counter, Liquid scintillography, Uses of Radio isotopes in Biology, Half life, Units of Radioactivity.

Total Periods: 45

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

LIST OF EXERCISES:

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
22BS102010	**ENZYMOLOGY**	3	-	3	-	4.5

Pre-Requisite -

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 allostearic 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:

Learning Outcomes	Program Outcomes								Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	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. Measurement and expression of enzyme activity, Enzyme activity 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 uni-substrate reactions. Km and its significance. Line WeaverBurk 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, Trypsin, Carboxypeptidase,. 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, Zymogen activation, 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
22BS102014	**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 selectrochemistry 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:

Learning 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 Freunds 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/AntiMarkownikoff), 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 Benzenebased on modern concepts (VBT andMOT).

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 OFCARBONCOMPOUNDS ***(10 Periods)***

Optical isomerism: Optical activity-wave nature of light, plane polarised light, optical rotation and specificrotation.

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) Ketonesv) Esters
   vi) Carbohydrates vii) Amines viii) Amidesix) 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, 8thedition, 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, 5thedition, 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
22BS101011	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 selectrochemistry 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:

Learning 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 electrontheory, thermal and electrical conductivity of metals, limitations, Band theory, formationof 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 andNO), Comparison of VB and MO approaches.

Module 5: SURFACECHEMISTRY ***(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. Freundlisch, 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

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS101022	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:

Learning 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 riceflakes)
   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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG107601	**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	2
CO2	2	3	2	-	2	2	2	2	2
CO3	2	-	3	-	2	2	2	2	2
CO4	2	-	-	-	-	2	2	2	2
CO5	2	2	3	2	-	3	2	2	2
Course Correlation Mapping	**2**	**3**	**-**	**-**	**2**	**2**	**2**	**2**	**2**

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

COURSE CONTENT

Module 1: PROFESSIONAL ETHICS ***(06 Periods)***

Scope and aim of ethics, Senses of ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral autonomy-Kohlberg's theory, Gilligan's theory, Consensus, and controversy.

Module2: PROFESSIONAL IDEALS AND VIRTUES ***(06 Periods)***

Theories on virtues and ideals, Professions, Professionalism, Characteristics, Expectations, Professional responsibility, Integrity, Self-respect, Sense of responsibility, Self-interest, Customs and religion, Self-interest and ethical egoism, Customs and ethical relativism, Religion and divine command ethics, Use of ethical theories, Resolving moral dilemmas and moral leadership.

Module 3: SOCIAL EXPERIMENTATION ***(06 Periods)***

Experimentation, Similarities to standard experiments, Learning from the past and knowledge gained, responsible experimenters, Conscientiousness, Moral autonomy and accountability, The challenger case, Codes of ethics and limitations, Industrial standards and Problems with the law of engineering.

Module 4: RESPONSIBILITIES AND RIGHTS ***(06 Periods)***

Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Rights of engineers, Professional rights, Whistle-blowing, The BART case, Employee rights, and discrimination.

Module 5: HARMONY WITH PROFESSIONALETHICS ***(06 Periods)***

Acceptance of human values; Ethical Human Conduct; Basis for Humanistic Education, Constitution, and Universal Order; Competence in professional ethics; Case studies: Holistic technologies, Management Models and Production Systems; Transition from the present state to Universal Human Order: socially and ecologically responsible engineers, technologists and managers - 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.

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. Seebauer 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. Subramanaian, *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
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 signaling, role of neurotransmitters in neurotransmission.

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

CO-PO-PSO Mapping Table:

Learning 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 ***(05 Periods)***

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

Module 2: Molecules of Life ***(05 Periods)***

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

Module 3: Story of Heredity and Mind ***(06 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 ***(06 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 ***(08 Periods)***

sensory peception, chemotaxis, olfaction, taste, flavor, vision, retina, photoreceptors, receptive fields, cortical visual areas, hearing, Fourier analysis, hair cell, vestibular, somatosensation, 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. Rosenzweig,: 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 Behavio, 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

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE201701	**DISASTER MANAGEMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion ondisaster prone areas in India, repercussions of disasters and hazards, disaster preparedness and management, risk assessment 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. Analyze the causes and impacts of disasters using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Suggest the preparedness measures using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO4. Analyze the Risk Assessment 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-PSO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	2	2	2	2	2	-	-	-	-
CO2	3	3	-	2	2	2	2	-	-	2	-	-
CO3	3	3	-	2	2	2	2	-	-	-	-	-
CO4	3	3	-	3	2	2	2	-	-	-	-	-
CO5	3	2	3	2	2	2	1	2	-	1	3	2
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**-**	**2**	**3**	**2**

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

COURSE CONTENT

Module 1: DISASTER PRONE AREAS IN INDIA ***(09 Periods)***

Introduction: Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types And Magnitude.**Disaster Prone Areas:**Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Module 2: REPERCUSSIONS OF DISASTERS AND HAZARDS ***(09 Periods)***

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module 3: DISASTER PREPAREDNESS AND MANAGEMENT ***(11 Periods)***

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module 4: RISK ASSESSMENT ***(08 Periods)***

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Module 5: DISASTER MANAGEMENT ***(08 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: 45

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. Also list 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.

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 Hazardsand 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.
5. R. Nishith, Singh AK, *Disaster Management in India: Perspectives, issues and strategies,* New Royal book Company.
6. Sahni, PardeepEt.Al. (Eds.), *Disaster Mitigation Experiences And Reflections*, Prentice Hall of India, New Delhi.
7. Goel S. L. , *Disaster Administration And Management Text And Case Studies*, Deep &Deep Publication Pvt. Ltd., New Delhi

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

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102025	PRINCIPLES OF MICROBIOLOGY	3	-	3	-	4.5

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

COURSE DESCRIPTION: This course provides a detailed discussion on overview of cell and cell organelles, Cytoskeleton and cell movement, Cell Communication, Cell development and Cancer development and treatment. This course also provides hands on training on culturing, Isolation and Identification of Bacteria.

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

CO1. Understand the History and different types of Microbial taxonomy.
CO2. Identify physical and chemical means of sterilization
CO3. Understand methods used for studying Microbes.
CO4. Understand and classify the structures in prokaryotic cells and how those structures vary across major groups of microorganisms
CO5. Understand Structure, Classification of viruses and how these are different from bacteria.
CO6. Evaluate methods to culture bacteria and characterization of different cells. Also work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Learning 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	2	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	3	-	-	-	-	-	3	-	-
CO6	3	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: HISTORY AND SCOPE OF MICROBIOLOGY& MICROBIAL TAXONOMY ***(9 Periods)***

Overview of history of Microbiology - Biogenesis and abiogenesis Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming [Penicillin], Importance and applications of Microbiology.
Classification of Microbes - Systems of classification, Numerical taxonomy, Identifying characters for classification, General properties and principles of classification of microorganisms Systematics of bacteria, Nutritional types [Definition and examples]. Classification on the basis of oxygen requirement.

Module 2: CONCEPT OF STERILIZATION& MICROSCOPY ***(8 Periods)***

Concept of Sterilization - Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation. Determination of phenol coefficient ofdisinfectant.

Module 3: MICROSCOPY & STAINING METHODS ***(10 Periods)***

Light & Electron Microscopy, Preparation for light microscopy
Stains and staining techniques - Definition of auxochrome , chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

Module 4 STRUCTURE & FUNCTIONS OF PROKARYOTIC CELLS ***(8 Periods)***

Size, shape and arrangement of prokaryotic cells, Cell wall, cytoplasmic membrane, membrane transport systems, Cytoplasm, cytoplasmic inclusions and vacuoles,cytoskeletonStructure and germination of endospore, microbial locomotion, An overview of difference between prokaryotes and eukaryotes.

Module 5 BASIC CONCEPTS OF VIROLOGY ***(10 Periods)***

Basic concepts of Virology - General characteristics of viruses, differences between bacteria andviruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis ofcapsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Capsids,complex (Bacteriophage, and Virion size, enveloped (Herpes), helical (TMV) and icosahedral (Polyoma),Capsids.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 10 experiments shall be conducted)

LIST OF EXPERIMENTS:

1. Sampling and quantification of microorganisms in air, soil and water.
2. Sampling and quantification of microorganisms in air, soil and water2
3. Isolation of bacteria [Streak plate, spread plate]
4. Isolation of bacteria [pour plate, serial dilution]
5. Identification of microorganisms from the habitats -Simple staining
6. Identification of microorganisms from the habitats - Differential staining
7. Identification of microorganisms from the habitats - Differential staining2
8. Identification of microorganisms from the habitats -Capsule staining and Spore staining
9. Motility Test
10. Methods of inoculation of different microbes in selective media.
11. Methods of inoculation of different microbes in selective media2.
12. Microscopic measurements, micrometer (ocular and stage), haemocytometer.

RESOURCES

TEXT BOOKS:

1. M. J Pelczar, E. C. S Chan and N. R Krieg. Microbiology, 5th edition, McGraw Hill Book Company, 2001.
2. G. J. Tortora, B. R. Funke and C. L. Case, Microbiology: An Introduction, Eleventh edition, Pearson Education, 2013.
3. R. M Atlas, Principles of Microbiology. 2nd Edition, Mc Graw Hill education, 2014.

REFERENCES BOOKS:

1. L.M. Prescott, J.P. Harley, & D.A. Klein, Microbiology. 11th ed, McGraw Hill, New York, 2020.
2. G.M. Garrity, Bergey's Manual of Systematic Bacteriology. 2nd ed, Vol.1 to 5, Springer, New York, 2005.
3. G. J Tortora, R.F Berdell, and L. C. Christine, Microbiology: An Introduction. 9th ed, Benjamin Cummings, USA, 2006..

VIDEO LECTURES:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=108
2. http://www.digimat.in/nptel/courses/video/102106053/L02.html
3. https://nptel.ac.in/courses/102107028
4. https://www.youtube.com/watch?v=mC0rYNlMz9Q

WEB RESOURCES:

1. https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-04.pdf
2. https://www.youtube.com/watch?v=aMU2euxpcyw

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102026	**MICROBIAL PHYSIOLOGY AND METABOLISM**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

This course provides a detailed discussion on Effect of Environment on Microbial Growth Nutrient uptake and Transport, Chemoheterotrophic Metabolism– Aerobic Respiration, Chemoheterotrophic Metabolism- Anaerobic respiration, Chemolithotrophic and Phototrophic Metabolism, and hands on training on Bacterial culture media preparation, cell culture and alcoholic fermentation.

COURSE OUTCOMES: On successful completion of the course, the student will be able to:

CO1. Understand the characteristics of microbial growth under unusual environmental conditions such as temperature, oxygen, solute and water.

CO2. Identify metabolic interactions among microorganisms in different ecosystems

CO3. Differentiate the concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms.

CO4. Understand Chemolithotropic and Phototropic metabolism

CO5. Analyze Microbial growth conditions via hands on and work independently as well 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	-	-	-	-	-	-	3	-	3
CO2	3	3	3	-	-	-	2	-	-	3	-	3
CO3	3	3	-	-	-	-	-	-	-	3	-	3
CO4	2	3	3	-	-	-	-	2	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	3	-	3
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**3**	-	**3**

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

COURSE CONTENT

Module 1: EFFECT OF ENVIRONMENT ON MICROBIAL GROWTH ***(9 Periods)***

Microbial Growth and Effect of Environment on Microbial Growth- Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate, Temperature and temperature ranges of growth, pH and pH ranges of growth Effect of solute and water activity on growth Effect of oxygen concentration on growth Nutritional categories of microorganisms.

Module 2: NUTRIENT UPTAKE AND TRANSPORT ***(8 Periods)***

Nutrient uptake and Transport- Passive and facilitated Diffusion Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake.

Module 3: CHEMOHETEROTROPHIC METABOLISM– AEROBIC RESPIRATION ***(8 Periods)***

Chemoheterotrophic Metabolism – Aerobic Respiration Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate Pathway, TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors

Module 4: CHEMOHETEROTROPHIC METABOLISM- ANAEROBIC RESPIRATION ***(10 Periods)***

Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation- Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction), Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways),concept of linear and branched fermentation pathways

Module 5 CHEMOLITHOTROPHIC AND PHOTOTROPHIC METABOLISM ***(10 Periods)***

Chemolithotrophic and Phototrophic Metabolism- Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic metabolism -groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria

Total Periods: 45

EXPERIENTIAL LEARNING

1. Demonstration of Winogradsky column
2. Sterilization procedures and contamination check
3. Preparation of basic culture media & Plating techniques
4. Study and plot the growth curve of Bacteriaby turbidometric and standard plate count methods.
5. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
6. Effect of temperature and pH on growth of Bacteria
7. Effect of carbon and nitrogen sources on growth of Bacteria
8. Effect of salt on growth of Bacteria
9. Demonstration of alcoholic fermentation
10. Demonstration of the thermal death time and decimal reduction time of Bacteria

RESOURCES

TEXT BOOKS:

1. Moat A.G., Foster J.W. and Spector M.P. 2002. *Microbial Physiology*, 4th edition. A Johan Wiley and sonsinc., publication.
2. Subba Rao, N.S. Soil Microorganisms and Plant Growth.

3. Microbiological Applications Laboratory Manual in General Microbiology, Benson, The McGraw Hill Companies 8th Edition

REFERENCES:

1. Gilbert H.F. 2000. *Basic concepts in biochemistry: A student's survival guide*. Second Edition. Mc-Graw-Hill Companies, health professions Division, New York.
2. Madigan M.T., Martinko J.M., Stahl D.A. and Calrk D.P. 2012. *Brock Biology of Microorganisms*. 13th ed. Pearson Education Inc.

VIDEO LECTURES:

1. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
2. https://programs.online/free-online-courses/p/cec/microbial-physiology-and-metabolism

WEB RESOURCES:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/0471223867
2. https://www.sciencedirect.com/bookseries/advances-in-microbial-physiology

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102029	**PHYCOLOGY AND MYCOLOGY**	**3**	**-**	**3**	**-**	**4.5**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides detailed discussion on introduction to the Algae, Introduction to fungi, Study of the different classes with reference to occurrence, Algae as pollution indicator, applied mycology and hands on experience on collection and study of Algae and fungi.

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

CO1 Understand different types of Algae and their classification

CO2 Categorize major fungal groups morphologically

CO3 Understand life cycles of fungi

CO4 Identify the applications of Algae and Fungi

CO5 Understand Lichen and Mycorrhizae structure and function, summarize environmental, medical, and industrial applications of mycology and also will practically study collection and study of various Algae and Fungi.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes								Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	2	-	-
CO3	3	3		2	-	-	2	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	2	-	3	-	-	3	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	-	-		-	-	**3**	-	-

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

COURSE CONTENTS

Module 1: INTRODUCTION OF ALGAE (12 Periods)

General characteristics, Distribution and Fritsch (1935) classification of Algae, algal nutrition, thallus organization, Applications of algae in Agriculture, Industry, Environment and Food. Life cyclesof Algae-Chlorophyceae: Volvox, Coleochaete ;Charophyceae: Chara; Diatoms: General features with reference to pinnate and centric diatoms; Xanthophyceae: Vaucheria; Phaeophyceae: Ectocarpus; Rhodophyceae: Polysiphonia; Cyanobacteria: Nostoc

Module 2: INTRODUCTION TO FUNGI (10 Periods)

Distribution, fungal cell structure, general characteristics, Classification of fungi, physiology and reproduction, importance in Agriculture, Environment, Industry, Medicine, Food, Biodeterioration (of wood, paper, textile, leather), Mycotoxins

Module 3: LIFE CYCLES OF Fungi (10 Periods)

Cellular slime molds - Dictyostelium; True slime molds (Myxomycetes) - Physarum; Oomycetes - Saprolegnia, Phytophthora; Chytridiomycetes - Neocallimastix; Zygomycetes – Mucor; Ascomycetes - Saccharomyces, Penicillium, Neurospora; Basidiomycetes - Agaricus ; Deuteromycetes - Candida, Alternaria

Module 4: ALGAE AS POLLUTION INDICATORS (07 Periods)

Eutrophication agent and role in bioremediation, algae in global warming and environmental sustainability, cyanobacteria and selected microalgae in agriculture- biofertilizer and algalization, importance of algae in production of algal pigments, biofuels, hydrogen production, important bioactive molecule.

