PANDIT DEENDAYAL ENERGY UNIVERSITY

B. Tech in Biotechnology

Department of Biotechnology

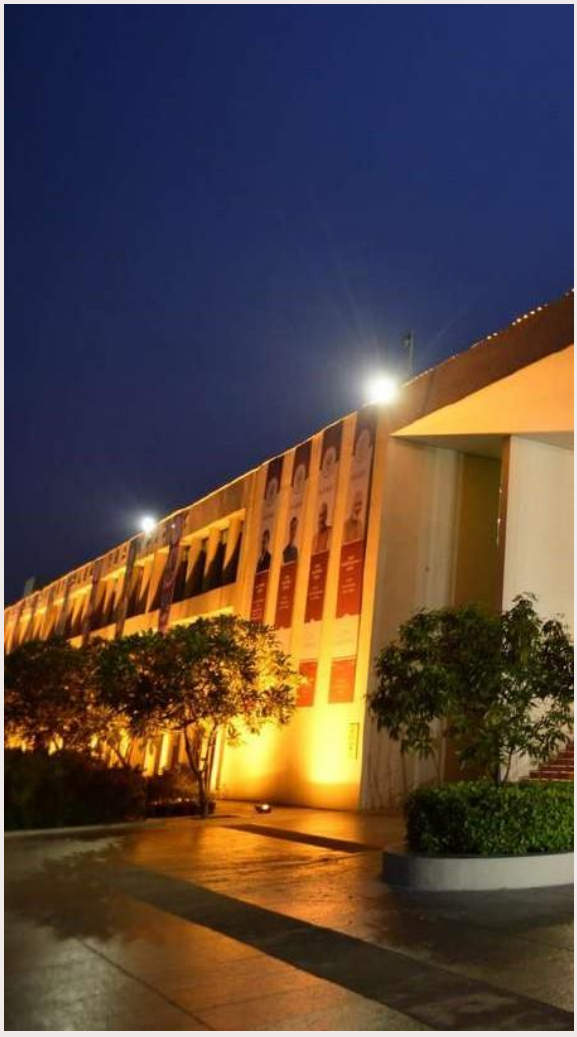
School of Energy Technology

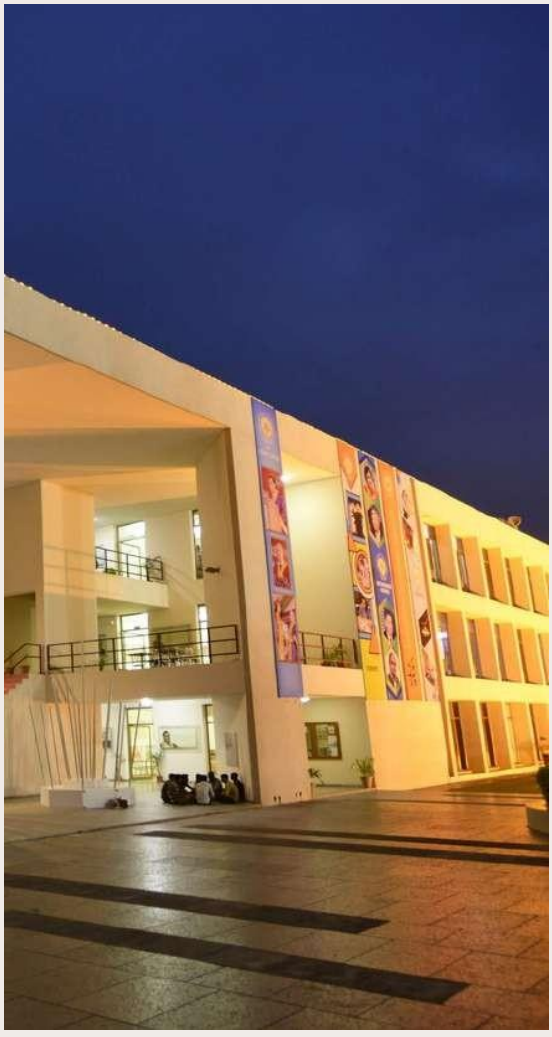
PDEU PANDIT DEENDAYAL ENERGY UNIVERSITY

Formerly Pandit Deendayal Petroleum University (PDPU)

UGC RECOGNIZED

B. TECH
BIOTECHNOLOGY





Program scope

DEPARTMENT OF BIOTECHNOLOGY

B.Tech in Biotechnology at School of Energy Technology (PDEU) will be a unique program for future ready bioengineers. This early initiative will play a significant role that was to be played by biochemical engineers and biotechnologists in future industrial development of biotechnology-related processes and products. The Department will provide a model for an integrated approach towards education as well as research and development of various bioprocesses.

During four years of graduate studies, future biotechnologist will be educated to participate in the performance, optimization, improvement and control of many biotechnological processes. The study program is aligned with programs at renowned universities in the world and in India and follows the latest trends and the state of science in the field of biotechnology. All courses and curricula are clearly distinguishable and in good correlation with similar courses in the premier institutions within India, allowing general recognition and unimpeded mobility of students. Despite the large number of elective courses, core of the study program involves Bioprocessing plant design, Bio separation Engineering, Bioinformatics & computational methods, Chemical reaction Engineering, Bio entrepreneurship and Recombinant DNA Technology.

About the Program

Present Scenario of Biotechnology Education

In the present scenario, Biotechnology is an exciting interdisciplinary area with the potential to improve people's lives significantly. Manufacturing recombinant pharmaceuticals, tissue engineering scaffolds, disease-resistant crops, marine bioproducts, regenerative therapies like stem cell and gene therapy, and many more biotechnology products hold more significant potential to improve human health and well-being.

Future of Biotechnology and the Need for competent academic curriculum

The future of biotechnology relies more on making the technology more accessible for people in real need. Hence it's become the need of the hour to architect the next-gen academic curriculum that renders the future-ready biotechnology who are professionally competent in addressing the problems as forefront soldiers. In this context, understanding the technologies and their relevant application indeed accelerates the young mind in delivering technology-based solutions.

Bridging the Gap Through skill-based academic Curriculum

Despite the academic schedule, there is a constant need for Industry demanding skills, which needs to be satisfied by the tailor-made educational program with aggressive exposure to actual industrial setup. Skill-based knowledge has become essential and mandates the future-ready biotechnologist to synergize their problem-solving capabilities.

SCOPE OF BIOTECHNOLOGY & BIOCHEMICAL ENGINEERING

Professional occupation of graduate students is recognizable in the industry and the future engineers will be trained to work in all areas of biotechnology, Pharma, Healthcare and food industries including breweries, wine, spirit and starch factories, vinegar and dairy factories, alcohol and yeast plants, factories for producing chemicals, pharmaceutical and diagnostic products, plants for water and waste treatment.

The engineers of this profile are also able to work in universities and the project offices, research and development institutes, in organizations involved in the distribution of raw materials, equipment, products, as well as in organizations for the supervision of hygiene, sanitation and food safety.

Vision & Mission

Pandit Deendayal Energy University, Gandhinagar
School of Energy Technology
Department of Biotechnology

Vision

To provide excellent education in industry-driven modules that stimulate young Biotechnologist to create knowledge wealth in order to produce employability while adhering to professional ethics and focusing on a sustainable environment and societal advantages.

Mission

- ✓ To provide state-of-the-art facilities to Biotechnology students with a focus on skill development, creativity, innovation, and strengthening leadership characteristics.
- ✓ To develop creative minds via mentoring, excellent education, and research in order to construct a value-based, sustainable society.
- ✓ To provide an inspiring atmosphere for young faculty and staff by offering a safe work environment, openness, professional ethics, and accountability, allowing them to lead the department in the appropriate spirit.
- ✓ To collaborate with academic and industry partners at the national and international levels to address societal challenges of greater importance.
- ✓ To instill a culture of continuous learning among faculty by encouraging them to participate in professional development programmes and to address social, economic, and environmental issues.

Program Objectives & Outcomes

Program Education Objectives (PEOs)

- Ability to learn the fundamental concepts of biotechnology with advanced experimental and computational techniques.
- Capacity to deal with complex problems of practical importance to society while complying with health, economical, environmental, ethical, and safety considerations.
- Demonstrate professional excellence, ethics, soft skills and leadership qualities with life-long learning's.
- Graduates will be active members ready to serve the society locally and internationally.

Programme Outcomes

Biotechnology Graduates will be able to:

1. **Knowledge**: Apply the knowledge of biology, chemistry, mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex biotechnological problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex biotechnological problems reaching substantiated conclusions using first principles of biology, mathematics, natural sciences, genetics, biotechnology and bioengineering sciences.
3. **Design/development of solutions**: Design solutions for complex industrial problems and design system components or processes that meet the specified need with appropriate considerations for public health and safety, and the cultural, societal and environmental considerations.
4. **Conduct investigations of complex problems**: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex bioengineering activities with an understanding of the limitations.

6. **The Biotechnologist and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practices.
7. **Environment and sustainability**: Understand the impact of the biotechnology based solutions in societal and environmental context, and demonstrate the knowledge of, and need for sustainable development. Ensuring healthy lives and promoting well-being at all ages is essential to sustainable development.
8. **Ethics**: Apply ethical practices and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings
10. **Communication**: Communicate effectively on complex bioengineering activities with the healthcare / engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the biotechnology and management principles and apply these to one's own work, as a member and leader in the team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning of broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. To analyse and tackle the complex and diverse biotechnological problems by appropriate experimentation, simulation, data analysis and interpretation, and, provide probable solutions by applying principles of biotechnology in combination to the fundamental knowledge of basic sciences and technology.
2. Competence to incorporate socio-economic considerations in biotechnology practices, including the concept of sustainable development.
3. An ability to work together collaboratively in multidisciplinary teams to tackle multifaceted problems and pursue a bright career in biotechnology and allied areas by demonstrating professional success at different platforms within industry, governmental bodies or academia.

Subject Layout

Pandit Deendayal Energy University, Gandhinagar
School of Energy Technology
Subject Layout B.Tech in Biotechnology

1st Year Sem I	Engineering Physics (Basic science)	Element of Civil Engineering & Mechanics (Eng Science)	Mathematics I (Basic science) NC: Bridge course Mathematics I	Environmental Studies (Humanities)	Elements of Electrical Engineering (Core Subject)	Engineering Graphics (Eng Science)	Element of Civil Engineering & Mechanics - Lab	Elements of Electrical Engineering - Lab	Engineering Physics Lab	Communication Skills – I NCC/NSS/Sports (Humanities)	Engineering Graphics Lab	Computer Programming II (Eng Science)
1st Year Sem II	Engineering Chemistry (Eng Science)	Computer Programming - I (Eng Science)	Mathematics II (Basic science) NC: Bridge course Mathematics II	Element of Mechanical Engineering (Eng Science)	Basic Electronics (Eng Science)	Professional Ethics and Human Values (Humanities)	Computer Programming - I Lab	Engineering Chemistry Lab	Element of Mechanical Engineering-Lab	Basic Electronics Lab	NCC/NSS/ Sports (Humanities)	Civic services and Social Internship (Summer Break)
2nd Year Sem III	Electromagnetism and Quantum Mechanics (Prog Core)	Fluid Mechanics for Chemical Engineers (Prog Core)	Principles of Biochemistry (Prog Core)	Fundamental of Human Anatomy and physiology (Prog Core)	General Microbiology (Prog Core)	Biochemistry – Lab	Fluid Mechanics Lab	Open Elective I (Elective)	Communication Skills - II (Humanities)	NC: Bridge course- Fundamental of Life science		
2nd Year Sem IV	Heat transfer for Chemical engineering (Prog Core)	Chemical reaction for Engineering (Prog Core)	Industry 4.0 (Industry curriculum)	Tissue Engineering & Regenerative Medicine (Prog Core)	Pharmaceutical Technologies (Prog Core)	Analytical methods in bioengineering (Prog Core)	General Microbiology Lab	Pharmaceutical Technologies Lab	Industry 4.0 Lab	Chemical Reaction Engineering I Lab	Open Elective II (Elective)	Industrial Orientation (3 weeks (Industry curriculum)
3rd Year Sem V	Process Dynamics and Control (Prog Core)	Biomaterial & Implants (Prog Core)	Genomics & Proteomics (Prog Core)	Pharmacology of Drug action I (Prog Core)	Immunology (Prog Core)	Chemical reaction for Engineering II (Prog Core)	Biomaterial & Implants Lab	1.Biomass conversion & utilisation 2.Biological waste treatment (Elective)	Open Elective - III (Elective)	Communication Skills - III (Elective)	Chemical Reaction Engineering II Lab	
3rd Year Sem VI	Enzyme Science and Engineering (Prog Core)	Bioinformatics & computational methods (Prog Core)	Molecular biology and Genetics (Core Subject)	Pharmacology of Drug action II (Core Subject)	Bioinformatics & computational methods Lab (Core Subject)	1. Publication Ethics 2. Bioentrepreneurship (Elective)	Pharmacokinetics & Pharmacodynamics (Elective)	Next Generation Sequence Analysis (Elective)	Novel Separation Processes/ Dyes and Pigments) (Elective)	Industrial Training/ IEP (6 weeks-summer break)		
Final Year Sem VII	Recombinant DNA Technology (Prog Core)	Bioprocessing plant design (Prog Core)	Nanotechnology (Prog Core)	Nanotechnology Lab	1.IPR values 2.Biomedical Engineering (Elective)	1.Catalysis and Surface Sciences 2.Computer Aided Process Design (Elective)	Mini Project					
Final Year Sem VIII	Project Internship with Industry											

Eng.Sci- Engineering Science | Prog. Core – Program core| Open Elective: Will be chosen from the electives offered from other disciplines| NC- Non-credit

Semester wise Credit Mapping

Department of Biotechnology
B.Tech in Biotechnology
Semester wise Credit Mapping: Year 1 (Semester 1 and 2)

Sr. No.	Semester	Category	Code	Course Name	L	T	P	C	Hrs/W
1	1	BSC	20SC102	Engineering Physics	3	0	0	3	3
2		ESC	20CE101T	Element of Civil Engineering & (Solid) Mechanics	4	0	0	4	4
3		BSC	20MA101T	Mathematics I	3	1	0	0	4
4		NC	-	Bridging- Mathematics- I	3	1	0	0	4
5		HSC	20HS102T	Environmental Studies	3	0	0	3	3
6		ESC	20EE101T	Elements of Electrical Engineering	3	0	0	3	3
7		ESC	20ME101P	Engineering Graphics	1	0	0	1	1
8		ESC	20CE101P	Element of Civil Engineering & Mechanics - Lab	0	0	0	1	2
9		ESC	20EE101P	Elements of Electrical Engineering - Lab	0	0	2	1	2
10		BSC	20SC102P	Engineering Physics Lab	0	0	2	1	2
11		HSC	20HS101P	Communication Skills – I NCC/NSS/Sports	3	0	2	1	2
12		ESC	20ME101P	Engineering Graphics Lab	3	0	0	2	3
13		ESC		Computer Programming II	3	0	0	3	3
14	2	BSC	20CH101T	Engineering Chemistry	3	0	0	3	3
15		ESC	20CP101T	Computer Programming - I	1	0	0	1	1
16		BSC	20MA103T	Mathematics II	3	1	0	4	4
17		NC	-	Bridging- Mathematics- II	3	1	0	0	4
18		NC	-	Bridging Biology- Fundamentals of Life Sciences	3	0	0	0	3
19		ESC	20ME102T	Element of Mechanical Engineering	3	0	0	3	3
20		ESC	20IC101T	Basic Electronics	2	0	0	2	2
21		HSC	16HS109T	Professional Ethics and Human Values	1	0	0	1	1
22		ESC	20CP101P	Computer Programming - I Lab	0	0	2	1	2
23		BSC	20CH101P	Engineering Chemistry Lab	0	0	2	1	2
24		ESC	20ME102P	Element of Mechanical Engineering-Lab	0	0	2	1	2
25		ESC	20IC101P	Basic Electronics Lab	0	0	2	1	2
26		HSC	16SP101/102/103	NCC/NSS/Sports	0	0	2	1	2
27		HSC	16TP110	Civic services and Social Internship (Summer Break)	0	0	0	1	0