Module 5: Lichens & Mycorrhizae (06 Periods)

Structure, different, types, physiology, importance

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collection and study of Algae Anabena
2. Collection and study of Chlorella
3. study of morphological characters of Rhizopus
4. study of morphological characters of Penicillium
5. study of morphological characters of Aspergillus and puccinia
6. study of morphological characters of Riccia
7. study of morphological characters of Cyanobacteria
8. Culturing of Blue green algae
9. Algal fuels
10. Demo of remediation methods using Algae

RESOURCES

TEXT BOOKS:

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
2. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition

REFERENCE BOOKS:

1. Sharma OP. (2005). Textbook of Algae. Tata McGraw Hill Publishing Co. Ltd.
2. Lee RE. (1999). Phycology. 4th edition. Cambridge Press.
3. Webster J. (1980). Introduction to Fungi. 2nd edition. Cambridge University Press.
4. Burnett J.H., Publisher: Edward, Arnold Crane Russak: Fundamentals of Mycology.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=y8lKGvN8YXY
2. https://www.youtube.com/watch?v=hULry4ePQKs
3. https://www.youtube.com/watch?v=zCvG35jKgUY
4. https://www.youtube.com/watch?v=yOeDfYkcty0

WEB RESOURCES:

1. https://www.ncbi.nlm.nih.gov/books/NBK8125/
2. https://www.microscopemaster.com/mycology.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102039	**INDUSTRAIL BIOTECHNOLOGY**	3	-	3	-	4.5
Pre-Requisite	**Biomolecules**					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The course aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products which have a huge industrial significance. It uniquely blends the science and engineering with various biochemical processes to obtain products of diverse fields such as chemicals, food, bioenergy etc. The course introduces bioreactors, its types, operation methods and provides an experimental demonstration of the same.

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

CO1 Understand the steps involved in the production of byproducts and methods to improve modern biotechnology.

CO2 Understand and correlates the theoretical aspects pertaining to concepts and application of fermentation process.

CO3 **Analysis and apply the kinetics of microbial growth and product formation in bioprocessing methods.**

CO4 To apply basic biotechnological principles, methods and models to solvebiotechnological tasks.

CO5 To design and deliver useful modern biotechnology products to the Society.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes										Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	3	-	-
CO3	2	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

Module01: Introduction to IndustrialProcesses **(08 Periods)**

Fermentation – Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology – A brief survey of organisms, processes, products. Basic concepts of upstream and downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation

Module 02: General concepts and application of fermentation (10 Periods)

Fermentation-general concepts, applications, and structure of a fermenter; Range of fermentation process- microbial biomass, enzymes, metabolites, recombinant products, transformation process; Components of fermentation process. Types of fermentations- aerobic and anaerobic fermentation, submerged and solid-state fermentation, factors affecting submerged and solid-state fermentation, substrates used in solid-state fermentation and its advantages; Sterilization and its kinetics: Batch and continuous sterilization.

Module 03: Role of diffusion in Bioprocessing(07 Periods)

Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.

Module 04: Kinetics of microbial growth and product formation (10 Periods)

Phases of cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms. Growth associated (primary) and non – growth associated (secondary) product formation Kinetics. Leudeking – Piret models, substrate and product inhibition on cell growth and product formation. Introduction to Structured Models for growth and product formation.

Module 5: Production of primary and secondary metabolites (09 Periods)
Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids, alcohols and vitamins. Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics and Steroids.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Perform serial dilution and standard plate count method.
2. Perform microbial growth culture study by batch culture.
3. Primary screening of antibiotic producing organisms by crowded plate technique
4. Extraction and analysis of pigments by TLC method.
5. Isolation and screening of microorganism producing amylases from soil.
6. Qualitative analysis of alpha-amylase enzyme activity
7. Isolation of Casein protein from Milk.

RESOURCES

TEXT BOOKS:

1. Satyanarayana U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2. Kumar H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt.Ltd., 1998.
3. Balasubramanian D. etal., "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
4. Ratledge Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001
5. Dubey R.C. "A Textbook of Biotechnology" S.Chand& Co. Ltd., 2006.

REFERENCE BOOKS:

1. A. H. Patel " Industrial Microbiology" Macmillan
2. Presscott S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
3. Cruger Wulf and AnnelieseCrueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
4. Moo-young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004
5. C.F. A. Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
6. K.G.Ramawat&ShailyGoyal, Comprehensive Biotechnology, 2009, S.Chand publications.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=2CqjfuTu4K0&list=PL0sPYH8zyA44ZIVNCxYhfJOK5MyKXufXO
2. https://www.youtube.com/watch?v=p2kK-mrtXzw&t=789s
3. https://www.youtube.com/watch?v=V0BzQQCCwgo

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_bt20/preview

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102001	**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. Analyze 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, 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 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, interchange languages and standardization efforts.

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, 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, Commercial packages.

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
22BS102015	ADVANCED CHEMISTRY	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 ofheterocyclic 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:

Learning 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**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	-	**3**

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

COURSE CONTENT

Module 1: HETEROCYCLIC COMPOUNDS ***(09 Periods)***

Introduction, Classification, systenatic method of nomenclatutre, structure and aromaticity of pyrrole, furan, thiophene and phridine, Methods of preparation and chemical reactions-pyrrole, furan, thiophene and phridine, applications of the heterocyclic compounds

Module 2: NITROGEN CONTAINING FUNCTIONAL GROUPS ***(09 Periods)***

Introduction, Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary 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). Electrophillic 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 Hittorfs method,Conductometric 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

13. **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 ArunBahl, 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
22BS101025	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:

Learning 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 hydroborationreaction 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 saltand 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, Aldolreaction, 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 acidsand 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/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS101003	**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-PSO 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, 6 th 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
22CM101401	PRINCIPLES OF BUSINESS ECONOMICS AND ACCOUNTANCY	3	-	-	-	3

Pre-Requisite

Anti-Requisite

Co-Requisite

COURSE DESCRIPTION: Business economics and demand analysis; theory of production and cost analysis; markets and pricing; principles of accounting and capital; final accounts and tally ERP 9.0

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

CO1 Demonstrate the principles of Business Economics and theories of Demand.

CO2 Apply the theories of Production and Cost to the managerial decision-making of an organization.

CO3 Determine the Price and Output relation in the different Market structures.

CO4 Demonstrate the principles of Accountancy and sources of Capital.

CO5 Analyze the profitability and soundness of an organization.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	1	-	3	-	2
CO2	3	2	-	-	-	-	-	1	-	3	-	2
CO3	3	2	-	-	-	-	-	1	-	3	-	2
CO4	3	2	1	-	-	-	-	1	-	3	-	2
CO5	3	2	1	-	-	-	-	1	-	3	-	2
Course Correlation Mapping	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	3	**-**	2

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

Module 1: BUSINESS ECONOMICS AND DEMAND ANALYSIS ***(09 Periods)***

Definition - Nature and Scope of Business Economics - Demand: Determinants of demand – Demand function - Law of demand, assumptions, and exceptions - Elasticity of demand –

Types of elasticity of demand - Demand forecasting and methods of demand forecasting.

Module 2 THEORY OF PRODUCTION AND COST ANALYSIS ***(09 Periods)***

Production Function: Input-output relationship - Law of Variable proportion- Isoquants and Isocosts

Cost Concepts: Total, Average and Marginal Cost **-** Fixed vs. Variable costs – Opportunity Costs Vs Outlay Costs– Separable Costs Vs Joint Costs, Urgent Costs VsPostponable Costs-Avoidable Costs Vs Unavoidable Costs

Break Even Analysis (BEA) – Assumptions, Merits and demerits - Determination of Break-Even Point (Simple problems).

Module 3 MARKETS AND PRICING ***(09 Periods)***

Market Structure: Types of Markets - Features of perfect competition - Monopoly and monopolistic competition - Price and Output determination in perfect competition, monopoly and monopolistic Markets.

Pricing: Objectives and policies of pricing – Sealed bid pricing - Marginal cost pricing - Cost plus pricing - Going rate pricing – penetration Pricing –skimming Pricing - Block pricing – Peak load pricing - Cross subsidization.

Module 4 PRINCIPLES OF ACCOUNTING & CAPITAL ***(09 Periods)***

Accountancy: Introduction – Concepts – Conventions – Double Entry Book Keeping – Journal – Ledger - Trial Balance (Simple problems)

Capital: Significance - Types of capital – Sources of Capital.

Module 5 FINAL ACCOUNTS & TALLY ERP 9.0 ***(09 Periods)***

Introduction to Final Accounts - Trading account - Profit and Loss account and Balance Sheet with simple adjustments (Simple problems)

Tally ERP 9.0: Introduction – Create a company – Create ledger – Posting vouchers – Advantages of Tally.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare the Journal Entries by the students with practical examples.
2. Conduct an event about the market structure.
3. Do the problems on Financial Statements with practical examples.
4. Prepare a report regarding the demand and supply of electric vehicles in the Indian market.
5. From the following balances of Mr. Aravind as at 31.12.2016, prepare Trading, Profit and Loss Account for the year ended and Balance Sheet as at that date after making the necessary adjustments.

Debit Balances	Amount (Rs.)	Credit Balances	Amount (Rs.)
Drawing Account	6,000	Capital	80,000

Plant and Machinery	25,000	Sundry Creditors	10,000
Stock (opening)	15,000	Sales	1,20,000
Purchases	82,000	Returns outwards	1,000
Return Inwards	2,000	R.B.D.D.	400
Sundry Debtors	20,600	Discounts	800
Furniture & Fixtures	5,000	Rent of Premises sublet	1,200
Freight and Duty	2,000	Reserve Fund	5,000
Carriage outwards	500		
Rent, Rates & Taxes	4,600		
Printing & Stationery	800		
Trade Expenses	400		
Postage and Telegrams	800		
Insurance charges	700		
Salaries and Wages	21,300		
Cash in Hand	6,200		
Cash at Bank	25,500		
	2,18,400		2,18,400

Adjustments:

- Stock on 31.12.2006 was Rs.14,600.
- Write off Rs.600 as bad debts and provide 5% for R.B.D.D.
- Provide for depreciation on furniture 5% & Plant & Machinery at 20%.
- Insurance prepaid was Rs.100.
- Outstanding salaries Rs. 700
- A fire occurred on 25th December 2006 and stock worth Rs.5,000 was destroyed and the insurance company admitted a claim for Rs. 4500 only.

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

RESOURCES:

TEXT BOOKS:

1. H L Ahuja, *Business Economics (Thirteenth edition)*, S Chand Publishing, Jan 2016.
2. S.P. Jain and K.L. Narang, *Financial Accounting*, Kalyani Publishers, Ludhiana, 12th edition, 2018.

REFERENCE BOOKS:

1. Joseph G.Nellis and David Parker, *Principles of Business Economics*, Pearson Education Canada, 2nd edition, 2016.
2. Larry M. Walther, *Financial Accounting*, Create Space Independent Publishing Platform, July 2017.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=xWKfKCnQqAE
2. https://www.youtube.com/watch?v=daYPYHbJ6Xc

WEB RESOURCES:

1. https://leverageedu.com/blog/scope-of-business-economics/
2. https://www.economicsdiscussion.net/break-even-analysis/break-even-point-of-a-firm-meaning-determination-and-types/21785

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101401	**ESSENTIALS OF LEADERSHIP**	2	-	-	-	2

Pre-Requisite

Anti-Requisite

Co-Requisite -

COURSE DESCRIPTION: This course is designed for learners who desire to improve their leadership, communications, and workplace skills.

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

CO1. Differentiate between leadership and management
CO2. Identify the values common among great leaders.
CO3. Discuss the power of positive expectations and how to apply it as a leader
CO4. Assess what, how, and to whom you should delegate.
CO5. Describe what it means to be an ethical leader.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	1	-	-	-	-	-	-
CO2	1	1	2	1	-	1	-	-	-	-	-	-
CO3	2	-	2	-	1	-	-	-	-	2	-	-
CO4	1	2	-	1	-	-	-	-	-	2	-	-
CO5	1	2	1	-	-	-	-	-	-	2	2	-
Course Correlation Mapping	**2**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	-	**2**	**2**	**-**

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

COURSE CONTENT

Module 1: Introduction ***(06 Periods)***
What is leadership, leadership vs management, leadership and change, Maxwell's 5 levels of leadership, how to move to the next level

Module 2: Leadership Values & Expectations ***(06 Periods)***
14 Leadership Values, what matters most exercise. Expectations, The Pygmalion Effect, impact of positive expectations, setting expectations

Module 3: Delegation ***(06 Periods)***
Definition, why delegate, delegate/empower, why people don't delegate, steps for delegation - the IDEALS model..

Module 4: Ethics ***(06 Periods)***

Definitions, introduction to ethics, ethics vs morals, self-assessment, Good People, Bad Choices examples, how to be an ethical leader, 8 Ethical Actions for Leaders.

Module 5: Commitment ***(06 Periods)***

Introduction, significance of commitment, Universal Laws of Leadership, tips towards being accountable and committed leader.

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collect the case studies related to successful leaders and their traits.
2. Different Case Studies Will be Given to students as per the topic that will be collected and evaluated.
3. The case studies will be collected as Assignments and the same will be evaluated.

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

RESOURCES

TEXT BOOKS:

1. Anderson T,*Transforming leadership*,St. Lucie Press, Boca Raton, FL, 2nd ed 1998
2. Babiak, P. & Hare, R.D., *Snakes in suits: when psychopaths go to work*, Regan Books, New York, 2006

REFERENCE BOOKS:

1. CongerJ, *Inspiring others: Th e language of leadership,* Academy of Management Executive, 5(1), 31-45, 1991
2. *Leadership Skills*. MTD Training &Ventus Publishing ApS, 2010

VIDEO LECTURES:

1. Marshall Goldsmith: The Essentials Of Leadership (fs.blog)
2. https://onlinecourses.nptel.ac.in/noc23_mg28/preview

Web Resources:

1. cdn2.hubspot.net/hubfs/4654529/Expert landing pages/Peter Cox/Resources/10 Leadership Essentials .pdf
2. 3-leadership-essentials-discovery-event-w.-no.-05.11.12.pdf (imd.org)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101402	ORGANIZATIONAL BEHAVIOUR	2	-	-	-	2

Pre-Requisite

Anti-Requisite

Co-Requisite -

COURSE DESCRIPTION: This course enables the students to know the principles in an organization, the system and process of effective controlling in the organization.

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

CO1 Interpretthescopeoforganizationalbehavioranditssignificance.

CO2 Understand the managerial strategies in achieving the organizational goals of an organization

CO3 Demonstratetheimpactofmotivationandleadershipingroupdynamics.

CO4 Solve organizational conflicts through negotiation and team building.

CO5 Improve the results – performance outcome through human behavior and organizational behaviour can aid them in their purist of the goals.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	2	-	2	-	2	-	2
CO2	1	-	2	1	-	2	-	-	-	-	-	2
CO3	2	-	2	-	1	-	-	-	-	2	-	2
CO4	1	2	-	1	-	-	-	-	-	2	-	2
CO5	1	2	1	-	-	-	-	-	-	2	2	2
Course Correlation Mapping	**2**	**2**	**2**	**3**	**2**	**2**		**2**		**2**	**2**	**2**

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

COURSE CONTENT

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

Nature and scope – Linkages with other social sciences- Individualroles andorganizationalgoals–perspectivesofhumanbehavior- Perception– perceptualprocess

Module 2: Learning ***(06 Periods)***

Learning - Learning Process- Theories- (Pavlov, Skinner and Thorndike) - Personality andIndividualDifferences -Determinants of Personality-Values, Attitudesand Beliefs.

Module 3: Motivation and Leadership ***(06 Periods)***

Definition andnature of motivation, Theories of Motivation(Maslow,Alderfer)-Leadership–Traits-Styles–Leadershipskills–Challengestoleaders.

Module 4: Organizationalconflicts ***(06 Periods)***

causesandconsequences-conflictandNegotiationTeamBuilding,Conflict Resolution in Groups and problem solving Techniques.

Module 5: Organizational Communication ***(06 Periods)***

Communication,typesandprocess,importance andbarriers–Organizationalchange-change process-resistance tochange–Organizational development and OD interventions.

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collect the case studies related to recent topics in OB and other Contemporary OB Practices and Present them as a seminar.
2. Different Case Studies Will be Given to students as per the topic that will be collected and evaluated.
3. The case studies will be collected as Assignments and the same will be evaluated.

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

RESOURCES

TEXT BOOKS:

1. Robbins.P.Stephen(2006),OrganizationalBehaviour,PearsonEducation,NewDelhi.
2. LuthansFred(1998),OrganizationalBehaviour, TataMcGrawHillInternationalEdition,NewDelhi
3. K.Aswathappa "Organizational Behaviour-Text, Cases and Games", HimalayaPublishingHouse,NewDelhi, 2008.

REFERENCE BOOKS:

1. Steven LMcShane,MaryAnnVonGlinow,RadhaRSharma:"OrganizationalBehaviour",TMHE ducation, NewDelhi,2008
2. PareekUdai (2007), Understanding Organizational Behaviour, Oxford University Press, New Delhi
3. Jerald Greenberg and Robert.A. Baron, (2009), Organizational Behaviour, PHI learning Private Ltd., New Delhi.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Sg64udtQ300&list=PL3Y_p3e-Lne2no2K5cNa8y7ti1uqCjZw8
2. https://www.youtube.com/watch?v=pHg3ZfGk5j0

Web Resources:

1. https://www.icmrindia.org
2. https://www.citeob.com/ 5 https://www.ob-guide.com

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101403	**PROJECT MANAGEMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To understand the importance of decision-making while implementing any project and interpret and discuss the results of qualitative and quantitative analysis

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

CO1 Understand the basic introduction to project management

CO2 Apply the methods of project identification and selection.

CO3 Understand project allocation methods and evaluation.

CO4 Analyse the techniques for project time, review, and cost

CO5 Understand the factors of risk and quality of a project.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	2	-		2		1			-
CO3	2	2	1	2	1	-	-	1	-	-	2	
CO4	3	1	2	2	1	-	-	-	-	-	-	2
CO5	2	2	1	2	1	1	-	-	-	-	-	1
Course Correlation Mapping	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	1	**-**	**2**	**-**

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

COURSE CONTENT

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

Concept of project management, project definition and key features of projects, project life cycle phases, typical project management issues, basic project activities

Module 2: Project Identification and Selection ***(06 Periods)***

Identification and screening (brainstorming, strength and weakness in the system, environmental opportunities and threats), Project evaluation methods- Payback period, Net present value, Internal rate of return and project evaluation under uncertainty.

Module 3: Project Resource Management ***(07 Periods)***

Scheduling resources, resource allocation methods, project crashing and resource leveling, working of systems, design of systems, project work system design, project execution plan,

project procedure manual project control system, planning scheduling and monitoring

Module 4: Time and Cost Management ***(05 Periods)***

Time Management-Network diagram, forward and backward pass, critical path, PERT and CPM, AOA and AON methods, tools for project network, Cost management-earned value method

Module 5: Risk and Quality Management ***(07 Periods)***

Risk identification, types of risk, risk checklist, risk management tactics, risk mitigation and contingency planning, risk register, communication management, Quality assurance and quality control, quality audit, methods of enhancing quality

Total Periods: 30

EXPERIENTIAL LEARNING

1. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT
2. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.
3.

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs.)	Crash Cost (Rs.)
A	-	4	3	8,000	9,000
B	A	5	3	16,000	20,000
C	A	4	3	12,000	13,000
D	B	6	5	34,000	35,000
E	C	6	4	42,000	44,000
F	D	5	4	16,000	16,500
G	E	7	4	66,000	72,000
H	G	4	3	2,000	5,000

   Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks
4. Collect any case study that discusses the process of probability calculation of success of the project and submit a report

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

RESOURCES

TEXT BOOKS:

1. R.Panneerselvam and P.Senthil Kumar (2013), Project Management, PHI Learning Private Limited.
2. Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation, and Review.

REFERENCE BOOKS:

1. A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
2. Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India.

3. S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. https://archive.nptel.ac.in/courses/110/104/110104073/

Web Resources:

1. https://www.pmi.org/about/learn-about-pmi/what-is-project-management
2. https://www.manage.gov.in/studymaterial/PM.pdf
3. https://imada.sdu.dk/u/jbj/DM85/lec7.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CS102402	BASIC COMPUTERS AND INFORMATION SCIENCES	3	-	2	-	4

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

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on basics of computer science and information science concepts of the I/O devices, CPU (central processing unit) memory, Storage devices and Introduction of windows operating systems and MS office and having the knowledge of computer networks, Internet and its applications.

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

CO1. Demonstrate knowledge on Basics of computer I/O devices, Processor and memory.

CO2. Prepare the Documents using the word processors.

CO3. Prepare the work sheet and Slide Presentations using the Excel and presentation tool.

CO4. Demonstrate the knowledge on Operating Systems usage and its types.

CO5. Interconnect two or more computers for Information sharing and access the Internet.

CO6. Work independently or in teams to solve problems with effective communication

CO-PO Mapping Table:

Course Outcomes	Program Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-
CO4	2	2	3	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	3	3	-
Course Correlation Mapping	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**

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

COURSE CONTENT:

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

Introduction, characteristics of computers, block diagram of computers, generations of computers, computer languages, Input-output devices: Input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices (monitors, pointers, plotters, screen image projector, voice response systems),Processor and memory: Central Processing Unit (CPU), main memory.

Module 2: STORAGE DEVICES AND WORD PROCESSOR ***(09 Periods)***

Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices, Introduction to word processor: Introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.

Module 3: INTRODUCTION TO SPREADSHEET AND PRESENTATIONS ***(09 Periods)***

Introduction to Excel: Introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs, Introduction to PowerPoint: Introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

Module 4: COMPUTER NETWORKS AND INTERNET APPLICATIONS ***(09 Periods)***

Computer networks: Introduction, types of networks (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network, Internet and its Applications: Definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet, Application of Computers in clinical settings.

Module 5: INTRODUCTION OF OPERATING SYSTEM ***(09 Periods)***

Introduction to Operating System, Characteristics of Operating System, Types of Operating System and its components, Installation of windows OS, History of OS and features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES

1. Demonstrate of basic hardware of Computers and laptops.
2. Demonstrate about the I/O Devices and CPU.
3. Create and Design Admission/Enquiry Forms.
4. Create Student Id Card using shapes, text and colors.
5. Create Chart and show the product price comparison between years.
6. Insert the Image into various shapes

7. Calculate students marks percentage using spreadsheet.
8. Create slides about yourself using with all the details.
9. What are the steps to connect Internet
10. How to send an Email? Explain the steps in detail.

RESOURCES

TEXTBOOKS:

1. PritiSinha and Pradeep K "Computer Fundamentals" BPB Publications, Edition 6, 2004.
2. James Bernstein "Office for the WebMade Easy" Independently published, Edition 1, 2021.

REFERENCE BOOKS:

1. Pete Matheson "Microsoft Office 365 for Beginners"
2. Dr Sabah Sayed "Fundamentals of Computer Science" Imperial College Press, 2009.

SOFTWARE/TOOLS:

1. Software: MS Office/ Window Operating System

VIDEO LECTURES:

1. Computer Fundamentals - Basics for Beginners - Bing video
2. https://youtu.be/-AP1nNK3bRs

WEB RESOURCES:

1. https://www.udemy.com/**computer**-**basics**/online-course
2. *https://www.educba.com/excel/courses/ms-office-course*

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22DF105001	**BIOMEDICAL WASTE MANAGEMENT**	-	1	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with biomedical waste management and environmental safety. Experimental learning on types of biomedical waste in health care system, waste minimization, General waste control and personal care in health care.

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

CO1. Analyze biomedical waste materials by applying decontamination and disposal techniques to prevent harm to health care professionals.

CO2. Work individually or Teams to solve problems with effective communication

CO-PO Mapping Table:

Course Outcomes	Program Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	1								1
CO2	3	1	2	-	-	-	-	-	-	1
Course Correlation Mapping	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

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

EXPERIENTIAL LEARNING:

COURSE CONTENT AND LIST OF EXERCISES

Biomedical waste management and environment safety- The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:

1. Definition of Biomedical Waste, Types of waste generated from Health Care Facility
2. Demonstration of various procedures for minimization of Biomedical Waste.
3. Demonstration of Biomedical Waste Segregation, collection, transportation, treatment and disposal (including color coding)
4. Study of Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
5. Study of BMW Management & methods of disinfection
6. Demonstration of Modern Technology for handling BMW

7. Use of Personal protective equipment (PPE)

8. Monitoring & controlling cross-infection (Protective devices)

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

RESOURCES

TEXT BOOK:

1. ShishirBasarkar"Hospital waste management A guide for self-assessment and review, Jaypee brothers Medical Publication, Edition 1, 2009.

2. R. Radhakrishna "Biomedical waste management" Sumit Enterprises, 2007.

REFERENCE BOOKS:

1. Anantpreet Singh and Sukhjit "Biomedical waste disposal" Haypee Brothers Medical Publishers (P) Ltd, 2012

2. Dr. Shalini Sharma and Prof. SVS Chauhan "An Analysis of Bio-Medical Waste Management" LAP Lambert Academic Publishing, 2010.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=qsclvnPvr18
2. https://www.youtube.com/watch?v=gKSPSKiB9PE
3. https://www.youtube.com/watch?v=SxkZdmBSkWo

WEB RESOURCES:

1. https://byjus.com/current-affairs/biomedical-waste/
2. https://www.aiims.edu/en/departments-and-centers/central-facilities/265-biomedical/7346-bio-medical-waste-management.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101702	**HUMAN RESOURCE MANAGEMENT**	3	-	-	-	3

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

COURSE DESCRIPTION:
Concepts of HRM; Environmental Scanning; Human Resource Planning; Job analysis; Job design; Job evaluation; Recruitment; Selection; Placement; Orientation; Training and Development; Performance appraisal; Merit rating; Compensation; Industrial relations; Trade unions; Industrial disputes; Ethical issues; Employee safety.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Demonstrate the knowledge on the principles, processes and practices of human resource management.
CO2. Analyze the key issues related to administering the human elements such as motivation, recruitment, training and development, compensation, appraisal, and career development.
CO3. Provide solutions to plan and manage human resource functions effectively within organization.
CO4. Apply HRM concepts and techniques in strategic planning to improve organizational effectiveness.
CO5. Evaluate HRM related social, cultural and safe responsibilities and issues in a global context.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: INTRODUCTION TO HRM & HRP ***(09 Periods)***
Introduction to Human Resource Management (HRM): Objectives, Scope and significance of HRM, Functions of HRM, Prospects in HRM, Environmental scanning.
Human Resource Planning (HRP): Introduction, Nature and importance of HRP, Factors affecting HRP, The planning process, Human resource planning and the Government, Requisites for successful HRP, Barriers to HRP.

Module 2: RECRUITMENT AND PLACEMENT ***(09 Periods)***
Job Analysis – Nature and process of job analysis, Methods of collecting job data, Potential problems with job analysis, Requisites for job analysis; Job Design - Factors, Job design approaches, Contemporary issues; Job evaluation - Process, Methods; Recruitment

- Nature, Purposes and importance, Factors governing recruitment, Recruitment process, Evaluation and control; Selection – Nature, Process, Barriers to effective selection, Evaluation of selection process, Placement; Separation.

Module 3: HUMAN RESOURCE DEVELOPMENT AND COMPENSATION ***(09 Periods)***

Orientation - Orientation programme, Requisites of an effective programme, Evaluation of orientation programme, Problems of orientation; Training and development – Nature, Inputs, Training process, Methods, Impediments to effective training, Management development, Career development, Talent management; Performance Appraisal - Nature, Appraisal process, Challenges of performance appraisal; Merit rating; Compensation - Philosophy, Components, Theories, Factors influencing employee compensation, Challenges, Wage and salary administration.

Module 4: INDUSTRIAL RELATIONS AND TRADE UNIONS ***(09 Periods)***

Industrial Relations (IR): Nature of IR, Importance of Peaceful IR; Approaches to IR - Unitary Approach, Pluralistic approach, Marxist approach; Parties to IR; IR strategy; Industrial Disputes - Nature, Causes, and Settlement.

Trade unions: Nature of trade unions, Strategic choices before unions, Union tactics, Trade union movement in India, Trends in trade union movement, Managing unions; Indian Factories Act; Employee's compensation Act; Industrial disputes Act.

Module 5: ETHICAL ISSUES AND SAFETY ADMINISTRATION ***(09 Periods)***

Managing Ethical Issues in HRM: Nature of ethics, Sources of business ethics, Myths about ethics, Ethical dilemmas, HR ethical issues, Managing ethics, Improving ethical decision making.

Employee Safety: Safety, Need for safety, Types of accidents, Safety programme, ISO safety standards.

Total Periods: 45

EXPERIENTIAL LEARNING

1. What are the challenges that are faced by HR in effective performance management including performance appraisal in MNCs? Discuss in detail in the contemporary of HRM.
2. Evaluate employee relations in a comparative perspective across few countries of your choice. Describe in brief by taking a case study.
3. Visit an organization or industry and Evaluate HRM related social, cultural, ethical and environmental responsibilities and issues in a global context.

(Note: Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. Aswathappa K, *Human Resource Management,* Tata McGraw Hill Private Limited, 8th edition, 2017.
2. Garry Dessler and BijuVarkkey, *Human Resource Management,* Pearson India, 16th Edition, 2020.

REFERENCE BOOKS:

1. Raymond A. Noe, John R. Hollenbeck, *HRM: Gaining a Competitive Advantage*, TMH, 7th edition, 2010.
2. Bohlander George W, Snell Scott, *Principles of Human Resource Management,*Cengage Learning, 16th edition, 2016.

3. Edwin B. Flippo, *Personnel Management,* McGraw-Hill International editions, 6th edition, 1984.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/122105020
2. https://onlinecourses.nptel.ac.in/noc20_mg15/preview
3. https://www.digimat.in/nptel/courses/video/122105020/L01.html

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG107601	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	1	-	-	-	-	-
CO2	1	1	1	-	-	-	-		1
CO3	2	2	1	-	-	-	-	1	-
CO4	3	1	1	-	-	-	-	-	-
CO5	2	2	-	-	-	1	-	-	-
Course Correlation Mapping	**2**	**2**	**1**	**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

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: 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. https://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

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS101033	BASIC CONCEPTS OF MICROBIAL GENETICS	3	-	-	-	3

Pre-Requisite Principles of Microbiology

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 analyze biological sequences, work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Learning 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: DNA REPLICATION ***(09 Periods)***

DNA and RNA as genetic material. Replication of DNA: Bidirectional and unidirectional replication, Mode of Replication, Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends, mechanism of DNA replication and inhibitors of DNA replication.