Semester wise Credit Mapping: Year 2 (Semester 3 and 4)

Sr. No.	Semester	Category	Code	Course Name	L	T	P	C	Hrs/W
28	3	PC		Electromagnetism and Quantum Mechanics	2	1	0	2	3
29		PC	20CH201T	Fluid Mechanics for Chemical Engineers	3	0	0	3	3
30		PC	16BSC203E	Principles of Biochemistry	3	0	0	3	3
31		PC		Fundamental of Human Anatomy and physiology	3	0	0	3	3
32		PC		General Microbiology	3	0	0	3	3
33		PC Lab		Biochemistry –Lab	0	0	2	1	2
34		PC Lab		Fluid Mechanics Lab	0	0	2	1	2
35		OE		Open Elective I	2	0	0	2	2
36		HSC		Communication Skills - II	2	0	0	2	2
37	4	PC	20CH209T	Heat transfer for Chemical engineering	3	0	0	3	3
38		PC		Chemical reaction for Engineering I	3	0	0	3	3
39		IND	20IF201T	Industry 4.0	2	0	0	2	2
40		PC		Tissue Engineering & Regenerative Medicine	3	0	0	3	3
41		PC	20CH315T	Pharmaceutical Technologies	3	0	0	3	3
42		PC		Analytical methods in bioengineering	3	0	0	3	3
43		PC Lab		General Microbiology Lab	0	0	2	1	2
44		PC Lab		Chemical Reaction Engineering I Lab	0	0	2	1	2
45		PC Lab		Pharmaceutical Technologies Lab	0	0	2	1	2
46		IND	20IF201P	Industry 4.0 Lab	0	0	2	1	2
47		OE		Open Elective II	2	0	2	1	2
48		Project	TP210	Industrial Orientation (3 weeks-summer break)	0	0	4	2	2

Semester wise Credit Mapping: Year 3 (Semester 5 and 6)

Sr. No.	Semester	Category	Code	Course Name	L	T	P	C	Hrs/W
49	5	PC		Process Dynamics and control	3	0	0	3	3
50		PC		Biomaterial & Implants	3	0	0	3	3
51		PC		Genomics & Proteomics	3	0	0	3	3
52		PC		Pharmacology of Drug action - I	3	0	0	3	3
53		PC		Immunology	3	0	0	3	3
54		PC		Chemical reaction for Engineering II	3	0	0	3	3
55		PC Lab		Biomaterial & Implants lab	0	0	2	1	2
56		PC Lab		Chemical Reaction Engineering II Lab	0	0	2	1	2
57		CE		Biomass conversion & utilisation	2	0	0	2	2
58		CE		Biological waste treatment	2	0	0	2	2
59		OE		Open Elective - II	0	0	0	2	2
60		HSC		Communication Skills - III	2	0	0	2	2
61	6	PC		Enzyme Science and Engineering	3	0	0	3	3
62		PC		Bioinformatics & computational methods	3	0	0	3	3
63		PC		Molecular biology and Genetics	3	0	0	3	3
64		PC		Pharmacology of Drug action - II	3	0	0	3	3
65		PC Lab		Bioinformatics & computational methods Lab	0	0	2	1	2
66		CE		Publication Ethics Bioentreprenuership	2	0	0	2	2
67		CE		Pharmacokinetics & Pharmacodynamics	2	0	0	2	2
68		CE		Next Generation Sequence Analysis	2	0	0	2	2
69		CE		Novel Separation Processes/ Dyes and Pigments)	2	0	0	2	2
70		Project		Industrial Training/ IEP (6 weeks-summer break)	0	3	6	6	9

Semester wise Credit Mapping: Year 4 (Semester 7 and 8)

Sr. No.	Semester	Category	Code	Course Name	L	T	P	C	Hrs/W
71	7	PC		Recombinant DNA Technology	3	0	0	3	3
72		PC		Bioprocessing plant design	3	0	0	3	3
73		PC		Nanotechnology	3	0	0	3	3
74		PC Lab		Nanotechnology Lab	0	0	2	1	2
75		CE		IPR values Biomedical Engineering	2	0	0	1	2
76		CE		Catalysis and Surface Sciences/Computer Aided Process Design	2	0	0	1	2
77		Project		Mini Project	0	0	6	3	6
78	8	Project		Major Project Internship with Industry	0	0	12	5	12
79		Project		Majo Project Defense and Viva	0	0	8	1	8
80		Project		Grand Viva	0	0	8	2	8

Total Credit of all Eight Semester will be 165

Sr No	Code	Component
1	HSC	Humanities & Social Science Including Management Courses
2	BSC	Basic Science Courses
3	ESC	Engineering Science Courses including Workshop, drawing, Basic of Electrical, Basic of Mechanical, Computer etc…
4	IND	Industry 4.0 Course
5	PC	Professional Core Courses
6	CE	Professional Elective Courses related to chosen specialization
7	OE	Open Elective Subjects from Other technical / emerging subjects
8	Project	Project work, Seminar or Internship in Industry or elsewhere

9	NC	Non-Credit course

Year 1- Examination Scheme

Sr. No.	Sem	Category	Code	Course Name	C	MS	IA	ES	LW	LE/Viva	Marks
1	1	BSC	20SC102	Engineering Physics	3	25	25	50	-	-	100
2		ESC	20CE101T	Element of Civil Engineering & (Solid) Mechanics	4	25	25	50	-	-	100
3		BSC	20MA101T	Mathematics I	0	25	25	50	-	-	100
4		NC	-	Bridging- Mathematics- I	0	25	25	50	-	-	100
5		HSC	20HS102T	Environmental Studies	3	25	25	50	-	-	100
6		ESC	20EE101T	Elements of Electrical Engineering	3	25	25	50	-	-	100
7		ESC	20ME101P	Engineering Graphics	1	25	25	50	-	-	100
8		ESC	20CE101P	Element of Civil Engineering & Mechanics - Lab	1	--	--	--	50	50	100
9		ESC	20EE101P	Elements of Electrical Engineering - Lab	1	--	--	--	50	50	100
10		BSC	20SC102P	Engineering Physics Lab	1	-	-	-	50	50	100
11		HSC	20HS101P	Communication Skills – I NCC/NSS/Sports	1	-	-	-	50	50	100
12		ESC	20ME101P	Engineering Graphics Lab	2	--	--	--	50	50	100
13		ESC		Computer Programming II	3	25	25	50	-	-	100
14	2	BSC	20CH101T	Engineering Chemistry	3	25	25	50	-	-	100
15		ESC	20CP101T	Computer Programming - I	1	25	25	50	-	-	100
16		BSC	20MA103T	Mathematics II	4	25	25	50	-	-	100
17		NC	-	Bridging- Mathematics- II	0	25	25	50	-	-	100
18		NC	-	Bridging Biology- Fundamentals of Life Sciences	0	25	25	50	-	-	100
19		ESC	20ME102T	Element of Mechanical Engineering	3	25	25	50	-	-	100
20		ESC	20IC101T	Basic Electronics	2	25	25	50	-	-	100
21		HSC	16HS109T	Professional Ethics and Human Values	1	25	25	50	-	-	100
22		ESC	20CP101P	Computer Programming - I Lab	1	--	--	--	50	50	100

23		BSC	20CH101P	Engineering Chemistry Lab	1	-	-	-	50	50	100
24		ESC	20ME102P	Element of Mechanical Engineering-Lab	1	--	--	--	50	50	100
25		ESC	20IC101P	Basic Electronics Lab	1	--	--	--	50	50	100
26		HSC	16SP101/102/103	NCC/NSS/Sports	1	-	-	-	-	100	100
27		HSC	16TP110	Civic services and Social Internship (Summer Break)	1	-	-	-	-	100	100

Year 2- Examination Scheme

Sr. No.	Semester	Category	Code	Course Name	C	MS	IA	ES	LW	LE/Viva	Marks
28	3	PC		Electromagnetism and Quantum Mechanics	2	25	25	50	-	-	100
29		PC	20CH201T	Fluid Mechanics for Chemical Engineers	3	25	25	50	-	-	100
30		PC	16BSC203E	Principles of Biochemistry	3	25	25	50	-	-	100
31		PC		Fundamental of Human Anatomy and physiology	3	25	25	50	-	-	100
32		PC		General Microbiology	3	25	25	50	-	-	100
33		PC Lab		Biochemistry –Lab	1	-	-	-	50	50	100
34		PC Lab		Fluid Mechanics Lab	1	-	-	-	50	50	100
35		OE		Open Elective I	2	25	25	50	-	-	100
36		HSC		Communication Skills - II	2	-	-	-	50	50	100
37	4	PC	20CH209T	Heat transfer for Chemical engineering	3	25	25	50	-	-	100
38		PC		Chemical reaction for Engineering I	3	25	25	50	-	-	100
39		IND	20IF201T	Industry 4.0	2	25	25	50	--	--	100
40		PC		Tissue Engineering & Regenerative Medicine	3	25	25	50	-	-	100
41		PC	20CH315T	Pharmaceutical Technologies	3	25	25	50	-	-	100
42		PC		Analytical methods in bioengineering	3	25	25	50	-	-	100

43		PC Lab		General Microbiology Lab	1	-	-	-	50	50	100
44		PC Lab		Chemical Reaction Engineering I Lab	1	-	-	-	50	50	100
45		PC Lab		Pharmaceutical Technologies Lab	1	-	-	-	50	50	100
46		IND	20IF201P	Industry 4.0 Lab	1	--	--	--	50	50	100
47		OE		Open Elective II	1	25	25	50	-	-	100
48		Project	TP210	Industrial Orientation (3 weeks-summer break)	2	-	-	-	-	100	100

Year 3- Examination Scheme

Sr. No.	Semester	Category	Code	Course Name	C	MS	IA	ES	LW	LE/Viva	Marks
49	5	PC		Process Dynamics and control	3	25	25	50	-	-	100
50		PC		Biomaterial & Implants	3	25	25	50	-	-	100
51		PC		Genomics & Proteomics	3	25	25	50	-	-	100
52		PC		Pharmacology of Drug action - I	3	25	25	50	-	-	100
53		PC		Immunology	3	25	25	50	-	-	100
54		PC		Chemical reaction for Engineering II	3	25	25	50	-	-	100
55		PC Lab		Biomaterial & Implants lab	1	-	-	-	50	50	100
56		PC Lab		Chemical Reaction Engineering II Lab	1	-	-	-	50	50	100
57		CE		Biomass conversion & utilisation	2	25	25	50	-	-	100
58		CE		Biological waste treatment	2	25	25	50	-	-	100
59		OE		Open Elective - II	2	25	25	50	-	-	100
60		HSC		Communication Skills - III	2	-	-	-	50	50	100
61	6	PC		Enzyme Science and Engineering	3	25	25	50	-	-	100
62		PC		Bioinformatics & computational methods	3	25	25	50	-	-	100
63		PC		Molecular biology and Genetics	3	25	25	50	-	-	100
64		PC		Pharmacology of Drug action - II	3	25	25	50	-	-	100

65		PC Lab		Bioinformatics & computational methods Lab	1	-	-	-	50	50	100
66		CE		Publication Ethics Bioentreprenuership	2	25	25	50	-	-	100
67		CE		Pharmacokinetics & Pharmacodynamics	2	25	25	50	-	-	100
68		CE		Next Generation Sequence Analysis	2	25	25	50	-	-	100
69		CE		Novel Separation Processes/ Dyes and Pigments)	2	25	25	50	-	-	100
70		Project		Industrial Training/ IEP (6 weeks-summer break)	6	-	-	-	-	100	100

Year 4- Examination Scheme

Sr. No.	Semester	Category	Code	Course Name	C	MS	IA	ES	LW	LE/Viva	Marks
71	7	PC		Recombinant DNA Technology	3	25	25	50	-	-	100
72		PC		Bioprocessing plant design	3	25	25	50	-	-	100
73		PC		Nanotechnology	3	25	25	50	-	-	100
74		PC Lab		Nanotechnology Lab	1	-	-	-	50	50	100
75		CE		IPR values Biomedical Engineering	1	25	25	50	-	-	100
76		CE		Catalysis and Surface Sciences/Computer Aided Process Design	1	25	25	50	-	-	100
77		Project		Mini Project	3						
78	8	Project		Major Project Internship with Industry	5				50	50	100
79		Project		Majo Project Defense and Viva	1						
80		Project		Grand Viva	2						

Semester-wise Detailed Syllabus

Semester – 1

20SC102					Engineering Physics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand basic concepts of quantum mechanics and solve the Schrödinger equation for various cases.
- To understand basics concepts of electric and magnetic properties of solids.
- To develop the fundamental understanding of optoelectronic devices.
- To understand the heat transfer mechanism in solids and fluids.

UNIT 1 Introduction to Quantum Mechanics **12 Hrs.**

Inadequacies in Classical Physics, Wave Nature of Matter, Heisenberg's Uncertainty Principle and its applications, zero point energy, Basic Postulates and Formalism of QM: Energy, Momentum and Hamiltonian Operators. Time-independent Schrodinger Wave Equation for Stationary States. Properties and interpretation of Wave Function. Probability Density and Probability. Conditions for Physical Acceptability of Wave Functions, Application of time-independent Schrödinger equation for various potentials.

UNIT 2 Electronic theory of Solids **10 Hrs.**

Elements of crystallography; lattice vibrations of solids; Bloch Theorem and Origin of energy bands, band structure of conductors, type of semiconductors, Free Electron Theory of metals, Wiede-mann Franz Law, Kronig-Penny model, Hall effect. Magnetism and its origin, magnetization and susceptibility, dia-para-ferro-magnetism. Ferromagnetism, Nano magnets and magneto resistance, hard disk drive storage technology. Phenomenology of Superconductors, Meissner effect, BCS theory - high temperature superconductors.

UNIT 3 OPTICS, LASER AND OPTO-ELECTRONICS **08 Hrs.**

Optics: Introduction, division of amplitude, thin film interference, Applications of interference, Laser: The Einstein coefficients, Spontaneous and stimulated emission, Optical amplification and population inversion, meta stable state, optical resonator, the principle of pumping scheme, laser beam characteristics. Types of LASER, Injection Laser Diode (ILD). Quantum Cascade Laser, Comparison between ILD and QCL. Applications of lasers.

UNIT 4 THERMAL PHYSICS **10 Hrs.**

Laws of thermodynamics-basic concepts, closed and open systems-first law. Heat transfer-thermal expansion of solids and liquids – Conduction in solids – thermal conductivity- Forbe's method, Lees' disc method, conduction through compound media, formation of ice on ponds, thermal insulation and its applications. Thermal Convection - properties of radiant heat, sea and land breeze. Thermal Radiation – emission and absorption radiation, emissive power, black body radiation – Kirchoff's, Stefan's laws, wien's law, Newton's law of cooling.

Max. 40 Hrs.

COURSE OUTCOMES

CO1 – identify and understand the experimental results which require conceptualization of quantum theory.
CO2 – Interpret the solution of Schrödinger equation to obtain physical information about the system.
CO3 - Identify basic concepts in semiconductors, superconductors and magnetism and apply it in engineering applications.
CO4 - To understand concepts of optical interference and LASER, analyse the lasing characteristics to apply in different laser diodes and other applications
CO5 - To understand concepts of thermal physics in terms of laws and modes of heat transfer.
CO6 - To apply knowledge of concepts of engineering physics to solve real world problems.

TEXT/REFERENCE BOOKS

1. N. Zettili, Quantum Mechanics: Concepts and applications, Willey Publications
2. Kittel, Charles. Introduction to Solid State Physics. John Wiley and Sons.
3. W.D. Callister and David Rethwisch, Materials Science & Engineering -An Introduction, 9th edn.,
4. Heat and Thermodynamics BrijLal, N. Subrahmanyam, S. Chand, Limited, 2001.
5. Optics by Ajay Ghatak, Tata macgraw hill publishing.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks	36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 Marks

20CE101T					Element of Civil Engineering and Solid Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	-	-	4	4	25	50	25	--	--	100

COURSE OBJECTIVES.

- To introduce and explain the basics scope of engineering.
- To understand different types of force systems and apply them to practical engineering application.
- To develop understanding of the basic concepts related to tensile, compressive and shear stresses in engineering components.
- To discuss the basic principles of torsion in shafts, shear force and bending moment in beams, Deflection in springs, Columns and Struts.

UNIT 1 INTRODUCTION TO CIVIL ENGINEERING & MECHANICS **14 Hrs.**

Basics and scope of Civil Engineering- Introduction to Civil Engineering- Branches of Civil Engineering- Application of Civil Engineering in other domain different types residential of buildings- green building and smart building. Introduction to Engineering Mechanics- Resolution of forces- Varignon's – couples- Lami's theorem-Centroid and Moment of Inertia- Determination of moment of inertia of simple planar laminas like rectangle- triangle- quarter-semi-circle and circle. Theorems of perpendicular and parallel axis-polar moment of inertia- radius of gyration.

UNIT 2. SIMPLE AND COMPOUND STRESSES AND STRAIN **14 Hrs.**

Introduction to stresses and strain – Stress-strain diagram- Elastic constants -relationship between elastic constants and Poisson's ratio – Generalised Hook's law – Strain energy -Deformation of simple and compound bars thermal stresses. Biaxial state of stress – Stress at a point -stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress, Theories of failure

UNIT 3 SFD- BMD AND STRESSES IN BEAM **12 Hrs.**

Types of beams- Cantilever, Simply supported, Overhanging: Shear Force and Bending Moment Diagrams Theory of simple bending – bending stress and shear stress in beams. Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams -Conjugate beam method.

UNIT 4 TORSION AND COLUMNS **12 Hrs.**

Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Stepped shafts – shafts fixed at the both ends – Stresses in helical springs. Theory of columns – Long column and short column – Euler's formula – Rankine's formula - Secant formula - beam column.

Total 52 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 -Describe the basics and scope of civil engineering, role of civil engineer and sub branches of civil engineering.

CO2 -Compute the stress and strain developed due to applied load in any structural member and solve the principal stress & strain at a point of stressed member.

CO3 -Calculate the sheer force & bending moment diagram under various loading & support condition.

CO4 - Analyze bending and shear stresses in the different layers of the beam for various loadings.

CO5 - Determine the torsion equation & pure torsion

CO6 - Explain the loaded structural members for deflection.

TEXT/REFERENCE BOOKS

1. N.H Dubey, Engineering Mechanics-Statics and Dynamics, Tata McGraw Hill Private limited
2. R. S. Khurmi, Engineering Mechanics, S. Chand Publication
3. S.S. Bhavikatti Elements of Civil Engineering (IV Edition) , Vikas Publishing House Pvt. Ltd., New Delhi.
4. Ferdinand P Beer and E Russel Johnson , Mechanics for Engineers (Statics & Dynamics) McGraw Hill book company, New York

END SEMESTER EXAMINATION QUESTION PATTERN

Max. Marks: 100 Exam Duration 3 Hrs.

Part A: 4 Question from unit-1 – 5 Marks Each 20 Marks

Part B: 8 Numerical Questions from unit 2 to unit 4 – 10 Marks Each 80 Marks

20MA101T					MATHEMATICS-I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	3	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to evaluate problems related to differential and integral calculus of complex functions.
- To be able to obtain area, volume using integral calculus.
- To be able to formulate and solve various engineering problems using the calculus.
- To study the properties of Matrix algebra and apply them to solve system of algebraic equations.

UNIT 1 DIFFERENTIAL CALCULUS AND ITS APPLICATIONS **08 Hrs.**

Partial derivative and its application, - Euler's theorem - Total derivatives - Jacobians – Maxima and Minima of two variables using Lagrange's multipliers. Convergence of infinite series.

UNIT 2 INTEGRAL CALCULUS AND ITS APPLICATIONS **12 Hrs.**

Definition Evaluation of double integral (Cartesian – Polar form) – Change of orders - Change of variables – Evaluation of triple integral, change of variables (Cartesian to spherical – and cylindrical) – Applications, area – volume – center of mass – center of gravity by double and triple integral.

UNIT 3 MATRIX ALGEBRA AND ITS APPLICATIONS **10 Hrs.**

Solution of system of algebraic equation - Rank of a matrix, consistency of system of equation - Characteristic equation of a square matrix- Eigen values and Eigenvectors of a real matrix - Properties of eigen values and eigen vectors - Cayley-Hamilton theorem (without proof) - finding inverse of a matrix - Diagonalisation of a matrix using orthogonal transformation.

UNIT 4 VECTOR CALCULUS **10 Hrs.**

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector Integration – Simple problems on line, surface and volume integrals – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (without proofs) – Simple application involving cubes and rectangular parallelopipeds.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of convergence of infinite series in engineering aspects.
CO2 – Understand the concept of Directional derivative, Irrotational and Solenoidal vector fields.
CO3 – Develop the ability to apply appropriate tool/method to extract the solutions of engineering problems.
CO4 – Analyze the obtained solution in context with theory.
CO5 – Appraise mathematical problems from real to complex domain.
CO6 – Evaluate problems on Green's, Stoke's and Divergence theorems.

TEXT/REFERENCE BOOKS

1. B. S Grewal, Higher Engineering Mathematics, (43rd Edition), Khanna Pub., Delhi (2014).
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science, 3rd Ed., 2007.
3. Erwin Kreyszig, Advanced Engineering mathematics, John Wiley, 10th Ed., 2015.
4. G. Strang, Linear Algebra and its applications, 4th Edition, Cengage Learning, 2005.
5. K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 10 questions 3 marks each	30 Marks (40 min)
Part B: 5 questions 6 marks each	30 Marks (50 min)
Part C: 5 questions 8 marks each	40 Marks (90 min)

20HS102T					ENVIRONMENTAL STUDIES					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide the basic understanding of various structural and functional aspects of environmental science and their role in life sustenance
- To identify and analyze different environmental pollution problems, as well as the risks associated with them

UNIT 1 – BIRD'S EYE VIEW TO ENVIRONMENT **10 Hrs.**

Environmental Studies –Its importance and Multidisciplinary nature, Ecosystem and its various types, factors affecting the functioning of an ecosystem, Biodiversity –its importance, threats and conservation, Natural Resources Forest, Water, Mineral, Energy, Food, Review of State of India's Environment.

UNIT 2 – MULTI-SCALE ENVIRONMENTAL POLLUTION (GLOBAL, REGIONAL AND LOCAL) **12 Hrs.**

Concept of Clean Environment, Introduction to various environmental standards air, water, soil, noise, heat, Causes and Effects ofAir Pollution, Water Pollution, Soil Pollution, Solid Waste (organic and Inorganic) Pollution, Hazardous Waste Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Radioactive Pollution, Pollution across Indian cities case studies, Introduction to man–made disasters like floods, heat waves, landslides, etc.

UNIT 3 – ENVIRONMENTAL POLLUTION CONTROL STRATEGIES **10 Hrs.**

Case studies of Pollution control strategies, Review of the Central and State Government's policies and mechanisms for managing various natural resources and controlling the various types of pollutions (including Swacch Bharat Abhiyan), Global Initiatives for environmental management,

UNIT 4 – SOCIAL ISSUES AND THE ENVIRONMENT **8 Hrs.**

Concept of sustainability and Sustainable Development, Environmental Sustainability Index, Environmental Ethics, Public awareness and people's participation, Consumerism and Waste products, Introduction to Carbon Footprint & Water Footprint, Green Buildings and Green Business

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Outline the importance of Ecosystem, Biodiversity and the conservation of natural resources CO2 – Understand the consequences and impact of multi scale environmental pollution
CO3 – Implement the various Pollution controlling strategies across all the frontiers of environment effectively
CO4 – Illustrate an integrative approach to deal with environmental issues with a focus on sustainable development
CO5 – Review the various Global initiatives for environmental management
CO6 – Facilitate the critical thinking skills for environmental Protection

TEXT/REFERENCE BOOKS

1. Bharucha Erach, Textbook for Environmental Studies, UGC New Delhi
2. Principles of Environmental Science, Cunningham W.P. and Cunningham M.A. (2002), Tata McGraw–Hill

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <60> Marks
Part B/Question: <Details> <40> Marks

20EE101T					Elements of Electrical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To impart knowledge on DC and AC circuits.
- To learn construction, working principles and characteristics of transformer and induction machines.
- To introduce students to various means for electrical safety and protection of electrical installations.
- To impart knowledge on electric wiring and illumination for domestic and industrial applications.

UNIT 1 DC CIRCUITS **10 Hrs.**

Electrical circuit elements (R, L and C), voltage and current sources, dependent and independent sources, Ohms Law, temperature co-efficient of resistance, Kirchhoff current and voltage laws, voltage and current divider circuit, Thevenin and Norton Theorems and their equivalents, maximum power transfer and superposition theorems, nodal and mesh analysis, star-delta transformation, Time domain analysis/natural response of first order RL and RC Circuit

UNIT 2 AC CIRCUITS **10 Hrs.**

Generation of AC voltage, representation of sinusoidal waveforms, rms values of different sinusoidal waveforms, Rectangular and Polar representation of phasor, Sinusoid representation in time and frequency domain. of Analysis of single-phase ac series circuits consisting of R, L, C, RL, RC, RLC combinations, instantaneous, average power and reactive power, complex power and power factor. AC parallel circuit and its solution in admittance form, resonance in AC series circuit and parallel circuit. Polyphase circuits, star and delta representation of polyphase circuit, power measurement in polyphase circuit

UNIT 3 TRANSFORMERS AND INDUCTION MACHINES **10 Hrs.**

Magnetic material and its B-H characteristic, Faraday's Law of Electromagnetic Induction **Transformers:** ideal transformer, emf equation for transformer, working of practical transformer on no-load and load **Induction Machine:** Types of induction motor, production of rotating magnetic field from 3-phase supply, operation of three phase induction motor, starting and running torque, Torque-slip characteristics of induction motor, Power Stages in IM

UNIT 4 ELECTRICAL INSTALLATION, SAFETY AND PROTECTION **10 Hrs.**

Fuse, MCB, ELCB, MCCB, underground cables. Domestic and Industrial Wiring. Types of lamps, illumination schemes and lumen requirement for domestic and industrial applications, Earthing and it schemes. Electrical safety rules, electric shock and first aid, energy conservation methods, elementary calculation of energy consumptions, tariffs

Max Hrs: 40

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Analyze electrical circuits using network theorems.
CO2 – Compare the behavior of R, L and C and their combinations in AC circuits.
CO3 – Analyze balanced polyphase systems in star and delta configuration
CO4 – Understand the construction, working and basic characteristics of transformer and induction machines
CO5 – Recognize the importance of protective devices and electrical safety measures
CO6 – Carry out domestic and industrial electrification

TEXT/REFERENCE BOOKS

1. J. Bird, "Electrical Circuit Theory and Technology", Routledge, Tailor and Francis Group, Sixth Edition, 2017.
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. B. L. Theraja, "Electrical Technology", Vol. 1, S. Chand Publication, New Delhi
4. Surjit Singh, "Electrical Estimating and Costing", Dhanpat Rai and Co.

END SEMESTER EXAMINATION QUESTION PATTERN

Max. Marks: 100 **Exam Duration 3 Hrs.**

Part A: 4 Question from unit-1 – 5 Marks Each 20 Marks
Part B: 8 Numerical Questions from unit-2 to unit-4 – 10 Marks Each 80 Marks

Teaching Scheme					Engineering Graphics					
					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	-	-	100

COURSE OBJECTIVES

- To learn fundamental of engineering drawing and standards used in drawing
- To enable the students with various concepts of projections and standards related to technical drawings.
- To demonstrate and communicate ideas using orthographic (2D) & isometric projection (3D) methods
- To help students to use CAD software to solve engineering problems

UNIT 1 **10 Hrs.**

Introduction to Engineering Graphics – Importance and applications, drawing instruments & accessories, lettering, types of lines, dimensioning methods, basic geometric drawing.
Computer Aided Engineering Drawing: Introduction to CAD, use of softwares in drawing, CAD software user interface, commands, menus and toolbars.

UNIT 2 **14 Hrs.**

Orthographic Projection – Introduction to projection, types of projection, 1st angle and 3rd angle projection, 2D sketch, sketch entities and tools – origin, points, lines, arcs, polygons, fillets and chamfer, trim, extend and offset, projections from pictorial view, orientation of views, sections and sectional views.

UNIT 3 **14 Hrs.**

Isometric Projection - Construction of isometric views from orthographic projections, approach to modelling, moving from 2D to 3D, creating 3D models using CAD features, assembly of components and exploded views.
Projection of Solids - Classification of solids, projections of solids like cylinder, cone, pyramid and prism with its inclination to reference plane, concept of development of lateral surfaces, intersection of solids.

UNIT 4 **14 Hrs.**

Drafting – Drafting standards, drawing views, alignment of drawing views, dimensions and tolerances, symbols, comments and annotations, computer aided drafting, drawing sheet and title block.
Tolerance - Introduction to limits, fits and tolerances, standardized representation of threads, fasteners, welds, bearings and springs, dimensional and geometric tolerances, surface finish symbols.