Module 2: INTRODUCTION TO GENE EXPRESSION ***(09 Periods)***

Transcription - Definition, promoter - concept and strength of promoter. Transcriptional Machinery and Mechanism of transcription. Types of RNA and their functions.
Structure of ribosomes Translation - Genetic code, Translational machinery and translation mechanism, inhibitors of transcription and Translation, Regulation of gene expression in bacteria - operon concepts - Negative and positive control of the Lac Operon, trp operon.

Module 3 INTRODUCTION TO GENE AND ITS DEMAGE AND REPAIR ***(10 Periods)***

Concept of gene: Muton, Recon and Cistron. One gene one enzyme and one gene one polypeptide hypotheses. Types of genes - structural, constitutive, regulatory, clustered genes. Mutagens - Physical and Chemical mutagens
Mutations - spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions. Outlines of DNA damage and repair mechanisms

Module 4 MECHANISMS OF GENETIC EXCHANGE ***(07 Periods)***

Transformation - Discovery, molecular mechanism of natural competence Conjugation - Discovery,molecular mechanism, Hfr and F' strains Transduction – Discovery ,Generalized transduction, specialized transduction.

Module 5 EXTRA CHROMOSOMAL GENETIC ELEMENTS ***(10 Periods)***

Properties, types and function of plasmids, Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Uses of transposons and transposition.

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 E. coli
4. Estimation of DNA using UV spectrophotometer.
5. Isolation of protein from yeast.
6. ResolutionandvisualizationofDNAby AgaroseGelElectrophoresis.
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, Transilluminator

TEXT BOOKS:

1. Strickberger,M.W.(1967).Genetics.Oxford& IBH,NewDelhi.
2. Verma,P.S.andAgarwal,V.K.(2004).CellBiology,Genetics,MolecularBiology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.
3. RamReddy,S.,Venkateshwarlu,K.andKrishnaReddy,V.(2007)AtextBookof Molecular Biotechnology. Himalaya Publishers, Hyderabad.
4. Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.

REFERENCE BOOKS:

3. Freifelder, D. (1997). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
4. Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.Lewin,B.(2000).GenesVIII.OxfordUniversityPress, England.
5. Maloy,S.R.,Cronan,J.E.andFreifelder,D.(1994).MicrobialGenetics,Jonesand Bartlett Publishers, London.
6. Smith,J.E.(1996).Biotechnology,CambridgeUniversityPress.\
7. Snyder,L.andChampness,W.(1997).MolecularGeneticsofBacteria.ASMpress,

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 CORE

Course Code	Course Title	L	T	P	S	C
22BS101034	MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT	3	-	-	-	3
Pre-Requisite	Principles of Microbiology					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course delves into the soil microbiology and microbial ecology, including the types of organisms living in soil, growth and survival strategies, biogeochemical functions, and environmental issues and applications involving soil microorganisms

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

CO1 Describe soil organisms and microbial habitats of soil environments.
CO2 Understand the environmental influences which control microbial distribution, growth, and activity in soil ecosystems.
CO3 Describe critical functional roles of soil microorganisms and processes and interactions affecting ecosystem productivity and environmental quality.
CO4 Apply knowledge of soil microorganisms and their activities to address global issues within environmental quality and agricultural sustainability.
CO5 Understand and interpret data in the context of soil microbiology.

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: SOIL MICROBIOLOGY ***(11 Periods)***

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil. Mineralization of Organic & Inorganic Matter in Soil: Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

Module 2: MICROBIAL ACTIVITITY IN SOIL AND GREEN HOUSE GASES ***(11 Periods)***

Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control.

Microbial Control of Soil Borne Plant Pathogens: Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds

Module 3: BIOFERTILIZATION, PHYTOSTIMULATION, BIOINSECTICIDES ***(11 Periods)***

Plant growth promoting bateria, biofertilizers – symbiotic (Bradyrhizobium, Rhizobium, Frankia), Non-symbiotic (Azospirillum, Azotobacter, Mycorrhizae, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs

Module 4: SECONDARY AGRICULTURE BIOTECHNOLOGY ***(07 Periods)***

Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters

Module 5: GM CROPS ***(05 Periods)***

GM crops: Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals

Total Periods: 45

EXPERIENTIAL LEARNING

1. Study soil profile (Demo)
2. Study microflora of different types of soils and write a report
3. Write assignment regarding Isolation of Rhizobium and Azotobacter.
4. Rhizobium and Azotobacter as soil inoculants and its application (pot test).
5. Group discussion on Isolation of cellulose degrading and phosphate solubilizing microorganisms.

RESOURCES

TEXT BOOKS:

1. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
2. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA

REFERENCE BOOKS:

1. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
2. Altman A (1998). Agriculture Biotechnology, I st edition, Marcel decker Inc.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=mU1tlx0JGM8
2. https://www.youtube.com/watch?v=C--KikaFXl4
3. https://www.youtube.com/watch?v=uZ6pCqCUIco

WEB RESOURCES:

1. https://archive.nptel.ac.in/content/storage2/courses/102103045/download/mod6.pdf

2. https://archive.nptel.ac.in/content/storage2/courses/102103045/download/mod1.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102027	MICROBIAL BIOTECHNOLOGY	3	-	3	-	4.5
Pre-Requisite	Microbes In Sustainable Agriculture And Development					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course delves into the Introduction to Microbial Biotechnology, Tools and Techniques in Microbial Biotechnology, Microbial Bioprocess Engineering, Environmental and Agricultural applications, Ethical and regulatory aspects in Microbial Biotechnology.

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

CO1 Understand Microbial Biodiversity, functions of Microbial cell components and metabolic pathways in Microorganisms
CO2 Identify tools used for Recombinant DNA technology, Fermentation techniques and Omics technologies.
CO3 Understand different types of Bioreactors, scaling up techniques and downstream processing.
CO4 Gain knowledge on Microbial biofertilizers, biopesticides and strategies of remediation of environment using Microbes
CO5 Understand Ethical and Regulatory aspects of Microbial Biotehcnology

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 MICROBIAL BIOTECHNOLOGY ***(11 Periods)***

Definition and scope, Historical development, Importance in various industries, Classification of microorganisms, Importance of microbial diversity in biotechnology, Exploration of extremophiles, Comparison of Prokaryotic and eukaryotic cells, Structure and function of microbial cell components, Metabolic pathways in microorganisms

Module 2: TOOLS AND TECHNIQUES IN MICROBIAL BIOTEHCNOLOGY ***(11 Periods)***

Recombinant DNA technology, Gene cloning and expression, Synthetic biology approaches, Basics of fermentation, Industrial applications of microbial fermentation, Optimization of fermentation processes, Genomics, transcriptomics, proteomics, and metabolomics, Applications in microbial biotechnology

Module 3: MICROBIAL BIOPROCESS ENGINEERING ***(11 Periods)***

Types of bioreactors, Scaling up techniques, Monitoring and control in bioprocessing, Separation and purification techniques, Recovery of microbial products, Quality control in downstream processing Case studies on the industrial production of various microbial products, Challenges and opportunities in industrial applications

Module 4: ENVIRONMENTAL AND AGRICULTURAL APPLICATIONS ***(07 Periods)***

Microbial degradation of pollutants, Applications in environmental cleanup, Bioremediation strategies, Microbial biofertilizers and biopesticides, Soil microbiome and plant-microbe interactions, Applications for sustainable agriculture

Module 5: ETHICAL AND REGULATORY ASPECTS IN MICROBIAL BIOTECHNOLOGY ***(05 Periods)***

Responsible conduct in research, Ethical issues in genetic engineering and bioprocessing, Biosafety and biosecurity, Approval processes for microbial products, Compliance with international regulations, Future trends and challenges in regulatory affairs

Total Periods: 45

EXPERIENTIAL LEARNING

1. Collection of Environmental samples for Isolation and characterization of Microbes.
2. Plasmid DNA isolation
3. Restriction enzyme digestion and gel run
4. Cultivation of Microbial Inoculum for Fermentation.
5. Measurement of effect of Temperature, Cell density and pH on Fermentation.
6. Preparation of Bioreactor and Sterilization procedures.

RESOURCES

TEXT BOOKS:

1. Stanbury, P. F., Whitaker and Hall, A. S. J., Principles of Fermentation Technology. Butterworth-Heinemann
2. Shuler, M.L. and Karg, I F., Bioprocess Engineering Basic Concepts , Prentice Hall
3. Vogel, H.C. Todaro, C.L. and Todaro C.C., Fermentation and Biochemical Engineering Handbook: Principles, Process Design, and Equipment, Noyes Data Corporation/ Noyes Publications

REFERENCE BOOKS:

1. Crueger W. and Crueger, A., Biotechnology. A Textbook of Industrial Microbiology, Sinauer Associates
2. Casida L. E. J. R., Industrial Microbiology, New Age (1968)

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=fyQjKYYREW8
2. https://www.youtube.com/watch?v=1m_p1ZRjoxE
3. https://www.digimat.in/nptel/courses/video/105107173/L17.html

WEB RESOURCES:

1. http://nitttrc.edu.in/nptel/courses/video/102105058/L01.html
2. https://archive.nptel.ac.in/courses/102/105/102105088/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102028	AGRI-FOOD MICROBIOLOGY	3	-	3	-	4.5

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

COURSE DESCRIPTION: This course delves into the Introduction to Agri-food Microbiology, Beneficial Microorganisms in Agriculture, Food Microbiology, Food safety and quality control and Advanced topics in Agri-food Microbiology.

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

CO1 Understand the fundamental principles of microbiology relevant to agriculture and food systems
CO2 Gain knowledge about the diverse groups of microorganisms present in agricultural and food environments.
CO3 Explore the beneficial and detrimental roles of microorganisms in agriculture and food production.
CO4 Learn about food spoilage, food-borne diseases, and methods for food preservation.
CO5 Develop an understanding of current advancements and applications of microbiology in agriculture and food science

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 AGRI-FOOD MICROBIOLOGY ***(09 Periods)***

Introduction to microbiology and its importance in agriculture and food systems, Classification of microorganisms (bacteria, archaea, fungi, viruses), Microbial morphology and physiology, Microbial growth and factors affecting growth, Introduction to microbial ecology - soil, water, air, and food ecosystems

Module 2: BENEFICIAL MICROORGANISMS IN AGRICULTURE ***(09 Periods)***

Nitrogen fixation and symbiotic relationships (rhizobia, mycorrhizae), Plant growth-promoting bacteria and their mechanisms of action, Biofertilizers and their applications in agriculture, Microorganisms in composting and waste management, Biocontrol agents and their use in sustainable agriculture

Module 3: FOOD MICROBIOLOGY ***(09 Periods)***

Microbial spoilage of food and spoilage mechanisms, Foodborne pathogens and their characteristics (bacteria, viruses, parasites), Foodborne intoxication and foodborne infection, Methods for food preservation (physical, chemical, biological), Food fermentation and its applications (bread, yogurt, cheese, etc.)

Module 4: FOOD SAFETY AND QUALITY CONTROL ***(09 Periods)***

HACCP (Hazard Analysis Critical Control Points) principles, Good Manufacturing Practices (GMP) in food processing, Microbiological analysis of food - standard plate count, pathogen detection methods, Food laws and regulations, Emerging trends in food safety and quality control

Module 5: ADVANCED TOPICS IN AGRI-FOOD MICROBIOLOGY ***(09 Periods)***

Probiotics and their health benefits, Prebiotics and their role in gut health, Genetically modified microorganisms (GMOs) and their applications in agriculture and food production, Nanobiotechnology in agriculture and food science, Microbiome analysis and its implications in agriculture and food systems

Total Periods: 45

EXPERIENTIAL LEARNING

1. Aseptic techniques and basic microbiological practices
2. Isolation and identification of microorganisms from agricultural and food samples
3. Food spoilage simulation experiments
4. Studying the effects of different preservation methods on microorganisms
5. Introduction to basic food quality control techniques

RESOURCES

TEXT BOOKS:

1. M. Willey, Linda M. Sherwood, and Christopher J. Wozniak, Prescott, Harley, and Klein's Microbiology by Joanne (11th Edition)
2. Michael T. Madigan, John M. Martinko, Paul V. Dunlap and David P. Clark, Brock Biology of Microorganisms (15th Edition)
3. Brenda D. Metting, Soil Microbiology, Ecology and Applications (3rd Edition)

REFERENCE BOOKS:

1. William C. Frazier and Dennis C. Westhoff, Food Microbiology (8th Edition)
2. Ahmed E. Yousef and James M. Jay,Modern Food Microbiology (8th Edition)

VIDEO LECTURES:

1. http://nitttrc.edu.in/nptel/courses/video/126105015/L53.html
2. http://nitttrc.edu.in/nptel/courses/video/126105015/L28.html
3. https://www.digimat.in/nptel/courses/video/126105011/L29.html

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/126/103/126103017/
2. https://dth.ac.in/medical/courses/Microbiology/block-4/11/index.php

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102034	MEDICAL MICROBIOLOGY	3	-	3	-	4.5

Pre-Requisite Principles of Microbiology
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Normal Microflora of Human body, Host-pathogen interactions, Bacterial and Viral diseases, Viral diseases, protozoan and fungal diseases, antibiotics and vaccines. Also, hands-on experience on different diagnostic methods for identification of infectious diseases and antibiotic sensitivity methods.

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

CO1. Gain knowledge on Human Microflora, Host-pathogen interactions.

CO2. Identify bacteria and virus responsible for different diseases

CO3. Identify different diseases related to exclusively related to viruses.

CO4. Understand about various Protozoan and fungal diseases and their pathogenecity

CO5. Gain knowledge on antibiotics and vaccines.

CO6. Analyze different laboratory techniques related to identification organism responsible for infectious diseases.

CO-PO-PSO Mapping Table:

Learning 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	-	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	-	**3**	-	-	**3**	-	-

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

COURSE CONTENT

Module 1: NORMAL MICROFLORA OF THE HUMAN BODY AND HOST PATHOGEN INTERACTION ***(09 Periods)***

Normal flora of human body. Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence and opportunistic infection. General account on nosocomial infection.

General principles of diagnostic microbiology- collection, transport and processing of clinical samples. General methods of laboratory diagnosis - cultural, biochemical, serological and molecular methods.

Module 2: BACTERIAL & VIRAL DISEASES ***(08 Periods)***

Symptoms, mode of transmission, prophylaxis and control of following diseases:
Respiratory Diseases: tuberculosis; Gastrointestinal Diseases: typhoid, cholera; Wound infections: tetanus; Veneral disease: Syphilis

Module 3 VIRAL DISEASES ***(10 Periods)***

Symptoms, mode of transmission, prophylaxis and control of following diseases: AIDS, Dengue, Chikungunya, Japanese Encephalitis

Module 4 PROTOZOAN & FUNGAL DISEASES ***(08 Periods)***

Protozoan diseases- Symptoms, mode of transmission, prophylaxis and control of following diseases: Malaria, Kala-azar

Fungal diseases- General account on transmission, symptoms and prevention of Cutaneous mycoses, Systemic mycoses, Opportunistic mycoses (Candidiasis

Module 5 ANTIBIOTICS & VACCINES ***(10 Periods)***

Antibacterial Agents- Penicillin, Streptomycin and Tetracycline.
Antifungal agents – Amphotericin B, Griseofulvin
Antiviral substances - Amantadine and Acyclovir
Tests for antimicrobial susceptibility.
Brief account on antibiotic resistance in bacteria - Methicillin-resistant Staphylococcus aureus (MRSA). Vaccines – Natural and recombinant.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 4 experiments shall be conducted)

LIST OF EXPERIMENTS

1. Identify bacteria (E. coli, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests
2. Isolation of bacterial flora of skin by swab method.
3. Antibacterial sensitivity by Kirby-Bauer method
4. Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ring worms)
5. Study of various stages of malarial parasite in RBCs using permanent mounts.