Total 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamentals of engineering graphics and remember the basic rules of dimensioning and labelling.
CO2 - Develop the ability to learn fundamental of CAD software and its use to solve engineering problems.
CO3 - Comprehend the concept of projection and use it to represent the views on reference planes.
CO4 - Apply the technical communication skill for 3-dimensional geometries in the form of 3D models using isometric projection.
CO5 - Analyze the orientation of geometrical bodies with respect to reference planes and evaluate the intricate details of solid using sectioning and development of lateral surfaces.
CO6 - Create drawing sheet by organizing drawing views and applying necessary dimensions and tolerances.

TEXT/REFERENCE BOOKS

1. R Hanifan, “Perfecting Engineering and Technical Drawing”, Springer International Publishing Switzerland
2. Bethune, J. D., “Engineering Design and Graphics with SolidWorks 2019, 1st edition”, Macromedia Press
3. K Morling, “Geometric and Engineering Drawing”, Elseveir Insights
4. DM Kulkarni, “Engineering Graphics with AutoCAD”, Easter Economy Edition
5. Agrawal, B. & Agrawal C. M., “Engineering Drawing”, Tata McGraw Hill Publishers
6. P.J. Shah, “Engineering Graphics”, S. Chand Publishing

20CE101P					Element of Civil Engineering and Solid Mechanics Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	0	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To conduct standard tests on construction steel under static load.
- To conduct standard tests on metals under impact load
- To conduct standard tests of flexure and compression on wooden items.
- To conduct standard tests of crushing, impact and abrasion on bricks and tiles.

LIST OF EXPERIMENTS

1. Tension test on mild steel
2. Compression test of ms bar/cost iron
3. Bending test on wooden beam / Steel bars
4. Shear test on steel bar
5. Hardness test
6. Charpy impact test
7. Izod impact test
8. Compression test of on bricks
9. Flexural test on clay roof tiles

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Define the standard tests of mild steel under tension, compression & shear.
CO2 – Compute and use the Charpy impact testing machine to evaluate the performance of metal under impact load.
CO3 – Compute Rockwell hardness testing machine to determine the hardness of metals
CO4 – Illustrate modulus of rupture of timber and steel bar.
CO5 – Determine the compressive and bending strength of clay items.
CO6 – Explain the crushing, impact and abrasion values of bricks.

REFERENCES:

7. S. B. Junarkar and Dr. H. J. Shah, Mechanics of Structures, 27th Revised and Enlarged, Charotar Publication.
8. Beer and Johnston, Mechanics of Materials, McGraw Hill International

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3Hrs**
Part A : Lab Work – Continuous Assessment	50 Marks
Part B : Lab Exam and Viva	50 Marks

20EE101P					Elements of Electrical Engineering Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To gain practical knowledge on DC and AC circuits
2. To learn operation of electrical instruments and electrical machines
3. To develop skills to implement electric wiring

LIST OF EXPERIMENTS

1. Introduction to elements of electrical engineering laboratory and to study different electrical measuring instruments
2. To validate Ohm's law with linear resistors and find power dissipation in resistor
3. To implement voltage divider and current divider circuit
4. To validate Thevenin and Norton theorem for DC circuit
5. To validate Superposition and Maximum Power Transfer theorem for DC circuit
6. To obtain transient response of RL and RC circuit
7. To evaluate performance of AC series circuit
8. To evaluate performance of AC parallel circuit
9. To analyse resonance condition in AC circuit
10. To establish relation between line and phase quantities in star and delta connected polyphase system
11. To measure power in polyphase system
12. To perform load test on 1-phase transformer
13. To perform load test on 3-phase transformer
14. To obtain current time characteristic for domestic protective devices
15. To carry out domestic electric wirin

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Operate basic electrical measuring instruments
CO2 – Simulate the basic electrical circuits and obtain results based on electrical laws and network theorem
CO3 – Understand the performance of AC circuit with different connection of R, L and C
CO4 – Formulate star and delta configuration of polyphase system and measure power in polyphase system
CO5 – Operate transformer and induction machines and evaluate its performance
CO6 – Understand the basic wiring and operation of protective devices for domestic application

END SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs**

Part A : Lab Work – Continuous Assessment 50 Marks

Part B : Lab Exam and Viva 50 Marks

20ME101P					Engineering Graphics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To understand the working of various electrical, mechanical and optical instruments in the laboratory.
- To gain practical knowledge in Physics through experiments.
- To understand basics concepts of Physics and be able to apply in performing the experiments..

List of Experiments

1. Introduction to Oscilloscope.
2. Study of Interference using Newton's Ring experiment.
3. Determination of thermal conductivity of different solids.
4. Experiment with solar collector.
5. Experimental to determine linear thermal expansion coefficient of solid bodies.
6. Experiment on reflection of Ultrasonic waves.
7. Experiments with heat pump.
8. Determining Plank's constant and Inverse square law.
9. Experiments on diffraction with He-Ne Laser Kit.
10. Study of Hall Effect.
11. Determining semiconductor energy band gap using four probe method.
12. Experiment to study forced oscillations.
13. Study of charging and discharging of capacitive plates.
14. Study of Bio-Savart's Law
15. Experiments on Fiber Optics.
16. Study of Photoconductivity.
17. Determining e/m by Thomson's method.
18. Study of Polarization of light using LASER.
19. Millikan's oil drop experiment.
20. Study of Holography.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply and analyze the concepts of electricity and magnetism.
CO2 - Understand the interaction of light waves and its propagation in different media.
CO3 - Demonstrate and implement the phenomenon of resonance
CO4 - Investigate the electrical properties of a given semiconductor device
CO5 - Examine the charge transport mechanism in different conductors
CO6 - Design and analyze the light propagation for communication application using fibre optics

REFERENCE BOOKS

1. Ghatak, Optics, 3rd edition, Tata McGraw Hill (2005).
2. Kittel, Knight and Ruderman, Mechanics - Berkeley Physics Course, Vol. 1, Tata McGraw-Hill.
3. Avadhanulu, A text book of engineering Physics, S. Chand & Company, Ltd.
4. Brij Lal, N. Subrahmanyam, Heat and Thermodynamics, S. Chand & Company, Ltd
5. Halliday, Resnick, Walker, Fundamentals of Physics (Wiley)

Evaluation

Max. Marks:100

Continuous evaluation	50 Marks
End semester examination and Viva-voce	50 Marks

20HSXXXP					Communication Skills – I (Semester I/II) (First Year)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- Understand of the fundamental elements of communication in English language.
- Know and understand different practices of verbal and non-verbal communication with inputs to improve basic language skills.
- Students are expected to be better equipped in the following areas:
  - **Listening:** Understanding basic content in lectures and common everyday situations
  - **Speaking:** Correct expression in the English language at a basic level
  - **Reading:** Understanding, retaining, and critically analyzing technical/non-technical content
  - **Writing:** Using appropriate vocabulary, grammar, effective paragraph construction, writing in day-to-day scenarios, including digital platforms

UNIT 1 **21 hrs**

Structure of English Language Academic, Research and Technical Vocabulary Phonetics and Accent

UNIT 2 **3 hrs**

Listening Skills Note Taking and Note Making Collective note-taking and note-making on digital platforms

UNIT 3 **3 hrs**

Reading Comprehension Speed Reading

UNIT 4 **1 hrs**

The art of introducing oneself Public speaking and articulation

Max. 30 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Confidence to listen, speak, read and write in English

CO2 Being able to produce something new with the help of inputs

CO3 Learning to critically analyze

CO4 Preparing reports/critique with the help of collected data

CO 5 Having a multi-dimensional/disciplinary perspective and approach

CO6 Better improved and sharpened skills to present, convince and persuade to be an effective and successful professional

TEXT/REFERENCE BOOKS

- Harmer, Jeremy. The Practice of English Language Teaching. Harlow: Pearson Longman, 2007.
- Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
- Maley, A. 'Literature in the Language Classroom', The Cambridge Guide to Teaching ESOL, Cambridge University Press, 2001.
- Richards, Jack C., and Willy A. Renandya, eds. Methodology in Language Teaching: An Anthology of Current Practice. Cambridge University Press, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Assessment Tool	Marks	Assignments
Lab Work	50	• Listening and Questionnaire – 15 • Grammar Worksheet – 20 • Short Story/Essay (750 – 1000 words) – 05 • Reading Comprehension – 10
Lab Exam/Viva	50	• Wordsworth – 10 • Narrating a Story along with Self Introduction/Speech – 15 • Reading Aloud – 05 • Vocabulary/Phonetics – 20

20ME101P					Engineering Graphics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	4	2	4	-	-	-	50	50	100

COURSE OBJECTIVES

- To learn fundamental of engineering drawing and standards used in drawing
- To enable the students with various concepts of projections and standards related to technical drawings.
- To demonstrate and communicate ideas using orthographic (2D) & isometric projection (3D) methods
- To help students to use CAD software to solve engineering problems

UNIT 1 INTRODUCTION TO ENGINEERING GRAPHICS **10 Hrs.**

Importance and applications, drawing instruments & accessories, lettering, types of lines, dimensioning methods, basic geometric drawing.

Computer Aided Engineering Drawing: Introduction to CAD, use of softwares in drawing, CAD software user interface, commands, menus and toolbars.

UNIT 2 ORTHOGRAPHIC PROJECTION **14 Hrs.**

Introduction to projection, types of projection, 1st angle and 3rd angle projection, 2D sketch, sketch entities and tools – origin, points, lines, arcs, polygons, fillets and chamfer, trim, extend and offset, projections from pictorial view, orientation of views, sections and sectional views.

UNIT 3 ISOMETRIC PROJECTION **14 Hrs.**

Construction of isometric views from orthographic projections, approach to modelling, moving from 2D to 3D, creating 3D models using CAD features, assembly of components and exploded views.

Projection of Solids - Classification of solids, projections of solids like cylinder, cone, pyramid and prism with its inclination to reference plane, concept of development of lateral surfaces, intersection of solids.

UNIT 4 DRAFTING **14 Hrs.**

Drafting standards, drawing views, alignment of drawing views, dimensions and tolerances, symbols, comments and annotations, computer aided drafting, drawing sheet and title block.

Tolerance - Introduction to limits, fits and tolerances, standardized representation of threads, fasteners, welds, bearings and springs, dimensional and geometric tolerances, surface finish symbols.

Total 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamentals of engineering graphics and remember the basic rules of dimensioning and labelling.

CO2 - Develop the ability to learn fundamental of CAD software and its use to solve engineering problems.

CO3 - Comprehend the concept of projection and use it to represent the views on reference planes.

CO4 - Apply the technical communication skill for 3-dimensional geometries in the form of 3D models using isometric projection.

CO5 - Analyse the orientation of geometrical bodies with respect to reference planes and evaluate the intricate details of solid using sectioning and development of lateral surfaces.

CO6 - Create drawing sheet by organizing drawing views and applying necessary dimensions and tolerances.

TEXT/REFERENCE BOOKS

1. R Hanifan, "Perfecting Engineering and Technical Drawing", Springer International Publishing Switzerland
2. Bethune, J. D., "Engineering Design and Graphics with SolidWorks 2019, 1st edition", Macromedia Press
3. K Morling, "Geometric and Engineering Drawing", Elseveir Insights
4. DM Kulkarni, "Engineering Graphics with AutoCAD", Easter Economy Edition
5. Agrawal, B. & Agrawal C. M., "Engineering Drawing", Tata McGraw Hill Publishers
6. P.J. Shah, "Engineering Graphics", S. Chand Publishing
7. David C Planchard, "Engineering Graphics with SOLIDWORKS 2019: A Step-by-Step Project Based Approach'', SDC Publications.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 2 Hrs**
Continuous evaluation	50 marks
End semester examination and Viva-voce	50 marks

Pandit Deendayal Petroleum University **School of Technology**

XXXXXXX					Computer Programming - II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To impart the basic concepts of Python Programming language
- To be familiar with data structures available in Python
- To understand testing and debugging in Python
- To draw different kinds of plots using for scientific research

INTRODUCTION TO PYTHON

The basic elements of Python, Branching programs, Strings and Input, Iteration

FUNCTION, SCOPING AND ABSTRACTION

Functions and Scoping, Specifications, Recursion, Global variables, Modules, Files

TESTING AND DEBUGGING

Testing, Debugging

STRUCTURED TYPES, MUTABILITY AND HIGHER-ORDER FUNCTIONS

Tuples, Lists and Mutability, Functions as Objects, Strings, Tuples and Lists, Dictionaries

EXCEPTIONS AND ASSERTIONS

Handling exceptions, Exceptions as a control flow mechanism, Assertions

SOME SIMPLE ALGORITHMS AND DATA STRUCTURES

Search Algorithms, Sorting Algorithms, Hash-tables

PLOTTING

Plotting using Py-Lab and extended examples

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand the basic concept of programming with python.

CO2- Understand the basics of creating applications.

CO3- Apply various data structures available in Python in solving computational problems.

CO4- Create applications for solving computational problems using the Python.

CO5- Test and debug applications written using the Python.

CO6- Draw different kinds of plots using PyLab and generating series.

TEXT/REFERENCE BOOKS

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
2. Allen Downey, Jeffrey Elkner and Chris Meyers "How to think like a Computer Scientist, Learning with Python", Green Tea Press.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs**

Part A/Question: <QUIZ/VIVA> <25> Marks

Part B/Question: <PRACTICAL PERFORMANCE> <25> Marks

Semester – 2

20CH101T					Engineering Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamental understanding about atomic structure and interatomic bonding.
- To provide the knowledge about structural features, synthesis, properties of various categories of materials.
- To develop the skills for phase, microstructural and elemental characterisation of materials.
- To provide the knowledge about the role of chemistry in modern engineering applications.

UNIT 1 Atomic structure and interatomic bonding **12h**

Electrons in atoms, Bohr atomic model, wave mechanical model, introduction to quantum chemistry, wave functions and probability densities, quantum numbers, orbital shapes - *s,p,d,f*- LCAO-MO of H_2, covalent, ionic and metallic bonding, bonding forces and energies, lattice energy and Madelung constant, metallic crystal structure, ceramic crystal structure and influencing factors.

UNIT 2: Chemistry of materials **10 h**

Introduction and classification of materials; structural features, synthesis, properties of metallic (e.g. noble metal), polymeric (e.g. thermoplastic and thermosetting), glass-ceramic (e.g. silicates, metal oxides) carbonaceous materials (e.g. fullerene, carbon nanotube, graphene); Introduction to nanomaterials, surface area to volume ratio and aspect ratio of nanomaterials, quantum confinement, top-down and bottom up chemical/physical approaches for synthesis of nanomaterials.

UNIT 3: Chemistry of Fuels and energy devices **10 h**

Fuels – Classification of fuels; Determination of calorific values of solid fuels by bomb calorimeter – Manufacture of synthetic petrol by Fischer-Tropsch method – Knocking in IC engines – Octane and cetane rating of fuels; Petrol and Diesel Engine, chemistry for alternative source and storage of energy (supercapacitor, fuel cell, battery); role of chemistry on in photo-voltaic devices (solar cell).

UNIT 4: Instrumental methods of chemical analysis **12 h**

Characterization of materials using X-ray diffraction (XRD), thermal Analysis (TGA-DTA-DSC), basics and application of Microwave spectroscopy, FTIR, UV-visible spectroscopy; NMR spectroscopy; Chromatographic techniques (GC, HPLC).

Max. 44 h

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental concept about atomic structure and interatomic bonding.

CO2 - Acquire knowledge about metallic and ceramic crystal structure.

CO3 - Acquire knowledge about structural features, properties of different classes of materials including nanomaterials.

CO4 - Explain the methodologies for the synthesis of different categories of materials.

CO5 - Develop the skill for phase, microstructural and elemental characterisation of materials.

CO6 - Develop the knowledge on the role of chemistry in various modern engineering applications.

TEXT/REFERENCE BOOKS

1. An Introduction to Materials Science & Engineering, W.D. Callister, John Wiley & Sons (2007).
2. Fundamental of Ceramics, MW Barsoum, IOP publishing (2003).
3. Text book of Nanoscience and Nanotechnology, T. Pradeep, Mc. Graw Hill Education (2003).
4. Textbook of Nanoscience and Nanotechnology, Murty, Shankar, B Raj, Rath, Murday, Springer (2013).
5. Materials Science and Engineering, V. Raghavan, Prentice-Hall of India Private Limited (2003).
6. Principles of Instrumental Analysis, Douglas A. Skoog, Donald M.West, 6th Edition, Cengage (2014)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 h**

Part A/Question: 3 Questions from each unit, each carrying 3 marks	36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 Marks

20CP101T					Computer Programming-1					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	-	-	100

COURSE OBJECTIVES

- Develop a greater understanding of the issues involved in programming language, design and implementation
- To inculcate functional and logical problem-solving skills through programming.
- To understand the basic concepts of C programming
- To understand design and implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing
- To develop understanding of Compilation process.

UNIT 1 BASICS OF C PROGRAMMING **4 Hrs.**

Writing C Programs to implement: Input, Output constructs, different data types, types of Operators, Precedence and associativity of Operators, Control Structure and Loop Structure.

UNIT 2 ARRAY AND STRINGS **4 Hrs.**

Writing C Programs to implement: 1-dimensional, 2-dimensional and 3-dimensional arrays, different types of user defined functions, String operations in form of Character arrays, In-built String functions

UNIT 3 POINTERS **4 Hrs.**

Writing C Programs to implement: Basic pointer arithmetic, arrays and String using Pointer, call the functions using Call-by reference property

UNIT 4 FILE HANDLING **2 Hrs.**

Writing C Programs to implement: open the file in write mode and write the data into it, open the file in read mode and read from the file, Open the file in append mode and append the contents in the file, handle the File operations using seek function.

Total Theory (14 Hrs.)+ Practical (24 Hrs.)= Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand functional and logical problem-solving skills through programming

CO2 - Write, compile and debug programs in C language

CO3 – Use basic and derived data types in C and Operators in C.

CO4 - Design programs involving decision structures, loops, and functions in C.

CO5 - Implement Programs to perform pointer arithmetic and array handling with Pointers.

CO6 - Perform File-handling operations in C.

TEXT/REFERENCE BOOKS

1. E.Balaguruswamy, Programming in ANSI C, McGraw-Hill
2. Jeri R. Hanly and Elli B.Koffman, Problem Solving and Program Design in C.
3. Brain W.Kernighan & Dennis Ritchie, C Programming Language, PHI

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice	20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying	80 Marks

20MA103T					MATHEMATICS - II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to apply the calculus of complex functions to construct analytic functions.
- To be able to compute residues and apply them to evaluate contour integrals.
- To be able to formulate and solve various engineering problems using the methods of solving ODEs.
- To study the properties of Laplace transforms and apply them to solve ODEs.

UNIT 1 COMPLEX DIFFERENTIATION **10 Hrs.**

Limit, Continuity, Differentiability of function of complex variable, Analytic function, Cauchy-Euler equation (in Cartesian and polar coordinates), Harmonic function and its significance, Singularities, Taylor's series, Mapping (translation, rotation and inversion), bilinear transformation, Conformal mapping, Applications of Conformal mapping.

UNIT 2 COMPLEX INTEGRATION AND APPLICATIONS **10 Hrs.**

Definition of a Complex line integral, Contour integrals, Cauchy- Goursat theorem, Cauchy integral theorem, Cauchy Integral formula (CIF), CIF for derivatives, Calculation of residues, Cauchy Residue theorem, Applications of residues to evaluate real definite integrals.

UNIT 3 ORDINARY DIFFERENTIAL EQUATIONS WITH APPLICATIONS **10 Hrs.**

Differential equations of first order and higher degree, Higher order differential equations with constant coefficients, Rules for finding C.F. and P.I., Method of variation of parameters, Cauchy and Legendre's linear equations, Linear differential equations of second order with variable coefficients; Simultaneous linear equations with constant coefficients, Applications of higher order differential equations in solving engineering problems.

UNIT 4 LAPLACE TRANSFORMS **10 Hrs.**

Piecewise continuous functions and exponential functions, Definition, Existence and Properties of Laplace transforms, Heavyside function, Inverse Laplace transform, Properties of inverse Laplace transforms, Convolution theorem, Applications of Laplace Transforms in solving differential equations.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of various special functions in engineering aspects.
CO2 – Illustrate the ability to handle mathematical models, to describe physical phenomena, using suitable techniques.
CO3 – Develop the ability to apply appropriate tool/method to extract the solutions of engineering problems.
CO4 – Analyze the obtained solution in context with theory.
CO5 – Appraise mathematical problems from real to complex domain.
CO6 – Create a mathematical model of engineering interest.

TEXT/REFERENCE BOOKS

1. R.V. Churchill and J. W. Brown, Complex variables and applications, McGraw-Hill, 7th Ed., 2003
2. J. M. Howie, Complex analysis, Springer-Verlag, 1st Ed., 2003.
3. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science, 3rd Ed., 2007.
4. Erwin Kreyszig, Advanced Engineering mathematics, John Wiley, 10th Ed., 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 10 questions 3 marks each	30 Marks (40 min)
Part B: 5 questions 6 marks each	30 Marks (50 min)
Part C: 5 questions 8 marks each	40 Marks (90 min)

20ME102T					Elements of Mechanical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce and define the basics concept of mechanical engineering.
- To familiarize the working principles of IC engines and industrial robotics systems.
- To enable the students to understand the details about the energy systems and its components.
- To demonstrate the various machine elements, materials and its function.
- To help the students acquire knowledge about the various manufacturing process.

UNIT 1 **10 Hrs.**

Introduction to Thermodynamics: Definition and applications, systems and control volumes, thermodynamic properties, thermodynamic systems, state and equilibrium processes and cycles, temperature and Zeroth law of thermodynamics, forms of Energy, energy transfer by work and heat, law of conservation of energy, energy conversion efficiencies.

Properties of Pure substances: Definition, examples and phases, phase change of pure substances, property diagrams and property tables. Solution of Numerical Problems through EES Software.

UNIT 2 **10 Hrs.**

Law of degradation of Energy and Internal Combustion Engines: Limitations of First Law, Thermal Energy reservoirs, heat engines, Refrigerators and Heat pumps, Kelvin Plank and Clausius statement and their equivalence.Introduction, classification and brief description of I.C. engines mechanism, 4–Stroke and 2–Stroke cycles and engines. Otto, Diesel and dual cycles; MEP and air standard efficiencies.

UNIT 3 **10 Hrs.**

Engineering materials and Introduction to Manufacturing Processes: Stresses, strains and material properties.
Conventional manufacturing process: Lathe Machines, CNC machines, drilling machines, universal Milling machines. Non–conventional manufacturing processes: Additive Manufacturing, 3D printing.

UNIT 4 **10 Hrs.**

Introduction to industrial robotics and Introduction to Industry 4.0. Introduction, Industrial and Non–industrial robots, Anatomy and configuration of Industrial Robots, Robot Components, Robot Applications.

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Define the "fundamentals' and "terminologies" used in Engineering Thermodynamics.
CO2: Explain the energy conservation principles applicable for ideal gas and pure substance applications
CO3: Analyse the performance of thermodynamic cycles.
CO4: Evaluate the performance of power cycles
CO5: Identify the principles of different machining techniques and material properties.
CO6: Understand the anatomy, applications of robots and introduction to industry 4.0.

TEXT/REFERENCE BOOKS

1. Yunus A. Cengel& Bole, Thermodynamics– Engineering Approach by Tata Mcgraw Hill.
2. Sharma PC. A Textbook of Production Enginerring. S. Chand Publishing.
3. P. K. Nag, Engineering Thermodynamics, Tata Mcgraw Hill, New Delhi.
4. Industrial Robotics, Mikell Groover, McGraw–Hill Education (India) Pvt Limited

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Unit 1 and 2: Two question from each unit (Total 4 question with subparts) 40 Marks
Unit 3 and 4: Two question from each unit (Total 4 question with subparts) 60 Marks

20IC101T					Basic Electronics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	0	0	100

COURSE OBJECTIVES

- To understand rectification through p-n junction diode and applications of diode
- To learn different configurations and static characteristics of bipolar junction transistor and MOSFET
- To illustrate the OPAMP application in different real life circuits
- To introduce basic concepts of digital electronics

UNIT 1: DIODES AND RECTIFIERS **8 Hrs.**

Review of p-n junction diode, 1-phase half wave, full wave and bridge rectifier using diode. Calculation of average & rms value, PIV, efficiency, transformer utilization factor and ripple for different diode rectifier circuit. Use of Capacitor Filter for ripple reduction, voltage multipliers, Zener diode in load and line regulation.

UNIT 2: BJT, FET AND MOSFET **07 Hrs.**

Working of a BJT, transistor biasing, different transient circuit configuration (CB, CE and CC), static characteristic for BJT, transistor as switch, amplifier, concept of feedback amplifier and oscillator. Classification of FET, static characteristics of FET, FET biasing and load line, MOSFET, static characteristic of MOSFET and biasing

UNIT 3: OPAMP **04Hrs.**

Introduction, Block Diagram and Characteristics of Ideal Op-Amp, Parameters of an Op-Amp, Inverting and Non- Inverting Amplifier, Virtual Ground, Adder, Subtractor, Comparator, Integrator and Differentiator.

UNIT 4: DIGITAL ELECTRONICS **07Hrs.**

Number system, Binary arithmetic, logic gates and combinational logic, Boolean algebra, DeMorgan's Theorems, Logic minimization and Karnaugh maps, full adder, multiplier, multiplexing, Flip Flops, Introductory Sequential Logic, Counters, Registers

Total 26 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 –Demonstrate application of different diode in circuits
CO2 –Evaluate zener diode as voltage regulator
CO3- Apply BJT, FET and MOSFET in different circuits
CO4–Understand static characteristics OPAMP
CO5–Illustrate basic concepts and theorem of digital systems
CO6–Build digital circuits using logic gates and flip flops

TEXT/REFERENCE BOOKS

1. Boylestad and Nashlesky, "Electronic Devices and Circuit Theory", PHI
2. N.N. Bhargava, S.C. Gupta, and D.C. Kulshreshtha, "Basic Electronics And Linear Circuits", McGraw Hill Education (India)
3. R. A. Gaikwad, "Operational Amplfier and Linear Integrated Circuits", PHI
4. Morris Mano, "Digital Design", PHI
5. J. Millman, C. Halkias and C. Parikh, "Integrated Electronics", Tata McGraw Hill.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc.(10 to 20 marks each)	80 to 60 Marks

16HS109T					Professional Ethics and Human Value					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	--	--	100

COURSE OBJECTIVES

- Identify the core values that shape the ethical behaviour of an Engineer
- Awareness on professional ethics and human values
- To know their role in technological development
- To appreciate the rights of others
- Improved communication and learn to work in group
- Learn to understand and discuss on issues of social interest

Unit 1: HUMAN VALUES [5 hrs]

Morals, Values and Ethics – Integrity – work Ethic – Service Learning – Civic Virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality

Unit 2: ENGINEERING ETHICS [4 hrs]

Sense of 'Engineering Ethics' – Variety of moral issued – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – Consensus and controversy – Models of Professional Roles & Professionalism – theories about right action – Self-interest – customs and religion – uses of ethical theories.

Unit 3: ENGINEERING AS EXPERIMENTATION [4 hrs]

Engineers as responsible experimenters – Research ethics –Codes of ethics – Industrial Standard – Balanced outlook on law – the challenger case study.

Unit 4: SAFETY, RISK AND GLOBAL ISSUES [5 hrs]

Safety and risk – assessment of safety and risk – Risk benefit analysis and reducing risk – Threat of Nuclear power – Collegiality and loyalty – respect for authority – Confidentiality – conflicts of interest – professional rights – employees' rights – Intellectual Property rights (IPR) – discrimination. Multinational corporations – Business ethics – Environmental ethics – Role in Technological Development – Weapons development - consulting engineers - engineers as expert witnesses and advisors-Ethics.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Find the core values that shape the ethical behaviour of an Engineer

CO2: Students will get aware of the professional ethics and human values

CO3: Develop and understand their role in technological development

CO4: Simplify to the rights of others

CO5: Perceive improved communication with activities and learning to work in group

CO6: Discuss on issues of social interest and make opinions based on logical reasoning

TEXT/REFERENCE BOOKS

1. A Textbook on Professional Ethics and Human Value by Prof. R. S. Nagaarazan, New Age International Limited Publisher, Chennai. 2006
2. A Text book on Professional Ethics and Human Values by M. Govindarajan, S. Natarajan, V. S. Senthilkumar, PHI Learning Pvt. Ltd., 2013.
3. A Text book on Professional Ethics and Human Values by Dinesh Babu, Firewall Media, 2007

20CP101P					**Computer Programming – I Lab**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To understand the basic concepts of C programming
- To understand design and implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing
- To develop understanding of Compilation process.

List of Experiments

1. Add, subtract, multiply, divide two numbers.
2. Convert hours into minutes, minute to hours.
3. Conversion related programs dollars into Rs. Where 1 $ = 48 Rs. , grams to KG, Kilobytes to Megabytes.
4. Convert Celsius into Fahrenheit. F = (9/5 * C) + 32 and Fahrenheit into Celsius. C = 5/9 * (F – 32)
5. Calculate simple and compound interest where I = PRN/100.
6. Calculate area & perimeter of a square, rectangle, circle, triangle.
7. Program to sort N numbers. (Ascending and Descending)
8. Program to calculate string length, reverse the string.
9. Program to check the string and number is palindrome or not.
10. Program to generate sine, cosine, tan series.
11. Program to generate Fibonacci series.
12. Program to calculate factorial using recursion.
13. Program to create a database using array of structures.
14. Programs related to pointers.
15. Programs related to file.

Design based Problems (DP)/Open Ended Problem:

1. Develop a game/Puzzle in C language.
2. Use interrupts to develop programs related to basic operations

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand functional and logical problem-solving skills through programming. CO2 - Write, compile and debug programs in C language.

CO3 – Use basic and derived data types in C and Operators in C.

CO4 - Design programs involving decision structures, loops, and functions in C.

CO5 - Implement Programs to perform pointer arithmetic and array handling with Pointers.

CO6 - Perform File-handling operations in C.