RESOURCES

TEXT BOOKS:

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill
2. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication

REFERENCE BOOKS:

1. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' **Medical icrobiology.** 4th edition. Elsevier

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=777y-XCHWIc&list=PLJoALJA_KMOCLX_4GKqeEiGl1tDeeGX3N
2. https://www.youtube.com/watch?v=SEYa0R62nWk
3. https://www.youtube.com/watch?v=Z4w1ccscoO4

Web Resources:

1. https://dth.ac.in/medical/course-inner.php?id=147

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102032	MEDICAL BACTERIOLOGY	3	-	3	-	4.5

Pre-Requisite Principles of Microbiology
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Cell organization, Bacteriological techniques and Microscopy, Reproduction in Bacteria, Growth and Nutrition and Bacterial systematics. Also, hands-on experience on different bacterial identification and characterization techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Gain knowledge on structure and function of Cell and Cellular organelle

CO2. Identify techniques for finding different types of Bacteria.
CO3. Gain knowledge about reproduction in bacteria.
CO4. Understand the growth and Nutritional aspects of bacteria.

CO5. Understand Bacterial systematics.

CO6. Analyze bacteria using different laboratory techniques.

CO-PO-PSO Mapping Table:

Learning 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	-	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	-	**3**	-	-	**3**	-	-

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

COURSE CONTENT

Module 1: CELL ORGANIZATION ***(09 Periods)***

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation

Module 2: BACTERIOLOGICAL TECHNIQUES AND MICROSCOPY ***(08 Periods)***

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria.

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluoresence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope

Module 3 REPRODUCTION IN BACTERIA ***(10 Periods)***

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Module 4 GROWTH AND NUTRITION ***(08 Periods)***

Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation Chemical methods of microbial control: disinfectants, types and mode of action

Module 5 BACTERIAL SYSTEMATICS ***(10 Periods)***

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing. Differences between eubacteria and archaebacteria

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 8 experiments shall be conducted)

LIST OF EXPERIMENTS

1. Preparation of different media: synthetic media BG-11,
2. Preparation of different media: Complex media-Nutrient agar, McConkey agar, EMB agar.
3. Simple staining & Gram's staining
4. Negative staining & Capsule staining
5. Acid fast staining & Endospore staining
6. Isolation of pure cultures of bacteria by streaking method
7. Preservation of bacterial cultures by various techniques.
8. Estimation of CFU count by spread plate method/pour plate method.
9. Motility by hanging drop method

RESOURCES

TEXT BOOKS:

1. Atlas RM. (1997).Principles of Microbiology.2nd edition.WM.T.Brown Publishers.
2. Madigan MT, and Martinko JM.(2014). Brock Biology of Micro-organisms.14th edition.Parker J. Prentice Hall International, Inc.
3. Pelczar Jr MJ, Chan ECS, and Krieg NR.(2004). Microbiology.5th edition Tata McGraw Hill.
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.

REFERENCE BOOKS:

1. 1. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
2. 2. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

VIDEO LECTURES:

1. https://dth.ac.in/medical/courses/Microbiology/block-1/2/index.php
2. https://www.youtube.com/watch?v=cdeScYRotrU
3. https://www.youtube.com/watch?v=BpZWU4Q1QxE

Web Resources:

1. https://www.youtube.com/watch?v=qETITz6v66M

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102034	MEDICAL MICROBIOLOGY	3	-	3	-	4.5

Pre-Requisite Principles of Microbiology
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Normal Microflora of Human body, Host-pathogen interactions, Bacterial and Viral diseases, Viral diseases, protozoan and fungal diseases, antibiotics and vaccines. Also, hands-on experience on different diagnostic methods for identification of infectious diseases and antibiotic sensitivity methods.

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

CO7. Gain knowledge on Human Microflora, Host-pathogen interactions.

CO8. Identify bacteria and virus responsible for different diseases

CO9. Identify different diseases related to exclusively related to viruses.

CO10 Understand about various Protozoan and fungal diseases and their pathogenecity

CO11 Gain knowledge on antibiotics and vaccines.

CO12 Analyze different laboratory techniques related to identification organism responsible for infectious diseases.

CO-PO-PSO Mapping Table:

Learning 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	-	-
Course Correlation Mapping	**3**	**3**	-	**-**	-	-	**3**	-	-	**3**	-	-

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

COURSE CONTENT

Module 1: NORMAL MICROFLORA OF THE HUMAN BODY AND HOST PATHOGEN INTERACTION ***(09 Periods)***

Normal flora of human body. Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence and opportunistic infection. General account on nosocomial infection.

General principles of diagnostic microbiology- collection, transport and processing of clinical samples. General methods of laboratory diagnosis - cultural, biochemical, serological and molecular methods.

Module 2: BACTERIAL & VIRAL DISEASES ***(08 Periods)***

Symptoms, mode of transmission, prophylaxis and control of following diseases:

Respiratory Diseases: tuberculosis; Gastrointestinal Diseases: typhoid, cholera; Wound infections: tetanus; Veneral disease: Syphilis

Module 3 VIRAL DISEASES ***(10 Periods)***

Symptoms, mode of transmission, prophylaxis and control of following diseases: AIDS, Dengue, Chikungunya, Japanese Encephalitis

Module 4 PROTOZOAN & FUNGAL DISEASES ***(08 Periods)***

Protozoan diseases- Symptoms, mode of transmission, prophylaxis and control of following diseases: Malaria, Kala-azar

Fungal diseases- General account on transmission, symptoms and prevention of Cutaneous mycoses, Systemic mycoses, Opportunistic mycoses (Candidiasis

Module 5 ANTIBIOTICS & VACCINES ***(10 Periods)***

Antibacterial Agents- Penicillin, Streptomycin and Tetracycline.

Antifungal agents – Amphotericin B, Griseofulvin

Antiviral substances - Amantadine and Acyclovir

Tests for antimicrobial susceptibility.

Brief account on antibiotic resistance in bacteria - Methicillin-resistant Staphylococcus aureus (MRSA). Vaccines – Natural and recombinant.

Total Periods: 45

EXPERIENTIAL LEARNING: (Minimum 4 experiments shall be conducted)

LIST OF EXPERIMENTS

6. Identify bacteria (E. coli, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests
7. Isolation of bacterial flora of skin by swab method.
8. Antibacterial sensitivity by Kirby-Bauer method
9. Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ring worms)
10. Study of various stages of malarial parasite in RBCs using permanent mounts.

RESOURCES

TEXT BOOKS:

3. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill
4. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication

REFERENCE BOOKS:

2. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' **Medical icrobiology.** 4th edition. Elsevier

VIDEO LECTURES:

4. https://www.youtube.com/watch?v=777y-XCHWIc&list=PLJoALJA_KMOCLX_4GKqeEiGl1tDeeGX3N
5. https://www.youtube.com/watch?v=SEYa0R62nWk
6. https://www.youtube.com/watch?v=Z4w1ccscoO4

Web Resources:

2. https://dth.ac.in/medical/course-inner.php?id=147

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102035	MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES	3	-	3	-	4.5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course delves Introduction and Principles, Microbial sampling and analysis techniques, microbial quality control in food industry, Microbial quality control in Pharmaceutical industry and advanced topics and Emerging Trends.

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

CO1 Gain comprehensive knowledge and skills in microbial quality control procedures for food and pharmaceutical products.
CO2 Understand the principles of Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in relation to microorganism control.
CO3 Learn and apply various techniques for sampling, isolation, identification, and enumeration of microorganisms.
CO4 Analyze the significance of microbial contamination in food and pharmaceutical products and its impact on safety and quality.
CO5 Develop proficiency in performing and interpreting microbial quality control tests relevant to both food and pharmaceutical industries.

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 & PRINCIPLES ***(09 Periods)***

Introduction to microbial quality control in food and pharmaceutical industries, Importance of microbial control in ensuring product safety and quality, Significance of microorganisms in food spoilage and pharmaceutical contamination, Overview of Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP), Regulatory requirements for microbial control in food and pharmaceutical industries.

Module 2: MICROBIOLOGICAL SAMPLING AND ANALYSIS TECHNIQUES ***(09 Periods)***

Principles of sampling for microbiological analysis in food and pharmaceutical environments, Aseptic techniques and methods for sample collection, handling, and storage, Introduction to different culture media and their selection for specific applications, Techniques for isolation and identification of Microorganisms (colonial morphology, biochemical tests), Enumeration methods for viable microorganisms (plate count, MPN).

Module 3: MICROBIAL QUALITY CONTROL IN FOOD INDUSTRY ***(09 Periods)***

Microbiological criteria for different food groups, Food spoilage microorganisms and their detection methods, Foodborne pathogens and their identificationHACCP (Hazard Analysis Critical Control Points) principles and their application in food safety, Hygiene monitoring and sanitation programs in food processing facilities

Module 4: MICROBIAL QUALITY CONTROL IN PHARMACEUTICAL INDUSTRY ***(09 Periods)***

Sterility testing of pharmaceutical products (aseptic and non-aseptic methods), Environmental monitoring for microbial contamination in pharmaceutical clean rooms, Microbiological testing of water used in pharmaceutical production, Microbial limits testing for raw materials and finished pharmaceutical products, Validation of sterilization and disinfection processes

Module 5: ADVANCED TOPICS AND EMERGING TRENDS ***(09 Periods)***

Rapid microbiological methods (e.g., PCR, flow cytometry) for food and pharmaceutical testing Antimicrobials and their role in food and pharmaceutical preservation, Biofilms and their implications in food and pharmaceutical processing, Automation and robotics in microbial quality control laboratories, Emerging technologies for microbial detection and control

Total Periods: 45

EXPERIENTIAL LEARNING

1. Aseptic techniques training and practice
2. Sampling simulations for various food and pharmaceutical environments
3. Practice of different culture media and isolation techniques
4. Identification of common foodborne pathogens and spoilage microorganisms
5. Performing microbial enumeration methods (plate count, MPN)
6. Case studies and hands-on exercises related to food and pharmaceutical industries

RESOURCES

TEXT BOOKS:

1. Joanne M. Willey, Linda M. Sherwood, and Christopher J. WozniakPrescott, Harley, and Klein's Microbiology, (11th Edition)
2. William Barry Hugo and Andrew Kenneth Russell, Pharmaceutical Microbiology (9th Edition)
3. Ahmed E. Yousef and James M. Jay, Modern Food Microbiology (8th Edition)

REFERENCE BOOKS:

1. Jay P. Davis, Pharmaceutical Microbiology Essentials (3rd Edition)
2. Peter Hugo, Gerald McDonnell, and Jean-Yves Maillard, Russell, Hugo & Ayliffe's Principles and Practice of Disinfection, Preservation and Sterilization (9th Edition)

VIDEO LECTURES:

1. http://nitttrc.edu.in/nptel/courses/video/126105015/L53.html
2. http://nitttrc.edu.in/nptel/courses/video/126105015/L28.html
3. https://www.digimat.in/nptel/courses/video/126105011/L29.html

WEB RESOURCES:

1. https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B1-1969%252FCXC_001e.pdf
2. www.babymilkaction.org/archives/33897

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS101008	**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 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. 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 ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102036	**RECOMBINANT DNA TECHNOLOGY**	3	-	-	-	3

Pre-Requisite Molecular Biology
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on.

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

CO1 Understand the principles underlying recombinant DNA technology.
CO2 Demonstrate proficiency in common techniques used in gene cloning and manipulation.
CO3 Evaluate the applications of recombinant DNA technology in various fields, including medicine, agriculture, and biotechnology.
CO4 Analyze and interpret experimental data related to recombinant DNA technology.
CO5 Discuss the ethical and societal implications of genetic engineering.

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 RECOMBINANT DNA TECHNOLOGY *(09 Periods)*

Overview of molecular biology techniques, Historical context and development of recombinant DNA technology, Basic concepts: DNA cloning, gene expression, genetic engineering, Ethics and safety considerations in genetic manipulation

Module 2: DNA MANIPULATION TECHNIQUES *(09 Periods)*

DNA isolation and purification techniques, Restriction enzymes and DNA cleavage, Gel electrophoresis and DNA visualization, Vector selection and preparation

Module 3: GENE CLONING AND EXPRESSION SYSTEMS *(09 Periods)*

Principles of gene cloning, Insertion of DNA fragments into vectors, Prokaryotic expression systems (e.g., bacterial expression vectors), Eukaryotic expression systems (e.g., yeast, mammalian cells)

Module 4: PCR, MUTAGENESIS AND GENE SEQUENCING *(09 Periods)*

Principles and applications of Polymerase Chain Reaction (PCR), Site-directed mutagenesis techniques, Principles and techniques of DNA sequencing, Analyzing and interpreting sequencing data

Module 5: APPLICATIONS AND ETHICAL CONSIDERATIONS *(09 Periods)*

Medical applications of recombinant DNA technology (e.g., gene therapy, recombinant vaccines), Agricultural and environmental applications (e.g., genetically modified organisms, bioremediation), Industrial applications (e.g., enzyme production, bioprocessing), Ethical considerations, regulations, and societal implications of genetic engineering

Total Periods: 45

EXPERIENTIAL LEARNING

Minimum of Eight experiments shall be conducted.

1. DNA isolation
2. Agarose gel electrophoresis and analysis of DNA bands.
3. Restriction Enzyme digestion of DNA and analysis.
4. Analysis of Restriction fragments on Agarose gel electrophoresis
5. Polymerase Chain reaction
6. Site directed mutagenesis
7. Analysis of point mutations
8. DNA sequence analysis
9. Usage of BLAST for identifying unknown sequences

RESOURCES

TEXT BOOKS:

1. S. B. Primrose and R. Twyman, (2013), Principles of Gene manipulation and Genomes, 7th Edition, Wiley-Blackwell publishers.
2. S. Carson, H. B. Miller, M. C. Srougi and D. S. Witherow, Molecular Biology Techniques: A Classroom Laboratory Manual (2019), 4th Edition, Publisher: Academic press.
3. J. Greene (2021), Recombinant DNA Principles and Methodologies, 1st edition, Publisher: CRC press.

REFERENCE BOOKS:

1. J. K. Setlow (2005), Genetic Engineering-Principles and Methods, Volume 27, Publisher: Springer.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6ztkp2dqp_I
2. http://www.digimat.in/nptel/courses/video/102103074/L07.html
3. https://www.youtube.com/watch?v=8K908NeuKJs

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/102/103/102103013/
2. https://archive.nptel.ac.in/courses/102/103/102103013/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102037	**PLANT BIOTECHNOLOGY**	3	-	3	-	4.5

Pre-Requisite Recombinant DNA technology
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion Genome organization, Plant Tissue Culture, Genetic Engineering, Transgenics in Crop improvement and Applications of Transgenic plants.

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

CO1 Understand and remember the basic concepts of genome organization.
CO2 Understand in detail about plant tissue culture and its perspectives.
CO3 Development the basics of genetic engineering.
CO4 Outline the role of transgenic in crop improvement.
CO5 Implement the techniques of Transgenic 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	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: GENOME ORGANIZATION ***(09 Periods)***

Genome Organization: Plant genome organization – nuclear, organelle genomes – mitochondria and chloroplast genome. Introduction - gene structure and gene expression-regulation. Arabidopsis thaliana – a model plant for genome analysis

Module 2: PLANT TISSUE CULTURE ***(09 Periods)***

Plant tissue culture – History and scope, totipotency, plant growth hormones in plant tissue culture – micropropagation – callus induction, organogenesis, embryogenesis, somatic embryogenesis, somaclonal variation, Protoplast culture.