REFERENCE BOOKS

1. E. Balaguruswamy, Programming in ANSI C, McGraw-Hill
2. 2. Jeri R. Hanly and Elli B. Koffman, Problem Solving and Program Design in C.
3. 3. Brain W. Kernighan & Dennis Ritchie, C Programming Language, PHI

20CH101P					Engineering Chemistry- Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To enhance and develop scientific and analytical skills
- To relate concepts learned in chemistry and engineering to the real-world situations.
- To acquire skills to perform laboratory experiments.
- To demonstrate safe and proper use of standard chemistry glassware and equipment.

LIST OF EXPERIMENTS

1. **External Indicator** To determine the strength of given solution of ferrous ammonium sulphate by titrating against standard N/40 $K_2Cr_2O_7$ using potassium ferricyanide as an external indicator
2. **Iodometry** To determine the strength of given copper sulphate solution by titrating against N/20 sodium thiosulphate (hypo) solution
3. **Iodimetry** –To determine the strength of given ascorbic acid by titrating against standard N/10 iodine solution
4. **Complexometric Titration** To determine the total, permanent and temporary hardness of given water by complexometric titration using standard 0.01M EDTA solution
5. **pH metric titration** To determine the strength of given HCl solution using a standard NaOH solution by performing a pH-metric titration
6. **Conductometric titration** To determine the strength of given HCl solution using a standard NaOH solution by performing a conductometric titration
7. **Potentiometric titration** To determine the strength of given HCl solution potentiometrically
8. **Chemical Kinetics** –To study the kinetics of decomposition of sodium thiosulphate by a mineral acid
9. **Chloride in Water** –Determination of Chloride in the given water sample by Mohr Method
10. **Polymerization** –To prepare a polymer (Nylon 6,10), identify the functional groups by FT-IR
11. **Spectrophotometry**– To determine the λmax and concentration of given unknown potassium permanganate using UV -Visible Spectroscopy technique

Max. <28> Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply the concepts learned in chemistry and engineering to the real-world situations.

CO2 - Enhanced ability to identify, analyse and interpret the results from the experiments

CO3- Carry out quantitative analysis by instrumental method using Conductometer.

CO4- Analyse compounds by titrimetric, gravimetric and instrumental methods

CO5- Determine the concentration of unknown solutions by Spectrophotometric method.

CO6- Investigate the reaction rate and predict the order and rate constant

TEXT/REFERENCE BOOKS

1. College Practical Chemistry, VK Ahluwalia, S Dhingra, A Gulati, Universities Press
2. Foundations of Experimental Chemistry, JB Baruah, P Gogoi, PharmaMed Press.
3. A Text Book of Chemistry Practicals Vol I & II, SS Sawhney, M S Jassal, SP Mittal, APH Publishing Corp.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs**

Part A : Lab Work – Continuous Assessment 50 Marks

Part B : Lab Exam and Viva 50 Marks

20ME102P					Elements of Mechanical Engineering Lab.		
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/Week	Practical		Total Marks
					Continuous Evaluation	End Semester LE/Viva	
0	0	2	1	2	25	25	50

COURSE OBJECTIVES

- To Perform experiments and collect experimental data on thermal and mechanical systems to validate theoretical principles.
- To analyse, differentiate and evaluate Law of conservation of energy on thermal systems.
- To evaluate performance of heat engine and heat pumps.
- To calculate and compare the components, application of the conventional manufacturing machines, non-conventional manufacturing machines and industrial robotic systems.
- To demonstrate the working principle of heat engine and additive manufacturing process.

LIST OF EXPERIMENTS

1. To understand and perform fluid property evaluation using property tables and engineering equation solver software.
2. To perform experimental study and verify 1st law of thermodynamics by energy balance of heat exchanger.
3. To evaluate thermodynamic systems using Engineering Equation Solver.
4. To determine Performance of Heat pump and evaluate its coefficient of performance.
5. To understand and demonstrate components and working cycle of Internal Combustion engine.
6. To understand and demonstrate construction and working of conventional manufacturing machine.
7. To understand and demonstrate construction and working of non-conventional manufacturing machine.
8. To study additive manufacturing process applied for 3D printing.
9. To develop a working model of a simple robotic system.

COURSE OUTCOME

On completion of the course, students will be able to

CO1 – Understand and evaluate conservation law of thermodynamics through experimentation.

CO2 – Understand and analyse thermal systems data using engineering equation solver.

CO3–Measure the coefficient of performance of heat pump.

CO4 – Examine the internal combustion engine components and its working.

CO5 –Demonstrate the various components of convention and non-conventional manufacturing machines and elaborate their applications.

CO6 – Classify the components in industrial robots and develop a simple robotic system.

RESOURCES/TEXT/REFERENCE BOOKS

1. Solar energy by Prof. Sukhatme.
2. Heat transfer by Yungus A. Cengel.
3. Industrial Robotics, Mikell Groover, McGraw-Hill Education (India) Pvt Limited

End Semester Lab Examination

Max. Marks	**Exam Duration: 2 hrs**
Quiz/Experiment	10 Marks
Viva	15 Marks

20IC101P					Basic Electronics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	25	25	50

COURSE OBJECTIVES

- To understand the characteristics of PN junction diodes and their applications
- To Observe properties of BJT, FET and MOSFET
- To illustrate the OPAMP application in different real life circuits
- To introduce basic concepts of digital electronics

Experiment Sessions would be simulation based covering but not limited to following topics:

1. To study the simulation tool and its features for analog circuit simulation
2. To study the VI characteristic of silicon and germanium diodes.
3. To study reverse characteristics of zener diode.
4. To study half wave, full wave and bridge rectifiers
5. To study BJT as switch
6. To study common emitter amplifier
7. To study different biasing circuits of BJT
8. To study transfer and drain characteristic of FET and MOSFET
9. To study the simulation of digital circuits
10. To study and verify logic gates
11. To implement X-OR and X-NOR gates using basic gates
12. To study and design adder and subtracter circuits
13. To study and design flip flops
14. To study OPAMP and its properties
15. To study ADC and DAC
16. Design of mini project in a group of 4-5 students

COURSE OUTCOMES

On completion of the course, student will be able to
CO1: Study the fundamentals of electronic components
CO2: Understand the working principle of semiconductor devices
CO3: Apply the analog and digital concept in building real time circuits
CO4: Analyze the behaviour of semiconductor devices, OPAMP, ADC and DAC
CO5: Evaluate different circuit for different device parameters
CO6: Build analog and digital sub-system

TEXT/REFERENCE BOOKS

1. Boylestad and Nashlesky, "Electronic Devices and Circuit Theory", PHI
2. N.N. Bhargava, S.C. Gupta, and D.C. Kulshreshtha, "Basic Electronics And Linear Circuits", McGraw Hill Education (India)
3. R. A. Gaikwad, "Operational Amplfier and Linear Integrated Circuits", PHI
4. Morris Mano, "Digital Design", PHI
5. J. Millman, C. Halkias and C. Parikh, "Integrated Electronics", Tata McGraw Hill.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 1 Hrs.**

PART A- Laboratory Exam: would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming-coding/ implementation/ investigation /solution-development. **50 Marks**

PART B: Viva **50 Marks**

16SP101/102/103					NCC/NSS/SPORTS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/ Viva	
0	0	2	1	2	-			--	100	100

COURSE OBJECTIVES

- To develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
- To develop youth leadership in the students.
- To induce social consciousness among students through various camps and 'Shibir' activities.
- To develop skills and physical fitness among students through indoor & outdoor sports, field & track events.

National Cadet Corps (NCC):

Introduction to NCC, Aims and objectives, Structure and organization, NCC Song, Incentives, National Integration and Awareness, Drill, saluting, Personality Development & Leadership, Disaster Management, Social Awareness & Community Development, Health & Hygiene, Adventure camps, Environment Awareness and Conservation, Obstacle Training, Armed forces, Map reading, Field Craft & Battle Craft, Introduction to Infantry Weapons & Equipment, Weapon Training (During camps), Participation into Republic and Independence day ceremonial parades,

National Service Scheme (NSS):

Importance and role of youth leadership, Life competencies, Youth development programmes and youth 'shibir', Health, hygiene and sanitation, Youth health, lifestyle, first aid, youth and yoga

Sports:

Importance of sports/games in life, Physical fitness, Introduction to various games and sports, field and track events, Physical training, exercises, running, walking, jogging, Teaching of different sports/games, track & field events , demonstration, practice, skills and correction, Introduction to Yoga & Meditation.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand the importance of Nation building and individual contribution to the same.
CO2 – Integrate physical fitness and mental wellbeing
CO3 – Discover grassroots challenges of community
CO4 – Creating societal impact
CO5 – Maintain discipline and team spirit
CO6 – Upholding the value of one for all and all for one

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: --**

* All registered students will be evaluated based on his/her attendance during the NCC/NSS/Sports sessions and participation to camps and other activities.

16TP110					Civic & Social Service Internship					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	0	1	0	--	--	--	--	100	100

COURSE OBJECTIVES

- To develop a holistic view of social work and social welfare in the community, with special emphasis on the role of different agencies like Govt. departments and NGOs in human services.
- To enlighten and sensitize students on various types of problems of the people and their diversified cultural background.
- To understand the agency as an organization, its structure, functions, activities and sources of funding.
- To understand and make a commitment to the basic humanistic values and principles of social work practice in a secular democratic society.
- To develop an understanding of the application of the methods of social work practice in the field.
- To develop an understanding of the opportunities in working with diverse populations.
- To develop the self –awareness necessary to assess one's own values, attitudes, feelings, strengths, limitations, and interests and performance.
- To inspire young technocrats to become change makers

UNIT 1: Overview of Civic and Social Service Sector
UNIT 2: Understanding of NGO/Civic Body/Government Body Management and their functioning
UNIT 3: Study of Individual organizational and government projects and schemes where students are interning
UNIT 4: Field visits

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Become sensitized workforce of enlightened Engineers and Managers who are socially concerned and willing to positively contribute to the society
CO2- Acquire desired work habits and attitudes with the sense of social responsibility and think innovatively to find solutions
CO3- Understand the role of different NGO/civic/government bodies in the service of citizens
CO4- Imbibe basic humanistic values and principles of social work practice in a secular democratic society
CO5- To assess one's own values, attitudes, feelings, strengths, limitations, interests and performance through opportunities of working with diverse populations
CO6- Obtain experiential learning via internship and be sensitive towards issues of modern-day citizenship and democracy

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Part A: NGO evaluation	50 Marks
Part B: Internal faculty	50 Marks

Pandit Deendayal Energy University **School of Technology**

					Mathematics-II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	0	4	25	50	25	--	--	100

COURSE OBJECTIVES:

- To make students acquainted with the basics of functions of several variables.
- To be able to formulate and solve various engineering problems using the methods of solving ODEs.
- To study the properties of Matrix algebra and apply them to solve system of algebraic equations.
- To understand the use of multivariable calculus in real world applications.

UNIT 1 FUNCTIONS OF SEVERAL VARIABLES **10 Hrs.**

Functions of two variables, Limits and Continuity, Partial derivatives, Total derivatives, Maxima and minima, Lagrange multipliers method.

UNIT 2 MULTIPLE INTEGRALS **10 Hrs.**

Definition Evaluation of double integral (Cartesian – Polar form), Change of orders, Change of variables, Evaluation of triple integral, change of variables (Cartesian to spherical – and cylindrical), Applications, Area, Volume, Center of mass, Center of gravity by double and triple integral.

UNIT 3 ORDINARY DIFFERENTIAL EQUATIONS **10 Hrs.**

Differential equations of first order and first degree, Exact differential equations, Integrating factors, Higher orderdifferential equations with constant coefficients, Rules for finding C.F. and P.I., Cauchy and Legendre's linear equations, Applications of higher order differential equations in solving engineering problems.

UNIT 4 MATRIX ALGEBRA AND ITS APPLICATIONS **10 Hrs.**

Rank of a matrix, consistency of system of equation, Characteristic equation of a square matrix, Eigen values and Eigenvectors of a real matrix, Properties of eigen values and eigen vectors, Cayley-Hamilton theorem (without proof). Diagonalization of a matrix.

40 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1 – Understand the basic concepts of multivariable calculus, matrix algebra and differential equations.
CO2 – Demonstrate the use of multivariable calculus, differential equations, eigen value and eigen vector.
CO3 – Apply appropriate tool/method to extract the solutions of engineering problems.
CO4 – Analyze the obtained solution in context with theory.
CO5 – Evaluate surface area, volume, center of mass, and center of gravity using multiple integrals.
CO6 – Create a mathematical model of engineering interest.

TEXT/REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering mathematics, John Wiley, 10th edition, 2015.
2. G. B. Thomas, J. Hass, C. Heil, M. D. Weir, Thomas' Calculus, Pearson Education, 14th edition, 2018.
3. G. Strang, Linear Algebra and its applications, 4th edition, Cengage Learning, 2005.
4. S.L. Ross, Differential Equations, Wiley, 3rd edition, 2007.
5. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science, 3rd edition, 2007.

XXXXX					Fundamentals of Life Sciences					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

Course Objective

- Gain the fundamental diversity of plant and animal kingdom
- Learn the significance of plant and human physiology
- Create interest in life science and impart knowledge on health and disease
- Learn the concepts of Biotechnology and its impact on Health care and Agriculture
- Understand the environmental issues and their approach and prevention strategies

Unit 1: Diversity: Origin of life. Animal Kingdom- Classification and taxonomical aids. Plant Kingdom- Classification, Structure and types. **Cell structure and function**: Cellular organelles and Functions, nuclear components, Concepts of cell division on plant and animal cell. **10 Hr**

Unit 2: Plant Physiology : Movement of water, gases and nutrients; Cell to cell transport, Mineral nutrition: Essential minerals, macro and micronutrients and their role; Photosynthesis: Photosynthesis as a means of Autotrophic nutrition, Plant growth and development: Seed germination. **10 Hr**

Unit 3: Human Physiology: Digestion, absorption and Excretion, Breathing and Respiration, Body fluids and circulation, Neural control and coordination, Locomotion and Movement. Human Reproduction: Male and female reproductive systems; Gametogenesis-spermatogenesis & oogenesis; Menstrual cycle; Fertilisation, embryo development upto blastocyst formation, implantation; Pregnancy. **10 Hr**

Unit 4: Fundamentals of Biotechnology: Significance of Biotechnology, rDNA technology, Gene cloning and Applications, Applications in Health care and Agriculture; Ethical Issues. **Health and Disease**: Pathogens; parasites causing human diseases, Basic concepts of immunology–vaccines; Alcohol abuse, Microbes in human welfare: Industrial production, sewage treatment and biofertilizers. **Environmental issues**: Air pollution and its control; Water pollution and its control; Agrochemicals and their effects; Solid waste management **12 Hr**

Max. 42 Hours

Course Outcomes

On completion of the course, students will be able to

CO1: Classify and Compare the diversity exist on plant and animal kingdom

CO2: Gain the fundamental knowledge on plant and human physiology

CO3: Understand the principles of Biotechnology and its industrial application

CO4: Get acquainted with the Pathogens and immunology

CO5: Focus professionally on Health, Disease and Environmental Issues

CO6: Develop solution of Health care problems and environmental issues

Reference

1. N.Murugesh. Basic Anantomy and Physiology.6th Edition. Sathya Publishers, 2019.
2. Campbell,N.A. Reece,J.B., and Simon, E.J. 2015. Essential Biology with Physiology (6th Edition). Campbell Biology Websites Series.
3. V.K.Jain.Fundamentals of Plant physiology. S.Chand & Co Ltd.2022

Semester – 3

XXXXXXX					Electromagnetism and Quantum Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	2	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To know about the basic concepts of magnetism and basic laws.
- To evaluate magnetic concepts and magnetic circuits
- To enable the students to understand the basic concepts of quantum mechanics.
- To introduce the key elements of quantum mechanics, including the statistical interpretation of wave functions, the role of operators and their connection with observables, and uncertainty.