Module 3: GENETIC ENGINEERING ***(09 Periods)***

Gene transfer methods in plants – types of plant cloning vectors, Agrobacterium mediated gene transfer –Ti-plasmid-process of T-DNA transfer and integration, Direct gene transfer methods. Binary vectors- basic features of vectors-optimization-clean gene technology.

Module 4: TRANSGENICS IN CROP IMPROVEMENT ***(09 Periods)***

Production of high yielding varieties, Biotic stress - resistance to herbicides, resistance to pests - Bt approach to insect resistance and disease resistance. Abiotic stress - water deficit stress and various approaches for tolerance

Module 5: APPLICATIONS OF TRANSGENIC PLANTS ***(09 Periods)***

Applications of Transgenic Plants: Transgenic plants- Bt cotton, Bt corn, Golden rice. Genetically modified crops-current status-concerns about GM crops. Molecular farming-Edible vaccines, plantibodies, fruit ripening. Molecular pharming of proteins. Bio fuel production

Total Periods: 45

EXPERIENTIAL LEARNING

Minimum of Eight experiments shall be conducted.

1. Preparation of media for plant tissue culture.
2. In vitro germination of seed.
3. Callus induction and differentiation.
4. Plant regeneration and pot-gardening.
5. Micro propagation
6. Anther and pollen cultures - production of haploids
7. Embryo Culture and
8. Artificial seed production
9. Isolation of protoplast culture
10 Agrobacterium mediated gene transformation

RESOURCES

Text Books:

1. Singh, B.D. Text Book of Biotechnology, Kalyani Publishers. 1998.
2. Neal Stewart, C. Plant Biotechnology & Genetics. John Wiley & Sons Inc., NJ. 2008.
3. Ignacimuthu S, "Plant Biotechnology", Tata Mcgraw-Hill Pub., New Delhi, 2006.

Reference Books:

1. Dubey R.C., "Textbook of Biotechnology. S. Chand publishers, 2005.
2. Satyanarayana U., "Biotechnology" Krishna Pakashan, 2009.
3. Neal Stewart, C. 2008. Plant Biotechnology & Genetics. John Wiley & Sons Inc., NJ.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=oTgXXxQruKs
2. https://www.youtube.com/watch?v=YR5fvTCMeUs
3. https://www.youtube.com/watch?v=LBfKdRwAr_Q
4. https://www.youtube.com/watch?v=NmdaXb_OCLQ

WEB RESOURCES:

3. https://archive.nptel.ac.in/courses/102/103/102103016/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102038	**ANIMAL BIOTECHNOLOGY**	3	-	-	-	3

Pre-Requisite Recombinant DNA technology
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on History and scope of Tissue Culture, Basic techniques of Mammalian Cell culture, Sericulture, Embryo culture and Animal Breeding and Applications of Animal Tissue culture for Invitro testing of drugs.

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

CO1 Understand and remember the basic concepts of History and Scope of Animal tissue culture.
CO2 Understand in Basic Techniques of mammalian cell culture.
CO3 Develop the understanding about sericulture and its importance.
CO4 Outline the role of Embryo Technology and Animal Breeding.
CO5 Develop the proper understanding about animal tissue culture for invitro testing of drugs

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: HISTORY AND SCOPE OF TISSUE CULTURE ***(09 Periods)***

History and Scope of Animal tissue culture: Design & layout of ATC laboratory. Requirements for Animal cell culture. Types of media, ingredients of media. Foetal Bovine Serum. Metabolic profiling of Animal cell culture.

Module 2: BASIC TECHNIQUES OF MAMMALIAN CELL CULTURE ***(09 Periods)***

Basic Techniques of mammalian cell culture: Disaggregation of animal tissue. Primary culture & secondary culture. Evolution of cell line & continuous cell line, characterization of cell lines. Monolayer, suspension culture. Organ culture, Embryo culture. Maintenance of cell culture. Common cell culture contaminants. Cell lines – (HELA) and other types.

Module 3: SERICULTURE ***(09 Periods)***

Sericulture, Commercial production of silk, Silkworm as a bioreactor. Biotechnology of aquaculture, apiculture. Animal cloning vectors. History, Principles and Scope of Tissue Engineering

Module 4: EMBRYO CULTURE AND ANIMAL BREEDING ***(09 Periods)***

Embryo Technology and Animal Breeding : Artificial insemination, In vitro fertilization, Embryo transfer, ICSI, Embryo splitting, Fertility control & regulation, test tube babies. Introduction to Stem Cell Technology and its applications- Different kinds of stem cells

Module 5: APPLICATIONS OF ANIMAL TISSUE CULTURE FOR INVITRO TESTING OF DRUGS ***(09 Periods)***

Applications of animal tissue culture for invitro testing of drugs. Production of transgenic animals & molecular pharming, animal cloning techniques. Cell culture based vaccines and hormones. Production of human proteins in milk and meat. Ethical values in animal biotechnology

Total Periods: 45

EXPERIENTIAL LEARNING

Minimum of Eight experiments shall be conducted.

1. Cleaning and sterilization of glassware.
2. Designing of animal cell culture laboratory.
3. Preparation of tissue culture media, sera for animal cell culture.
4. Preparation of single cell suspension from Animal tissue (Primary cell culture).
5. Chick embryo cell Culture 6. Trypsinization of monolayer and sub culturing.
6. Cryopreservation and thawing of cell line.
7. Cell counting and Cell viability assay
8. Identification of fish/poultry pathogen

RESOURCES

TEXT BOOKS:

1. Sasidhara R., Animal Biotechnology, MJP Publishers. 2006.
2. Satyanarayana U., Biotechnology, Books and Allied (p)Ltd .2008.
3. Primrose, S.B., R.M. Twyman& R.W. Old, Principles of Gene Manipulation, Blackwell Scientific Publications, London. 2000.

REFERENCE BOOKS:

1. Davies, J.M., Basic Cell Culture, Oxford University Press, Oxford. 2002.
2. R.C. Dubey., A Text Book of Biotechnology. S. Chand& Co Ltd, NewDelhi. 5th edition. 2014.
3. Sudha Gangal, Animal Tissue culture. University Press (India)PvtLtd. Hyderabad. Second

edition.2010.

VIDEO LECTURES:

4. https://www.youtube.com/watch?v=Mktxmj41cR8&list=PLLA34Ra3DpcxPYYEhf3db5Nvlv3ZIYdXY
5. https://www.youtube.com/watch?v=-CMpqUJI98Y&list=PL2gj7qy1yF_elPi2G0XDE3MsxMUp8iEbB
6. https://www.youtube.com/watch?v=Xl1VMUHuaCA&list=PL8bZZHwl4U14anBIl_j4RfzHhw7-1OujX

WEB RESOURCES:

4. https://archive.nptel.ac.in/courses/102/104/102104042/
5. https://onlinecourses.swayam2.ac.in/cec22_bt07/preview

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS101009	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 know

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 signalling andmechanism 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:

Learning 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	-
CO6	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 laminaChromatin: 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 Cell
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
22BS101010	**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 carbohydrate metabolism

Module 3: LIPID METABOLISM ***(09 Periods)***

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

Module 4: PROTEIN METABOLISM ***(10 Periods)***

The structure and function of proteins, Amino acid structure, properties, and classification, Protein synthesis (translation) and 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 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, Macmilan 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
22BS102010	**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 allostearic 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:

Learning Outcomes	Program Outcomes								Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	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. Measurement and expression of enzyme activity, Enzyme activity 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 uni-substrate reactions. Km and its significance. Line WeaverBurk 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, Trypsin, Carboxypeptidase,. 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, Zymogen activation, 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
22BS102011	**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 enzymes 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 analyze biological sequences, work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Learning 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. organisation 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 ***(10Periods)***

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. ResolutionandvisualizationofDNAby AgaroseGelElectrophoresis.
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, Transilluminator
12. Determination of melting temperature (Tm) of DNA

TEXT BOOKS:

1. Strickberger,M.W.(2015).Genetics. Ist edition, Pearson Education India publisher.
2. RamReddy,S.,Venkateshwarlu,K.andKrishnaReddy,V.(2007)Atext bookof Molecular Biotechnology. Himalaya Publishers, Hyderabad.
3. Freifelder, D. (2004). Molecular Biology. Ist Edition, Narosa publisher, New Delhi.
4. Maloy SR, Conan Jr, J.E, Freifelder, D. (1994). Microbial Genetics, Second Edition. Jones and Bartlett publishers

REFERENCE BOOKS:

1. Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.
2. Lewin,B.(2000).GenesVIII.OxfordUniversityPress, England.
3. Watson, Hopkins, Goberts, Steitz and Weiner Molecular Biology of the Gene –Publisher: Pearson Education

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 ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS102012	IMMUNOLOGY	3	-	3	-	4.5

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

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Immunology, Cellular and Humoral Immunity, Immune regulation and tolerance, Immunology and applications, and Immunology and Infectious diseases. Also learn techniques used in studying the diseases and treatment of diseases individually and in team.

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

CO1 Describe the structure and function of Immune system and will differentiate between adaptive and Native Immunity.
CO2 Analyze the pathways involved in antibody and cell mediated immunity.
CO3 Understand mechanism of Immune regulation and Hpersensitivity reactions.
CO4 Identify the different types of Immune deficiency disorders and treatment methods such as Immunotherapy.
CO5 Gain knowledge on Host-pathogen interactions and Immune evasion strategies.

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 IMMUUNOLOGY ***(09 Periods)***

Introduction to the immune system and its components (lymphoid organs, immune cells), Innate immunity: Barriers, phagocytosis, inflammation, natural killer cells, Adaptive immunity: B and T lymphocytes, antigen recognition (MHC molecules), Introduction to antigen-antibody interactions

Module 2: CELLULAR AND HUMORAL IMMUNITY ***(09 Periods)***

Cellular immunity: T cell activation, antigen presentation, cytotoxic T cells, MHC restriction, Humoral immunity: B cell activation, antibody structure and function, antibody diversity, The complement system and its role in immunity

Module 3: IMMUNE REGULATION AND TOLERANCE ***(09 Periods)***

Mechanisms of immune regulation: T regulatory cells, cytokines, and immune checkpoints, The concept of self-tolerance and autoimmune diseases, Hypersensitivity reactions: Allergies, autoimmune diseases, and transplantation rejection

Module 4: IMMUNOLOGY AND APPLICATIONS ***(09 Periods)***

Vaccination and immunoprophylaxis: Types of vaccines and their mechanisms of action, Immunotherapy: Monoclonal antibodies, adoptive cell therapy, and immune checkpoint inhibitors, Immunodeficiency disorders: Primary and secondary immunodeficiencies, Immunoassays: Techniques for detecting antigens and antibodies for diagnosis

Module 5: IMMUNOLOGY AND INFECTIOUS DISEASES ***(09 Periods)***

Immune response to different pathogens (viruses, bacteria, parasites), Host-pathogen interactions and immune evasion strategies, Case studies: Analyzing the role of the immune system in specific infectious diseases

Total Periods: 45

EXPERIENTIAL LEARNING

Minimum of five experiments to be conducted.

11 Microscopic observation of different cells involved in Immune system- Spleen, Lymph node and Thymus
12 Separation of Blood and different Cell counts
13 Demonstration of ELISA
14 Immune reactions by diffusion methods such as Mancini, Ouchterlony methods.
15 Conducting Pregnancy test
16 Demonstration of different Immuno assays

RESOURCES

Text Books:

1. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, and Janis Kuby (2014) Kuby Immunology (Eighth Edition) Publisher: W. W. Norton & Company,
2. Kenneth Murphy, Paul Travers, Mark Walport, and Charles Janeway Jr (2018). **J**aneway's Immunobiology, Ninth Edition, Publisher: Garland Science.
3. Ivan Roitt, Jonathan Brostoff, and David Male, (2016), Essential Immunology,Twelfth Edition, Publisher: Wiley-Blackwell.

Reference Books:

1. David Male, David Burton, Janine Wraith, and Ivaylo Ivanov (2016),Paul's Fundamental Immunology, Eighth Edition, Publisher: Wolters Kluwer.
2. Andrew H. Lichtman and Shiv Pillai., (2019) Abbas and Lichtman's Basic Immunology (Functions and Processes), Fifth Edition, Publisher: Elsevier.

VIDEO LECTURES:

1. https://www.bing.com/videos/riverview/relatedvideo?&q=immunology+nptel&&mid=3B8CDA20247A4F1F683B3B8CDA20247A4F1F683B&&FORM=VRDGAR
2. https://www.bing.com/videos/riverview/relatedvideo?q=immunology%20nptel&mid=71C3AD2D49CBC345E0BC71C3AD2D49CBC345E0BC&ajaxhist=0
3. https://www.bing.com/videos/riverview/relatedvideo?q=basic+immunology+functions+and+disorders+of+the+immune+system&&view=riverview&mmscn=mtsc&mid=D1885602AD289A081A55D1885602AD289A081A55&&aps=26&FORM=VMSOVR
4. https://www.bing.com/videos/riverview/relatedvideo?q=host%20pathogen%20interactions&mid=09A58BFB80F8D87CCB8409A58BFB80F8D87CCB84&ajaxhist=0

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_bt43/preview
2. https://egyankosh.ac.in/bitstream/123456789/77427/1/Block-2.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS101023	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	PSO4
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, phytogenomics, 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

17 Sequence Homology determination by BLAST
18 Unknown protein identification by MASCOT search
19 Assignment on CRISPR- CAS9 editing methodology
20 DNA Cot curve Analysis
21 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.
2. **B. R. Korf and M. B. Irons, Human Genetics and Genomics (2021), 4th edition, John Wiley and sons 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

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS101005	EMBRYOLOGY	3	-	-	-	3

Pre-Requisite Human Physiology
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
22BS102021	ENDOCRINOLOGY	3	-	3	-	4.5

Pre-Requisite Human Physiology
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. Williams Textbook of Endocrinology (14th Edition) by Larsen, Kronenberg, Melmed, Polonsky
2. Goodman & Gilman's The Pharmacological Basis of Therapeutics (14th Edition) by Brunton, Chabner, Knollmann
3. Comprehensive Clinical Endocrinology (6th Edition) by David G. Gardner, Dolores Shoback

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/)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS101401	**ENVIRONMENTAL STUDIES**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onmultidisciplinary nature of environmental studies, scope and importance of environmental education, ecosystems, ecology, renewable and non-renewable energy resources. Biodiversity and its conservation. Environmental pollution and its control measures, global environmental issues and Acts. Green Chemistry and its tools.

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-PSO 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: ENERGY SOURCES ***(06 Periods)***

Renewable energy Resources:Solar energy - solar cells, wind energy, tidal energy.
Non-renewable energy resources:Natural gas, coal gas, biogas.

Module 2: WATER POLLUTION ***(06 Periods)***

Potable water, Sources of water, impurities in water and their consequences, Eutrophication, Effect of Hardness of water, Municipal and Industrial wastewater management.

Module 3: ENVIRONMENTAL POLLUTION AND ITS CONTROL MEASURES ***(06 Periods)***

Definition, causes, effects and control measures of: Air, Water (thermal and marine pollution), Land pollution, Radiation pollution and Nuclear hazard, Noise pollution, Overgrazing, effects of modern agriculture – fertilizer and pesticides.

Module 4: ENVIRONMENTAL AND SOCIAL ISSUES ***(06 Periods)***

Climate changes: global warming, acid rain, ozone layer depletion, nuclear accidents. ***Social Issues:*** Population growth, variation among nations and population explosion. Urban problems related to Water conservation, rain water harvesting and watershed management.

Module 5: GREEN TECHNOLOGY ***(06 Periods)***

Introduction, principles of green chemistry, tools of green chemistry, Green Computing, green construction, Green manufacturing Systems.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Submit a document on your plan of action in maintaining the sustainable environment.
2. Visit the Tirupathi Municipal corporation water treatment plant and submit a report on your observations
3. List any two major environmental issues in Tirupathi and make a report with solutions using your expertise.
4. Submit your ideas on the importance of Environmental Education for technical students.
5. How do unequal urban planning and green space distribution affect temperatures in a city?
6. How are water sources affected by urbanization?

RESOURCES

TEXT BOOKS:

1 Anubha Kaushik and C. P. Kaushik, Perspectives in Environmental Studies, New Age International (P) Ltd. Publications, 6 th 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://study.com/academy/lesson/what-is-environmental-science-definition-and-scope-of-the-field.html

2 https://www.youtube.com/watch?v=Y5B1nWYle40

3 https://www.digimat.in/nptel/courses/video/127105018/L26.html

Web Resources:

1 https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

2 https://www.hzu.edu.in/bed/E%20V%20S.pdf

3 https://cpcb.nic.in/7thEditionPollutionControlLawSeries2021.pdf

4 https://www.clearias.com/environmental-laws-india/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22BS102013	**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, Theories of Bonding in Metals, liquidstate, 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 liquid crystals properties and their applications.

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-blockElements: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-blockElements: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: THEORIES OF BONDING IN METALS ***(08 Periods)***

Metallic properties and its limitations, Valence bond theory, Free electron theory, Explanation of thermal and electrical conductivity of metals, Band theory- formation of bands, explanation of conductors, semiconductors and insulators.

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

LiquidState: 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 andTuli, Advanced physical chemistry,28th Edition, schamd 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
22BS102014	**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 selectrochemistry of organic compounds.

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

CO7. Recall and apply the basic concepts of nomenclature, classification and basic properties of organic compounds.

CO8. Understand and explain differential behaviour organic compound based on the fundamental concepts learnt.

CO9. Formulate and identify the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants learnt.

CO10. Describe the concept of aromaticity, molecular structure of benzene based on modern concepts. Ring activating and deactivating groups.

CO11. Correlate and explain stereo chemical properties of organic compounds and configurations.

CO12. Develops independent working ability, through problem solving and effective communication.

CO-PO-PSO Mapping Table:

Learning 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 Freunds 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/AntiMarkownikoff), 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 Benzenebased on modern concepts (VBT andMOT).

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 OFCARBONCOMPOUNDS ***(10 Periods)***

Optical isomerism: Optical activity-wave nature of light, plane polarised light, optical rotation and specificrotation.

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) Ketonesv) Esters
   vi) Carbohydrates vii) Amines viii) Amidesix) 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
22BS102015	**ADVANCED CHEMISTRY-1**	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:

CO7. Understand the preparation, properties and reactivity ofheterocyclic compounds**.**

CO8. Design the synthesis of new nitrogen containing functional groups.

CO9. Illustrate the laws of photochemistry and photochemical reaction mechanism.

CO10 Understand the advanced concepts of electro chemistry and its applications.

CO11 Explain kinetics of a chemical reactions and factors influences chemical reactions.

CO12 Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Learning 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**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	-	**3**

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

COURSE CONTENT

Module 1: HETEROCYCLIC COMPOUNDS ***(09 Periods)***

Introduction, Classification, systenatic method of nomenclatutre, structure and aromaticity of pyrrole, furan, thiophene and phridine, Methods of preparation and chemical reactions-pyrrole, furan, thiophene and phridine, applications of the heterocyclic compounds

Module 2: NITROGEN CONTAINING FUNCTIONAL GROUPS ***(09 Periods)***

Introduction, Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary 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). Electrophillic 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 Hittorfs method,Conductometric 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

1. **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 ArunBahl, 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
22BS102016	**ADVANCED CHEMISTRY-2**	**3**	**-**	**3**	**-**	**4.5**

Pre-Requisite - Advanced Chemistry-1

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-enoltautomerism; 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 equlibria 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)tetramminecopper(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 ArunBahl, 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
22BS101012	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-Gouymethod

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, nuclearfission-theory of nuclear fission; chain reaction, critical mass; nuclear reactors-fastbreeder reactors, fuels used in nuclear reactors, separation of isotopes, moderators,coolants; nuclear fusion; Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelingstudies, 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 daiichi 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
22BS101013	**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 azeotropicdistillation, Partially miscible binary systems (CST-UCST, LCST, and both UCST andLCST). Effect of addition of solute on CST. Steam distillation. Solubility of gases inliquids; Henry's law, its relationship with Raoults law.

Lowering of vapour pressure: Thermodynamics derivation for elevation of boiling pointand 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 studyingassociation, dissociation and solvation. Study of formation of complex ions. Extractionwith 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 differentmethods. 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, solventpolarity and ionic strength (only qualitative ideas). Arrehenius theory of chemical reactionrates. 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 ofenzyme 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 Hartleymethod.
3. Study of kinetics of pesudo-first-order reactions – acid and base catalyzed hydrolysis ofester 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
22BS101014	**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 energyand decomposition of polymers.Determination of Molecular mass of polymers: Number Average molecular mass (Mn) andWeight average molecular mass (Mw) of polymers and determination by (i) viscosity (ii)Light scattering method (iii) Gel Permeation Chromatography (iv) osmometry andultracentrifuging

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 catalysed, acid catalysed polymerization, molecular weightdistribution, Step growth polymers

Module 3: CRYSTALLIZATION, CRYSTALLINITY AND ***(08 Periods)***

DEGRADATION

Determination of crystalline melting point and degree of crystallinity, Morphology of crystallinepolymers, 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 expoxide 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 retardantsand 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 applicaitons
3. Solid and gas phase polymerisation
4. Poly methylmethacrylate, polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropylene glycols
5. Film casting,Thermofofming, 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
22BS101015	**COORDINATION CHEMISTRY**	**3**	**-**	**-**	**-**	**3**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onTheory 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 inindustry and in medicine
CO3 Study the active roles played by metal ions and coordination compounds inbiological 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-dtransitions, spin-spin splitting, hyperfine splitting, adjusted crystal field theoryMO Theory: Metal orbitals and LGOs suitable for σand ∏bonding in octahedralgeometry, construction of qualitative MO energy level diagram for σ bonding inoctahedral geometry.

Module 2: REACTION MECHANISMS IN COORDINATION COMPOUNDS ***(10 Periods)***

Substitution reactions in octahedral complexes: dissociative and associative andinterchange mechanisms.
Electron transfer reactions: inner-sphere and outer-sphere mechanisms, noncomplementary electron transfer reactions.
Inorganic photochemistry: principles, photosubstitution, photoisomerization, and photoredox 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 andterminal carbonyls, transition metal alkyls, carbenes, and carbynes, and metallocenes.Wilkinson's catalyst and alkene hydrogenation, hydroformylation, Monsanto acetic acidprocess, 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 inbiological system. Na/K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiencyof some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use ofchelating agents in medicine.Iron and its application in bio-systems, Haemoglobin 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, metalalkyls, 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., OxfordUniversity 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
22BS102023	**BASICS OF SPECTROSCOPY**	**3**	**-**	**3**	**-**	**4.5**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onIntroduction 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 inindustry and in medicine

CO3 Study the active roles played by metal ions and coordination compounds inbiological 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, quantisation of energy, Electronic, vibrational and rotational energy levels, and transitions in atoms and molecules. Absorption and emission spectra. Boltzman 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 photocolorimeter 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 applicationss

Module 3: INFRARED SPECTROSCOPY ***(09 Periods)***

Principle, types of stretching and bending vibrations, vibrational frequencies, IR instrumentation, block diagram, source, monochramator, 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
22BS101028	**THERMODYNAMICS**	**3**	**-**	**-**	**-**	**3**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onFirst Law of Thermodynamics and its Applications, Thermo 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.

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
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 Walls 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 internalenergy from the enthalpy change, standard states and standard heats of formation, Heat of combustion; integral heat of solution and dilution, heat of neutralization, heat ofhydration; 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 ofthermodynamics on the basis of Cannot cycle. Thermodynamic principle of the working ofrefrigerator.Criteria of spontaneity. Changes in S, G and A as criteria for spontaneous process, dS, dGand dA – exact differentials.Evaluation of DG and DS for the mixing, Maxwell's equations and thermodynamicequation 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 andKC; properties of equilibrium constants. Vant Hoff isotherm. Derivation of thermodynamicequilibrium constant, and its relationship with free energy changes under standardconditions. Vant Hoff isochore. Le-Chatelier-Braun principle: Formation of ammonia.Application of law of mass action and Le-Chatelier-Braun principle to homogeneousgaseous 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
22BS101029	**ORGANIC FUNCTIONAL GROUPS**	**3**	**-**	**-**	**-**	**3**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onpreparation, 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 carbonyal 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
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 carbonylcompounds, 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)*

Mechnism of aldol, Perkin, Knoevenagel reactions and benzoin condensation, Claisen, Wittig, Cannizarro 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, Jablonskii diagram, photochemical reactions ofcarbonyl 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
22BS101030	**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 propertiesMagnetic 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-raystructure determination (NaCl and KCl only) – powder and single crystal- methods andapplications-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 Stockbarger methods.

Module 3: ELECTRICAL AND OPTICAL PROPERTIES ***(09 Periods)***

Defects in solid state – point defects – Frenkel and Schottky defects and non-stoichiometricdefects.Conductors – variation of conductivity with temperature –

semiconductors – p and n types,pn- junction, photoconduction, photo voltaic cell and photogalvanic cell – solar energyconversion, organic semiconductors.Introduction and applicationof Piezoelectric, pyro-electric and ferroelectrics, Photoluminescence.

Module 4: MAGNETIC PROPERTIES ***(09 Periods)***

Magnetic properties – classification - diamagnetic, paramagnetic, antiferromagnetic, ferroand 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 andSchrieffer theory and Cooper pairs – examples of superconducting oxides, Chevrel phases
– applications of superconducting materials.Ionic conductors – sodium-b alumina, sodium-sulphur battery. Intercalation – layeredcompounds – graphitic compounds. Special applications of solid state materials. Highenergy 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
22BS101031	**ELECTROCHEMISTRY**	**3**	**-**	**-**	**-**	**3**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Equilibrium Electrochemistry, Electrochemical Reactions, quantitative aspects ofelectrochemistry, 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 electochemistry
CO3 Study the quantitative aspects ofelectrochemistry
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 ionsbased on half-cell potentials, applications of electrolysis in metallurgy and industry.Chemical cells, reversible and irreversible cells with examples. Electromotive force of a celland its measurement, Nernst equation; Standard electrode (reduction) potential and itsapplication to different kinds of half-cells. Application of EMF measurements in determiningfree energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pHvalues, 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 Hittorfs 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 theoryLimitations
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. 33rdedition, 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 CORE

Course Code	Course Title	L	T	P	S	C
22BS102024	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:

Learning 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, DonaldM. 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, SChand & 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
22ME101703	**MANAGEMENT SCIENCE**	3	-	-	-	3

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

COURSE DESCRIPTION:
Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:
CO1 Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.
CO2 Apply the concepts of HRM for selection and management of human resources.
CO3 Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services
CO4 Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints
CO5 Develop network models in time-cost trade-off for effective project management.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1		1	1	1	1			1	
CO2	3	2	1		1						1	
CO3	3	3	1	1	1						1	
CO4	3	2	1		1	1					1	
CO5	3	3	3	1	1	1					2	
Course Correlation Mapping	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**			**1**	

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

COURSE CONTENT

Module 1: MANAGERIAL FUNCTION AND PROCESS ***(10 Periods)***
Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

Module 2: HUMAN RESOURCE MANAGEMENT ***(08 Periods)***
Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

Module 3: OPERATIONS MANAGEMENT ***(10 Periods)***
Fundamentals of Operations Management, Services as a part of operations management;

Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

Module 4: MARKETING MANAGEMENT ***(08 Periods)***

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

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

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Find the social responsibilities in the context of management theoretically and practically in an organization? Explain them by taking a real case study in any organization (preferably in your organization).
2. Gaining market share should be one of management's primary goals because of its effect on operations and profitability. Comment. What Strategies Do Companies Employ to Increase Market Share?
3. A Gantt chart is a visualization that helps in scheduling, managing, and monitoring specific tasks and resources in a project. Prepare a gantt chart for Online food ordering system.

(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. MartandT. Telsang, *Industrial Engineering and Production Management,* S. Chand, 3rd Edition, 2018.
2. Koontz and Weihrich, *Essentials of Management*, TMH, New Delhi, 11th Edition, 2020.

REFERENCE BOOKS:

1. O.P. Khanna, *Industrial Engineering and Management,* Dhanpat Rai and Sons, 2018.
2. N.D. Vohra, *Quantitative Techniques in Management,* TMH, New Delhi, 5th Edition, 2014.
3. L.M. Prasad, *Principles and practice of Management,* S. Chand and Sons, 2019.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/122/106/122106032/
2. https://www.digimat.in/nptel/courses/video/122102007/L01.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101704	MANAGING INNOVATION AND ENTERPRENEURSHIP	3	-	-	-	3

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

COURSE DESCRIPTION:
Evolution of entrepreneurship from economic theory Managerial and entrepreneurial competencies; Concepts of Shifting Composition of the Economy Purposeful Innovation &Sources of Innovative Opportunity; The Innovation Process; Innovative Strategies; Entrepreneurial Motivation; Entrepreneurs versus inventors; Ethics and International Entrepreneurship; Strategic Issues in International Entrepreneurship; Problem solving Innovation and Diversification

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

CO1. Demonstrate the principles of innovation process for establishing Industrial ventures.
CO2. Identify and analyze the gaps in an organization for innovation in the context of developed economies
CO3. Develop a comprehensive and well-planned business structure for a new venture.
CO4. Demonstrate knowledge on intellectual property rights, patents, trademarks, copyrights, trade secrets and commercialization of intellectual property.
CO5. Apply ethics in constructive innovation framework and problem solving.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1		1	1	1	1			1	
CO2	3	2	1		1						1	
CO3	3	3	1	1	1						1	
CO4	3	2	1	1	1	1					1	
CO5	3	3	3	1	1	1					2	
Course Correlation Mapping	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**			**1**	

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

COURSE CONTENT

Module 1: CREATIVITY AND INNOVATION ***(09 Periods)***

Introduction, Levels of innovation, Purposeful innovation and the sources of innovative opportunity, The innovation process, Innovative strategies, Strategies that aim at introducing and innovation, Dynamics of ideation and creativity – Inbound, Outbound; Context and process of new product development, Theories of outsourcing.

Module 2: PARADIGMS OF INNOVATION ***(09 Periods)***

Systems approach to innovation, Innovation in the context of developed economies and Emerging economies, Examining reverse innovation and

itsapplication,Performancegap,Infrastructuregap,Sustainabilitygap,Regulatory gap, Preference gap, organizational factors effecting innovation at firm level.

Module 3: SOUCES OF FINANCE AND VENTURE CAPITAL ***(09 Periods)***

Importance of finance, Comparison of venture capital with conventional development capital, Strategies of venture funding, Investment phases, Investment process, Advantages and disadvantages of venture capital, Venture capital developments in India.

Module 4: INTELLECTUAL PROPERTY INNOVATION AND ENTREPRENEURSHIP ***(09 Periods)***

Introduction to Entrepreneurship, Evolution of entrepreneurship from economic theory, Managerial and entrepreneurial competencies, Entrepreneurial growth and development, Concepts, Ethics and Nature of International Entrepreneurship, Intellectual property – forms of IP, Patents, Trademarks, Design registration, Copy rights, Geographical indications, Patent process in India.

Module 5: OPEN INNOVATION FRAME WORK &PROBLEM SOLVING ***(09 Periods)***

Concept of open innovation approach, Difference between open innovations and Cloud innovation approaches, Limitations and Opportunities of open innovation frame work, Global context of strategic alliance, Role of strategic alliance, Problem Identification and Problem Solving, Innovation and Diversification

Total Periods:45

EXPERIENTIAL LEARNING

1. Identify the Innovative Marketing Strategies for Startups
2. Identify the Coca-cola Company Intellectual Property Rights

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

CASE STUDIES/ARTICELS:

Contemporary relevant case studies/ Articles will be provided by the course instructor at the beginning.