UNIT I

Electromagnetic Induction: Laws of electromagnetic induction– Self and mutual induction– Self-inductance of a solenoid– Mutual inductance of a pair of solenoids–Coefficient of coupling– Experimental determination of self (Rayleigh's method) and mutual inductance–Growth and decay of current in a circuit containing L and R–Growth and decay of charge in a circuit containing C and R– Measurement of High resistance by leakage.

Unit –II

AC Circuits**:** Alternating EMF applied to series circuits containing LC, LR and CR– Alternating EMF applied to circuits containing L, C and R–Series and Parallel resonance circuits– Sharpness of resonance–Q factor– Comparison between Series and Parallel resonant circuits –Power in AC circuits (R, L-R, L-C-R only) – Power factor–Wattless current – Choke Coil – Transformer – Uses of Transformers – Skin Effect. Magnetism Intensity of Magnetization– Magnetic Susceptibility– Magnetic Permeability –Types of magnetic materials– Properties of para, dia and ferromagnetic materials–Langevin's theory of dia and para magnetism– Weiss's theory of ferromagnetism –B-H curve–Energy loss due to magnetic hysteresis – Ballistic Galvanometer method for plotting B-H curve - Magnetic properties of iron and steel.

Unit III

Introduction to Quantum Mechanics**:** Postulates of quantum mechanics - Properties of Wave Function. Interpretation of Wave Function- Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Position, momentum and Energy operators; Commutator of position and momentum operators; Expectation values. Uncertainty principle. Schrodinger Wave Equation: Time independent Schrodinger equation –derivation- General solution of the time dependent Schrodinger equation; Eigenvalues and Eigenfunctions; Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wave function as a linear combination of energy eigenfunctions; probability current densities.

Unit-IV

General Discussion of bound states in an arbitrary potential: Continuity of wave function, boundary condition and emergence of discrete energy levels. Quantum theory of Hydrogen-like atoms: Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation. Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:- Understand the types of biological databases.

CO2:- Explain the different methods of protein/DNA/RNA sequence analysis.

CO3:- Describe the structure of protein by using visualization softwares.

CO4:- TO get familiar with advanced concepts in Bioinformatics.

CO5:- To understand the basics of energy minimization simulation methods.

REFERENCE BOOKS

1. Andrew R.Leach Molecular Modelling Principles and applications. (2001) II ed. Prentice Hall.
2. A.D. Baxevanis et. Al., Current Protocols in Bioinformatics, (2005) Wiley Publishers
3. I.N. Levine, Quantum Chemistry, (2000), Pearson Educ., Inc., New Delhi.
4. Robert Eisberg and Robert Resnick, Quantum Mechanics, 2nd Ed., 2002, Wiley.

CH201T					Fluid Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop basic concepts of fluid flow and flow analysis leading to systematic problem solving skills.
- Understand the concept of designing a flow system involving various flow types.
- Design and analysis of fluid transportation devices and systems including agitation and mixing.

UNIT 1 FLUID STATIC AND ITS APPLICATION **10 Hrs.**

Dimensional Analysis: Different methods of dimensional analysis applied to fluid flow problems. Definition and properties of fluid, Types of flow, Hydrostatic equilibrium, relationship between shear stress and pressure gradient, Hagen Poiseuille equation, losses in pipes and fittings.

UNIT 2 BASIC EQUATIONS OF FLUID FLOW **10 Hrs.**

Continuity equation, Bernoulli equation, Euler equation. Equation of motion. Darcy-Weisbach equation for frictional head loss, friction factor, Moody diagram. Velocity profile and boundary layer calculations for turbulent flow.

UNIT 3 TRANSPORTATION OF FLUIDS **10 Hrs.**

Handling of fluids: Pumps, compressors and blowers for handling different fluids, Standards for pumps, compressors and blowers, valves, pipe fittings and their standards, power requirement for flow. Piping layout and economical pipe diameter.

UNIT 4 METERING OF FLUIDS **10 Hrs.**

Flow metering devices: orificemeter, venturimeter, rotameter, pitot tube, anemometer etc. Flow through open channels such as notches, weirs, nozzles. Vacuum producing devices; two phase flow: basic principles and applications

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Define principles of fluid mechanics operations

CO2 – Explain the theoretical importance and relevance of fluid flow in chemical process industry

CO3 - Identify and apply the theoretical concept of fluid flow in chemical process industry

CO4 - Comprehend and analyse fluid mechanics problems with the application of conservation principles of mass, energy and the momentum

CO5 - Evaluate fluid mechanics problems with the application of conservation principles of mass, energy, momentum.

CO6 - Design fluid transportation systems such as pumps, compressors and pipe network etc, and choose the fluid transportation devices for process applications

TEXT/REFERENCE BOOKS

1. W. L. McCabe and J. C. Smith, P. Harriot, Unit Operations of Chemical Engineering 7th ed. McGraw Hill 2014.
2. S. Foust, L.A.Wenzel, C.W. Clump, L.B. Andersen. Principles of Unit Operations, 2nd ed. Wiley, NewYork 2008.
3. P N Modi and S M Seth, Hydraulics and fluid Mechanics, 19th Edition, Standard Book House, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A/Question: Theoretical Questions	50 Marks
Part B/Question: Analytical Questions	50 Marks

XXXXXX					Principles of Biochemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To learn the basic function of different biomolecules in human body.
- To learn different physical & chemical properties of biomolecules.
- Provide explanation of general features of certain human body systems.

UNIT I

Introduction to biological system, features of biological systems, structure-function relationship. Introduction to different types of biomolecules: Proteins, Carbohydrates, Lipids, Nucleic Acids

Unit –II

Proteins: Definitions, biological functions, Physical properties. Essential of amino acids, Properties of amino acids arising from their dipolar nature, Basics understanding of primary, secondary, tertiary, quaternary & domain structure of proteins. Protein denaturation and renaturation. Carbohydrates: Definitions, biological functions, Physical properties. Classification of carbohydrates.

Unit III

Lipids: Definitions, General formula, Nomenclature and properties of fatty acids, Classification of lipids, General structure and functions of major lipid subclasses. Nucleic acids: Generalized structure plan of nucleic acids, basic ideas of DNA replication, transcription and protein biosynthesis, mutation – definitions & types.

Unit-IV

Properties of biomolecules in solution: Diffusion, ultra-centrifugation and electrophoresis. Optical properties. Characterization of biomolecules by molecular shape, size and molecular weight. Spectroscopic methods for biomolecules: IR, NMR. Optical rotary and circular dichroism & imaging methods: Bright, darkfield and fluorescence imaging.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:- To clear the fundamentals of biomolecules.

CO2:- To understand the basic classification & functions of Proteins, Carbohydrates, Lipids & Nucleic acids.

CO3:- To understand the Physical & chemical properties of biomolecules.

CO4:- To be able to characterize the biomolecules using different spectroscopic techniques.

REFERENCE BOOKS

1. Lehninger Principles of Biochemistry by Nelson and Cox (2008) Worth Publishers, Inc. New York.
2. Biochemistry by Berg, Tymoczko and Stryer (5th Edition, 2007)W.H. Freeman Press, San Francisco, USA.

Pandit Deendayal Energy University

					Fundamental of Human Anatomy and physiology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Gain fundamental knowledge on Structure and functions of the various organ systems and organs of the human body
- Learn the homeostatic mechanisms and their imbalances in the human body
- Understand the different Various vital physiological parameters of the human body and their significances.

UNIT I: Cell and Tissues of Human Body **12 Hr.**

Structure of Cell: Components and its functions. Classification on Tissues of the human body. Haemopoietic system: Composition and functions of blood, Characteristics and functions of Blood cells, Mechanism of Blood Clotting, Importance of Blood groups. structure and functions of bones of axial and appendicular skeleton Classification, types and movements of joints, disorders of joints

UNIT II: Respiratory system & Cardiovascular system **10 Hr.**

Anatomy of respiratory organs and their functions, Regulation, and Mechanism of respiration. Respiratory volumes and capacities. Anatomy and Physiology of heart. Blood vessels and circulation. Cardiac cycle, Blood pressure and its regulation

UNIT III: Digestive and Urinary system **10 Hr.**

Anatomy and Physiology of the GIT. Anatomy and functions of accessory glands. Physiology of digestion and absorption. Anatomy and physiology of urinary system. Physiology of urine formation. Renin - angiotensin system. Clearance tests and micturition

UNIT IV: Nervous system and Sense organs **10 Hr.**

Classification of nervous system. Classification of nervous system. Anatomy and physiology of cerebrum, cerebellum, mid brain. Function of hypothalamus, medulla oblongata and basal ganglia. Spinal cord-structure and reflexes. Names and functions of cranial nerves. Sense organs: Eye, Ear, Skin, Tongue and Nose

Max. 42 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Gain fundamental knowledge of human anatomy and physiology.
CO2: Understand the functions of vital organs and their control mechanism.
CO3: Classify and compare various tissues, bones, nerves, organs and their applications.
CO4: Get acquainted with homeostatic mechanisms of human body.
CO5: Focus on consequence in organ dysfunction and its clinical significance.
CO6: Design and develop solutions to various clinical conditions.

TEXT/REFERENCE BOOKS

1. Ross and Wilson Anatomy and Physiology in Health and illness
2. Fundamentals of Medical Physiology by K. Sambulingam and P Sambulingam
3. Human Anatomy and Physiology by S. Chaudhary and A. Chaudhary
4. Human Physiology by C. C. Chatterjee
5. Goyal R.K., Natvar M.P. and Shah S.A., Practical Anatomy, Physiology and Biochemistry, Experimental Physiology

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks

XXXXXXX					General Microbiology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

This course is aimed give an understanding about the basics of microbiology dealing types of microbes, classification & characterization

UNIT 1 History and Classification

History and scope of Microbiology, Spontaneous generation - Biogenesis theory - Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich and Sir Alexander Flemming. Germ theory of disease. Binomial Nomenclature, Whittaker's five kingdom and Carl Wiese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms

UNIT- 2 Microscopy and Staining

Microscope- Principles, working mechanism and application - Simple and compound microscope -Dark field - Phase contrast, Fluorescence, SEM and TEM. Structure and organization of bacterial cell, Gram positive and Gram-negative bacterial cell wall. Types of Staining - Simple, Differential (Gram's, AFB), Special - Capsular staining (negative), Spore. LPCB, KOH mount

UNIT- 3 Subcellular Structures

Microbial cell: Ultrastructure of bacteria, subcellular structures and cell envelope – slime, capsule, cell wall, pili, flagella, cell inclusions, biosynthesis of bacterial cell wall, cell membrane – Bio-membrane, liposomes – membrane transport – diffusion, active and passive transport and osmoregulation.

UNIT- 4 Sterilization & Media and Techniques

Sterilization and Disinfection- principles -methods of sterilization- physical methods - Dry heat- Moistheat- Radiation. Filtration (Membrane and HEPA). Chemical sterilization- Chemical agents- mode of action- phenol coefficient test sterility testing. Culture and media preparation - solid and liquid. Types of media- Semi synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media. Pure culture techniques – Tube dilution, Pour, Spread, Streak plate. Anaerobic culture technique Wright's Tube, Roll tube method, Anaerobic Jar.

COURSE OUTCOMES

- Understand the fundamentals of Microbiology
- To learn microscopic techniques
- To get idea about the microbial cell & sterilization & disinfection

TEXT / REFERENCE BOOKS

1. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
2. Bernard R. Glick & Jack J. Pasternak. 2002. Molecular Biotechnology. Indian edition. Panima Publishing Corporation.
3. Pelzer, Chan and Kreig. 1986. Microbiology. 5th Edition. McGraw-Hill.
4. Tortora, G.J., Funke, B.R. and Case, C.L. 2012. Microbiology - An Introduction. 11th Edition. Pearson Education.
5. Stainer, Ingharam, Wheelis and Painter. 1987. General Microbiology. 5th Edition. Macmillan Education,
6. London.
7. A.J. Salle. 1974. Fundamental Principles of Bacteriology. Tata McGraw – Hill Edition.

XXXXXXX					Biochemistry Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To learn the basics of bio chemistry.
- To relate concepts learned in chemistry and engineering to the real-world situations.
- To acquire skills to perform laboratory experiments.
- To demonstrate safe and proper use of standard chemistry glassware and equipment.

List of Experiments

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enzymatic hydrolysis of starch
10. Determination of Salivary amylase activity
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:- To get basic knowledge of practical biochemistry.

CO2:- To be able to do quantitative and qualitative analysis of biochemicals.

REFERENCE BOOKS

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by D. Satyanarayan and U.Chakrapani
4. Outlines of Biochemistry by Conn and Stumpf

CH201P					Fluid Mechanics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- Describe how to design experiments, perform experiments, and analyse and interpret the observations yielded.
- To compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows.
- To discuss and practice standard measurement techniques of fluid mechanics and their applications.

List of Experiments:

1. Study of flow regimes by Reynolds's apparatus
2. Study of Bernoulli's equation
3. Determination of Viscosity by efflux time measurement
4. Study of friction factor in close conduits
5. Study of minor losses and determination of equivalent length of pipe fittings
6. Study of venturimeter
7. Study of orifice meter
8. Calibration of rotameter
9. Studies of Pitot tube
10. Characteristics of centrifugal pump
11. Study of friction factor in annular flow
12. Determination of Viscosity by Stokes's Law

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 To relate the theoretical and practical concepts of fluid mechanics used in industry.

CO2 Compare the results of analytical study introduced in lecture to the actual behaviour of real fluid flows and draw correct and sustainable conclusions.

CO3 Develop the ability to work in groups on small design projects that are appropriate to the course.

CO4 Categorize ethical issues associated with decision making and professional conduct.

CO5 Assess the ability to write clear lab reports.

CO6 Take part in successful completion of an experiment as a part of team building exercise and follow ethical practices judiciously.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A/Question: Practical Work	50 Marks
Part B/Question: Practical and Viva Exam	50 Marks

20HSXXXP					Communication Skills – II (Semester – III/IV) (Second Year)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To understand communication and its process and effect on giving and receiving information.
- To learn and apply communication skills in different public and interpersonal contexts.
- To develop analytical, research, and organizational skills through communication skills for a fulfilling career.

UNIT 1 **7 hrs**

Technical Writing- Report Writing, Creating Lab Journals and Manuals, Portfolio of Critical Writing and Creative Writing - Essay, Story-writing, etc.