1. Tesla Inc.: Disrupting the Automobile Industry
   This case study examines how Tesla Inc. disrupted the traditional automobile industry through its innovative electric vehicles and sustainable energy solutions. It discusses the sources of innovative opportunity that Tesla leverages, the ideation and creativity dynamics involved in new product development, and the strategies that the company uses to introduce and market its innovations.
2. Google Inc.: Innovation in Developed Economies
   This case study explores how Google Inc. became a global leader in the technology industry through its innovative search engine, advertising, and cloud computing solutions. It highlights the performance gap that Google addressed, the regulatory and sustainability gaps that it leveraged, and the impact of its innovation strategies on the company's growth and profitability.

3. Flipkart: From Startup to Unicorn
   This case study examines how Flipkart, an Indian e-commerce company, secured venture capital funding to become one of the largest online marketplaces in India. It discusses the importance of finance in entrepreneurship, the advantages and disadvantages of venture capital, and the strategies that Flipkart used to attract venture funding.

4. Patanjali Ayurved: Building a Brand through Intellectual Property
   This case study explores how Patanjali Ayurved, an Indian consumer goods company, built a strong brand through its intellectual property strategies. It discusses the forms of IP that Patanjali leverages, the patent process in India, and the impact of IP on the company's growth and profitability.

5. Procter & Gamble: Innovation through Open Innovation
   This case study analyzes how Procter & Gamble, a global consumer goods company, leveraged open innovation to achieve unprecedented success in product development and marketing. It discusses the difference between open and cloud innovation approaches, the limitations and opportunities of open innovation, and the role of strategic alliances in global innovation.

RESOURCES

TEXT BOOKS:

1. Vinnie Jauhari, Sudhanshu Bhushan, *Innovation Management*, Oxford University Press, 1st Edition, 2014.
2. Drucker, P.F., *Innovation and Entrepreneurship*, Taylor & Francis, 2nd Edition, 2007.

REFERENCE BOOKS:

1. Robert D Hisrich, Claudine Kearney, *Managing Innovation and Entrepreneurship,* Sage Publications,1st Edition, 2014.
2. V.K. Narayanan, *Managing Technology and Innovation for Competitive Advantage,* Pearson India,1st Edition, 2002.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=wWsl48VLfVY
2. https://www.youtube.com/watch?v=dDpQ9ALKX0U
3. https://www.youtube.com/watch?v=Eu_hkxkJGTg

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG101701	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	PO10	PO11	PO12
CO1	3	1	-	-	2	-	-	-	-	3	-	-
CO2	1	2	-	-	2	-	-	-	-	3	1	-
CO3	1	-	-	-	2	-	-	-	-	3	-	-
CO4	1	2	-	-	2	-	-	-	-	3	-	-
Course Correlation Mapping	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**-**

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

COURSE CONTENT

Module 1: NATURE AND SCOPE OF COMMUNICATION ***(9 Periods)***

Introduction – Communication Basics – Functions of Communication – Communication Networks – Interpersonal Communication – Informal Communication – Communication Barriers – Roles of a Manager.

Module 2: CORPORATE COMMUNICATION ***(9 Periods)***

Introduction – Corporate Communication – Cross-Cultural Communication; Concept & Styles – Corporate Communication Strategy – Corporate Citizenship – Crisis Communication: Case Study.

Module 3: WRITING BUSINESS MESSAGES & DOCUMENTS ***(9 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 ***(9 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 ***(9 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

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
22MG101701	**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**	**PO10**	**PO11**	**PO12**
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	-	-		2		1			-
CO3	2	2	1	-	-	-	-	1	-	-	2	
CO4	3	1	2	-	-	-	-	-	-	-	-	2
CO5	2	2	1	-	-	1	-	-	-	-	-	1
Course Correlation Mapping	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	1	**-**	**2**	**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

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
22SS101704	**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	PO10	PO11	PO12
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
22SS101706	**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	PO10	PO11	PO12
CO1	3	1	-	-	1	3	-	1	–	–	-	-
CO2	3	1	-	-	-	2	-	-	-	–	-	-
CO3	3	1	-	-	-	2	-	-	-	3	-	-
CO4	3	1	-	-	-	-	-	-	-	-	2	-
Course Correlation Mapping	3	1	-	-	1	3	-	1	–	3	2	-

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 NatureSocio–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. SahaySushama, *Women and Empowerment,* Discovery Publishing House, New Delhi, 2013.
2. NayakSarojini, 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*, Booksclinic 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
22CE101703	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	PO10	PO11	PO12
CO1	3	3	-	-	-	2	2	-	-	-	-	-
CO2	3	3	-	-	-	2	2	-	-	-	-	1
CO3	3	3	-	-	-	2	2	2	-	-	1	-
CO4	3	3	-	-	2	2	2	2	-	-	1	-
CO5	3	3	-	-	2	2	2	2	-	1	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**2**	**2**	**2**	**2**	-	**1**	**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

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
22CM101701	**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**	**PO10**	**PO11**	**PO12**
CO1	3							2				1
CO2	3							2				1
CO3	3							2				1
CO4	3							2			1	1
CO5	3							2			1	1
Course Correlation Mapping	**3**							**2**			**1**	**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

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. RanganadhaChary, A.V. and Paul, R.R., *Banking and Financial system*, Kalyani Publisher, New Delhi, 3rd edition, 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
22CM101702	**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**	**PO10**	**PO11**	**PO12**
CO1	3				2			1				
CO2	3				2			1			1	
CO3	3				2			1			1	
CO4	3				2			1			1	
CO5	3				2			1				
Course Correlation Mapping	**3**				**2**			**1**			**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

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
22SS101702	**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 hominin walked like a human but climbed like an ape."
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*, Routledge, 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
22SS101703	**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	PO10	PO11	PO12
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
22SS101705	**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	PO10	PO11	PO12
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 Aachaarya and Mahaapragya - 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, Eswarchandravidyasagar 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
22SS101701	**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	PO10	PO11	PO12
CO1	1	-	-	-	-	3	2	-	-	-	-	-
CO2	2	-	-	-	-	3	-	3	-	-	-	-
Course Correlation Mapping	**2**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**-**

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

COURSE CONTENT

Module 1: PREAMBLE AND ITS PHILOSOPHY ***(9 Periods)***

Introduction to Indian Constitution; Evolution of Indian Constitution; preamble and its philosophy

Module 2: UNION LEGISLATURE ***(9 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 ***(9 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 ***(9 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 ***(9 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 these 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
22EE101704	**GREEN TECHNOLOGIES**	3	-	-	-	3

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

COURSE DESCRIPTION: This course provides a detailed discussion on green technology concepts, the role of industry and government in establishing green energy footprints and cleaner development mechanisms. It also presents energy-efficient and sustainable green production systems, concepts of energy ecosystems, and concepts of green buildings.

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

CO1. Understand the green technology concepts and the consequences of greenhouse gas emissions.
CO2. Acquire basic knowledge on cleaner development mechanism, the importance of re-use of materials, and the oxidation technology for wastewater.
CO3. Go beyond energy-efficient machinery, biofuels, and environmentally friendly materials.
CO4. Acquire basic knowledge on man-made ecosystems, sources, and control of pollution.
CO5. Understand the concepts and requirements for green buildings.

CO-PO Mapping Table

Course Outcome	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	3	-	-	-	-	1
CO2	3	-	-	-	-	-	3	-	-	-	-	1
CO3	3	-	-	-	-	-	3	-	-	-	-	1
CO4	3	-	-	-	-	-	3	-	-	-	-	1
CO5	3	-	-	-	-	-	3	-	-	-	-	1
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**-**	**3**	-	-	-	-	**1**

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

COURSE CONTENT

Module 1: INTRODUCTION TO GREEN TECHNOLOGY ***(09 Periods)***

Green technology-definition, importance, factors affecting green technology. Global atmosphere- green house gases, global warming, acid rain, ozone depletion and photochemical smog. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

Module 2: CLEANER DEVELOPMENT TECHNOLOGIES ***(08 Periods)***

Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labeling. Oxidation technology for wastewater treatment - cavitation, fenton chemistry, photocatalysis and hybrid processes.

Module 3: ENERGY EFFICIENT SYSTEMS AND PROCESSES ***(09 Periods)***

Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green production systems.

Module 4: ENERGY ECOLOGY AND ENVIRONMENT ***(08 Periods)***

Concept and theories of ecosystems - energy flow in major manmade ecosystems- agricultural, industrial and urban ecosystems - sources of pollution from energy technologies and its impact on atmosphere - air, water, soil, and environment - environmental laws on pollution control – innovation and sustainability: - eco-restoration / phyto-remediation, renewable energy technologies, industrial ecology and agro ecology.

Module 5: GREEN BUILDINGS ***(10 Periods)***

Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Eco-friendly and cost effective materials, energy management. Rooftop solar photovoltaic system and solar tracking system, alternating roofing systems.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The student shall prepare a report on the causes of global warming and should suggest possible remedies for reducing the global warming
2. The student shall prepare a report on the wastewater management system.
3. The student shall prepare a report on controlling pollution in the environment.
4. The student shall observe the various considerations in a greenhouse building and should prepare the report on the observations made and should suggest possible avenues for improvement.

(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. Khan B.H, *Non conventional energy resources*, Tata McGraw-Hill, New Delhi 2006.
2. Paul L. Bishop, *Pollution prevention –Fundamentals and Practices*, McGraw-Hill-international 2000.

REFERENCE BOOKS:

1. P. Aarne Veslind, *Introduction to environmental engineering*, Cenage Learning 2010.
2. Joseph A. Salvato, *Environmental engineering,* Wiley
3. Tom D Reynolds, *Unit operations and processes in environmental engineering*, PWS Publishing.
4. D. Y. Goswami, F. Kreith and J. F. Kreider, *Principles of Solar Engineering*, Taylor and Francis.
5. C. S. Solanki, *Solar Photovoltaics: Fundamental Applications and Technologies*, Prentice Hall.

WEB RESOURCES:

1. N. Vinutha bai, R. Ravindra, Energy efficient and green technology concepts, International Journal of Research in Engineering and Technology p 253-258, Volume: 03 Special Issue: 06, 2014, eISSN: 2319-1163 pISSN: 2321-7308.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101701	GLOBAL STRATEGY AND TECHNOLOGY	3	-	-	-	3

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

COURSE DESCRIPTION:
Introduction to strategic management; Strategic management process; Principles of good strategy; Globalization strategies; Research and Development strategies; Technology Management and Transfer; Elements of Transfer Process; Corporate Governance in the Indian scenario.

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

CO1 Demonstrate the knowledge on strategic management, its approaches, and tools through ethical decision making.
CO2 Analyse the globalization challenges for scrupulous selection of globalization strategies.
CO3 Apply the R&D strategies and trends to enhance the technological breakthroughs for new products and applications.
CO4 Demonstrate the knowledge on technology management and transfer that strengthen the economy and accelerate the application of technology and resources.
CO5 Analyze the challenges of corporate governance in Indian scenario for the effective development of value-oriented organizations.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	1	-	1	-	-	1	-
CO2	3	2	1	-	1	1	-	-	-	-	1	-
CO3	3	2	1	-	1	1	-	-	-	-	1	-
CO4	3	2	1	-	1	1	-	-	-	-	1	-
CO5	3	2	1	-	1	1	-	1	-	-	1	-
Course Correlation Mapping	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**-**

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

COURSE CONTENT

Module 1: STRATEGIC MANAGEMENT (09 Periods)
Introduction, Classes of decisions, Levels of strategy, Core competence, Strategic intent and stretch, Approaches to strategy making, Roles of different strategists, Strategic Management-Process, Benefits, Limitations; Ethics in strategic decision making, Principles of good strategy, Strategic Management in India; Common managerial strategy formulation tools.

Module 2: GLOBALIZATION (09 Periods)
Definition, Stages, Essential conditions for globalization, Globalization strategies, Competitive advantage of Nations and regions, Factors affecting Globalization, Globalization of Indian business.

Module 3: RESEARCH & DEVELOPMENT STRATEGIES (09 Periods)

Concept, Evolution of R and D Management, R and D as a business, R and D as competitive advantage, Elements of R and D strategies, Integration of R and D, Selection and implementation of R and D strategies, R and D trends and challenges.

Module 4: TECHNOLOGY MANAGEMENT AND TRANSFER (09 Periods)

Technology Management: Introduction, Technology-Definition, Components, Classification Features; Technology Management-Concept, Nature; Drivers of Management of Technology-Significance, Scope, Responding to technology challenges.

Technology Transfer: Introduction, Definition, Classification, Significance, Elements of process, Types of Technology Transfer, Package, Modes of Transfer, Routes, Channels and Effectiveness of Technology Transfer.

Module 5: CORPORATE GOVERNANCE: THE INDIAN SCENARIO (09 Periods)

Emergence of corporate governance in India-Landmarks, Models, Codes and status in India, Role and Responsibilities of Regulators, The Board of Directors; Corporate Governance- Specific issues in India, Family-owned Business, Corporate Governance and the Indian ethos.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Case studies: Using real-world examples of global businesses and their technological strategies, students can examine the challenges and opportunities presented by different markets and technologies. This can involve analyzing data, conducting market research, and making decisions based on their findings.

2. Simulation games: Students can participate in simulation games that allow them to make decisions about global strategy and technology in a virtual environment. This can help them understand the complexities of international business, such as navigating different cultures, regulations, and economic systems.

3. Industry partnerships: Partnerships with technology companies and global businesses can provide students with hands-on experience in global strategy and technology. This can include internships, shadowing, or working on real projects with industry professionals.

4. Project-based learning: Students can work on real-world projects that require them to apply their knowledge of global strategy and technology. This can include developing a business plan for a new product or service, designing a marketing campaign for a global audience, or analyzing the impact of a new technology on a specific industry.

5. Field trips: Visiting international businesses or attending technology conferences can provide students with a first-hand look at global strategy and technology in action. This can help them understand the challenges and opportunities of different markets and technologies, as well as connect with industry professionals.

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

CASE STUDIES:

1. Tesla: Can Elon Musk's electric car company succeed globally?
2. Uber: How the ride-sharing giant is expanding its global footprint.
3. Alibaba: How China's e-commerce giant is competing on the global stage.
4. Airbnb: How the home-sharing platform is disrupting the global hotel industry.
5. Netflix: How the streaming service is expanding globally and adapting to local markets.

ARTICLES:

1. "Digital Transformation: Why it Matters for Global Business" by Forbes
2. "How AI is Changing Global Business Strategy" by Harvard Business Review
3. "The Future of Globalization: Exploring the Role of Technology" by World Economic Forum
4. "Globalization 4.0: What it Means for Technology and Strategy" by McKinsey & Company
5. "How Technology is Transforming Global Supply Chains" by MIT Sloan Management Review

RESOURCES

TEXT BOOKS:

1. Francis Cherunilam, *Strategic Management*, Himalaya Publishing House, 3rdEdition, 2002.

2. C. S. G. Krishnamacharyulu and Lalitha Ramakrishnan, *Management of Technology*, Himalaya Publishing House, Second Edition, 2012.

REFERENCE BOOKS:

1. White and Bruton, *The Management of Technology and Innovation: A Strategic Approach*, Cengage Learning, 1stEdition, 2007.
2. S.K.Mandak, *Ethics in Business and Corporate Governance*, TMH, 2ndEdition, 2012.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/110106157/L01.html
2. https://www.digimat.in/nptel/courses/video/110106157/L43.html