UNIT 2 **7 hrs**

Summarizing, Writing Reviews (Books/Articles/Movies/websites), Reading Skills (Advanced)

UNIT 3 **7 hrs**

Digital Literacy- Emails, Creating e-content, Editing and proofreading online, Using grammar and spell check software, Using plagiarism checkers

UNIT 4 **8 hrs**

Group Discussion, Resume Writing, Interview Skills

Max. 30 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO 1 Apply current technology for effective communication leading to better dissemination of knowledge and expertise.
CO 2 Demonstrate relevant knowledge of communication skills in different settings to cater to different purposes and audiences.
CO 3 A sound understanding of communication theory, practice and application to optimize career opportunities.
CO 4 Dynamic communication skills to build and maintain robust and effective professional relationships.
CO5 Augmented communication skills to prepare and present messages, reports and documents in intent and to integrate different sources of information and knowledge.
CO 6 Monitoring and critical reflection on communication skills for the adoption of appropriate strategy required in achieving the desired outcomes.

TEXT/REFERENCE BOOKS

1. Harmer, Jeremy. The Practice of English Language Teaching. Harlow: Pearson Longman, 2007.
2. Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
3. Maley, A. 'Literature in the Language Classroom', The Cambridge Guide to Teaching ESOL, Cambridge University Press, 2001.
4. Richards, Jack C., and Willy A. Renandya, eds. Methodology in Language Teaching: An Anthology of Current Practice. Cambridge University Press, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Assessment Tool	Marks	Assignments
Lab Work	50	• Essay/Journal Writing – 10 • Report Writing – 10 • Creating e-content – 10 • Blog Writing – 10 • Review Writing - 10
Lab Exam/Viva	50	• Mock Interview – 15 • Group Discussion – 15 • Cover Letter/Curriculum - 20

Semester – 4

XXXXXXX					Heat Transfer for Chemical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the modes of heat transfer (conduction, convection and radiation) and their application in process industries.
- To understand heat balance equations in heat exchangers.
- To understand heat transfer with phase change
- To understand combined heat transfer, this involves all modes of heat transfer.

UNIT 1 CONDUCTION **12 Hrs.**

Introduction and fundamentals of heat transfer, heat transfer rate, flux, resistances, Conduction through a single homogeneous solid, thermal conductivity of solids, liquids and gases. Conduction through objects in series, Contact resistances, Heat losses and insulation, Concept of critical insulation thickness.

12 Hrs.

UNIT 2 CONVECTION

Film and overall heat transfer coefficients, Solid-fluid heat transfer, Natural and forced convection, Laminar and turbulent flow heat transfer, Coefficients for scale deposits, concept of L.M.T.D. in heat exchangers with co and counter current flow, Effectiveness, N T U method in finned tube heat exchangers.

9 Hrs.

UNIT 3 HEAT TRANSFER WITH PHASE CHANGE

Nucleation and boiling, Film wise and drop wise condensation, Condenser design, Fundamentals of pervaporation Unsteady state heat conduction, lumped heat capacity system, transient heat flow in a semi-infinite solid.

7 Hrs.

UNIT 4 RADIATION

Black and gray body radiations, Plank's law, Stephen-Boltzmann law, View factor, Luminous and non-luminous gases. Combined heat transfer, i.e. conduction, convection and radiation together.

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Define the basic principles of heat transfer operations, related to different mode of heat transfer.

CO2 - Demonstrate the principles of heat transfer operations involving conduction, convection, radiation including phase change.

CO3 - Apply principles of heat transfer operations involving conduction, convection, radiation including phase change.

CO4 -Analyze the problems related to conduction, convection and radiation involving heat exchanger, evaporators and condensers.

CO5 - Justify the applications of theory learned in industrial practices regarding conduction, convection and radiation involving heat exchanger, evaporators and condensers.

CO6 - Design heat transfer equipments based upon the conditions given in the problem statement.

TEXT/REFERENCE BOOKS

1 J. M. Coulson and J. F. Richardson, Chemical Engineering Vol. I and II, 6th Edition, Elsevier Press, 2000.

2. W. L. McCabe and J. C. Smith, P. Harriot, Unit Operations of Chemical Engineering, 7th ed. McGraw Hill 2014.

3. D. Q. Kern, "Process Heat Transfer", McGraw Hill, 2014.

4. J. P. Holman and S. Bhattacharyya, "Heat Transfer", McGraw Hill Education, 10th edition, 2011

5. B. K. Dutta, "Heat Transfer: Principles and Applications" PHI Publishers, 2014

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: Theoretical Question	50 Marks
Part B/Question: Analytical and Numerical Question	50 Marks

20CH302T					Chemical Reaction Engineering 1					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide understanding of basic principles and terminology in reaction kinetics
- To acquaint students towards basic designing of ideal reactors
- To allow students to analysis the rate data and thereby find the kinetics parameters of interest
- To illustrate concept of reactor sequencing, and evaluate the performance of ideal reactors

UNIT 1 BASICS OF KINETICS **08 Hrs.**

Mole balances, kinetics of homogeneous reactions – rate of reaction, type of reactions, reaction mechanism, temperature and concentration dependent term of a rate equation, searching for a reaction mechanism, rate law and stoichiometry, approach to reactor sizing and design.

UNIT 2 ANALYSIS OF RATE DATA **12 Hrs.**

Collection and analysis of rate data, integral and differential method of analysis of data, batch reactor data, variable and constant volume system, method of initial rates, method of half-life, differential reactors, least square analysis.

UNIT 3 ISOTHERMAL REACTOR DESIGN **10 Hrs.**

Ideal reactors: batch reactors, semi-batch reactors, continuous-flow reactors, recycle reactors conversion and reactor sizing, design equations, applications of the design equations for continuous-flow reactors, introduction to micro reactors, membrane reactors and bioreactors

UNIT 4 REACTOR SEQUENCING **10 Hrs.**

Reactors in series, reactors for parallel reactions, maximizing desired product in parallel reactions, maximizing desired product in series reactions, temperature and pressure effect in single and multiple reactions, adiabatic reactor design.

Max. 40Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Relate to the basics of kinetics and basic theories to get the underlying mechanisms
CO2 – Interpret and evaluate the rate data and get the kinetics parameters
CO3 – Select proper design equations and perform reactor sizing for ideal reactors
CO4 – Examine the suitable combinations of ideal reactors for optimal performance
CO5 – Decide the reactor sequencing for single and multiple reactions towards desired products
CO6 – Design ideal reactor systems based on experimental data and optimize its performance

TEXT/REFERENCE BOOKS

1. H. S. Fogler, "Elements of Chemical Reaction Engineering", 3rd Ed, New Delhi-Prentice Hall, 2001
2. O. Levenspiel," Chemical Reaction Engineering" Willey Eastern, 3rd Ed., 2000
3. J. M. Smith, "Chemical Engineering Kinetics", 3rd Ed., McGraw- Hill, 1988

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: Theoretical knowledge and understanding	20-30 Marks
Part B/Question: Problem Solving, Design and Analysis	70-80 Marks

20IF201T					Industry 4.0					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

- To interpret the core elements and basic technologies of Industry 4.0
- To understand how the core elements and technologies of Industry 4.0 are interconnected
- To develop a holistic approach to improve processes and products with Industry 4.0

UNIT I: INDUSTRY 4.0 – CONCEPTS & TERMINOLOGIES **08 Hrs.**

Industry 4.0, Smart business model, Technology road-map, Sensing & actuation, Communication, Internet of things (IoT), Cyber Physical Systems and Next Generation Sensors, Visualization, Cloud Computing.

UNIT II: SMART WORLD & SUSTAINABLE ENVIRONMENT **08 Hrs.**

Sensors and their integration, Renewable Energy System, Hybrid Energy System, Smart Grid, Smart Metering, Communication Protocols, 5G Technology, Smart Agriculture, Smart Infrastructure, Physiological Sensors, Human Machine Interface.

UNIT III: SMART MANUFACTURING **08 Hrs.**

Automation Systems, Additive Manufacturing, Micro-Electro-Mechanical Systems (MEMS), Smart Factories and Interconnection, Advanced Robotics – Autonomous and Swarm, Self-Propelled Vehicles, Drones–Unmanned Aerial Vehicle (UAV), 3d Printing, Spacecrafts.

UNIT IV: TRANSFORMING TECHNOLOGIES IN BIOENGINEERING **08 Hrs.**

Establishment of Smart Biotechnology Factory, Artificial Intelligence in Bioprocess Technology, 3D Bio Printing for Tissue Engineering, Simulation Tools, RSM and Box Model, Cyber Physical System based Telemedicine, Real Time Biosensors, Bio nanotechnology, biofuel.

Total Hours 32 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand the core elements and basic technologies for Industry 4.0
CO2- Apply the different computational techniques and algorithms for realizing Industry 4.0
CO3- Transform the traditional business approach by integrating the data and intelligence
CO4- Develop the traditional industries with intelligent and automated machines
CO5- Utilize data and intelligence for the development of Smart World
CO6- Understand the concept, significance and means to achieve sustainable development

TEXT/REFERENCE BOOKS

1. Ustundag Alp, and Emre Cevikcan, Industry 4.0: Managing the Digital Transformation, Springer,First Edition, 2018
2. Kaushik Kumar, Divya Zindani, and J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0., CRC Press, Taylor & Francis First Edition, 2019.
3. Antonella Petrillo, Raffaele Cioffi, and Fabio De Felice, Digital Transformation in Smart Manufacturing., IntechOpen Publisher, First Edition, 2018.
4. J. Ekanayake, K. Liyanage, J. Wu, A. Yokoyama and N. Jenkins, Smart Grid: Technology and Applications, John Wiley and Sons Ltd., First Edition, 2012
5. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, First Edition, 2016
6. Ibrahim Garbie, Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0, Springer, First Edition, 2016

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: Theoretical Questions 50 Marks
Part B/Question: Analytical Questions 50 Marks

Pandit Deendayal Energy University

					Tissue Engineering & Regenerative Medicine					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of tissue engineering and tissue repairing
- Understand the basic concept behind tissue engineering focusing on the stem cells, biomaterials and its applications.
- Acquire knowledge on clinical applications of tissue engineering

UNIT I: Tissue Architecture **10Hr.**

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing. Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix & Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.

UNIT II: Biomaterials **10 Hr.**

Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT III: Biology of Stem Cell **10 Hr.**

Stem Cells: Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, haematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuri potent stem cells.

UNIT IV: Clinical Applications **12 Hr.**

Stem cell therapy, Molecular therapy, *In vitro* organogenesis, Neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopaedic applications, Stem cells and Gene therapy. 3D bioprinting of tissues and organs. Tissue engineered product characterization, components, safety, efficacy. Preservation –freezing and drying. Patent protection and regulation of tissue-engineered products, ethical issues.

Max. 42 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Gain the fundamental knowledge of tissue architecture.

CO2: Understand the mechanism of tissue repair.

CO3: Classify different categories of Biomaterials used in tissue engineering.

CO4: Get acquainted with stem cell characteristics and their relevance in medicine.

CO5: Focus on properties and broad applications of biomaterials.

CO6: Design and develop 3D scaffolds and engineered substitutes for clinical conditions.

TEXT/REFERENCE BOOKS

1. Bernhard O.Palsson, Sangeeta N.Bhatia, "Tissue Engineering" Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P.Fundamentals of Tissue Engineering and Regenerative Medicine.2009.
3. Bernard N. Kennedy (editor). Stem cell transplantation, tissue engineering, and cancer applications, Nova Science Publishers, 2008.
4. Raphael Gorodetsky, Richard Schäfer. Stem cell-based tissue repair. RSC Publishing, 2011.
5. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two- Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells, Academic Press, 2004.
6. R. Lanza, J. Gearhart etal (Eds), Essential of Stem Cell Biology, Elsevier Academic press,2006.
7. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches In Tissue Engineering & Regenerative Medicine" Artech House, INC Publications,2008.
8. Naggy N. Habib, M.Y. Levicar, L. G. Jiao and N. Fisk, Stem Cell Repair and Regeneration, volume-2, Imperial College Press,2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks

20CH315T					Pharmaceutical Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Acquire the knowledge of basic pharmaceutical technology and characteristics of pharmaceutical industries.
- Gain an understanding of Sterilization applications and Dosage farms.
- Understand and apply methods for Manufacturing and packaging of pharmaceutical products.

UNIT 1 BASICS OF PHARMACEUTICAL TECHNOLOGY **8 Hrs.**

Characteristics of Pharmaceutical industries, Product Standards: IP, BP, USP, Methods of production, Chemical synthesis, Isolation from plants, isolation from animals, Fermentation, API and Formulation.

UNIT 2 STERILIZATION **10 Hrs.**

Sterility and requirement of sterility, Concept of sterilization. Methods of Sterilization with, applications, Heat sterilization, Steam sterilization, Dry heat sterilization, Radiation sterilization Gas sterilization, Filtration sterilization. Sterile facilities.

UNIT 3 CLEAN FACILITIES AND DOSAGE FORMS **12 Hrs.**

Design parameters for clean facilities: Air change rate, Pressurization, Temperature control, Humidity control. Architectural design issues. Material of construction for wall, doors, ceilings, floors, Clean construction. HEPA filters. Solid dosage forms: Tablets, Coated tablets, Gelatine capsules, Chewable tablets. Excipients in solid dosage forms. Semi-Solid dosages: Ointments and creams, Bases for ointments and creams, Types of Gels, Commercial Gelling agents

UNIT 4 MANUFACTURING AND PACKAGING **10 Hrs.**

Manufacturing, tablets and capsules, Packaging and storage of ointments and creams, Critical aspects of liquid manufacturing: particle size of raw materials, parameters of compounding, uniformity, stability problems. Packaging materials: General considerations, Glass, Plastic and metal. Quality control of packaging materials

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand key concepts of Pharmaceutical technology.
CO2 - Identify appropriate methods in medicine production.
CO3 - Apply various methods of sterilization.
CO4 - Use design parameters for clean facilities
CO5 - Produce different dosage forms
CO6 - Identify appropriate packaging materials.

TEXT/REFERENCE BOOKS

1. Pharmaceutical Process Engineering, Hickey, Anthony J, David Ganderton. Marcel Dekker Inc. USA, 2001.
2. Pharmaceutical Manufacturing handbook. Gad, Shayne Cox. John Wiley and Sons, 2008
3. Good pharmaceutical Manufacturing practice. Sharp, John, CRC press, New York, 2005.

XXXXXXX					Analytical Methods in Bioengineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To understand the fundamentals of analytical methods used in Bioengineering.
- To learn the principles and instrumentation of chromatographic techniques and spectrometric techniques.
- To learn the principles and instrumentation of Microscopic techniques.

UNIT I

Introduction and classification of methods used in Analytical Bioengineering

Unit –II

Principles, Instrumentation and applications of Electrophoretic methods, Principles, Instrumentation and applications of different chromatography techniques: GC, HPLC, FPLC, HPTLC

Unit III

Principles, Instrumentation and applications of UV-Vis Spectrophotometry, Principles, Instrumentation and applications of Fluorescence methods, FT-IR, Circular dichroism, Mass spectrometry: GC=MS, LC-MS, ICP-MS.

Unit-IV

Principles, Instrumentation and applications of Immunology based analytical methods (ELISA), qPCR and Advanced Microscopy Techniques: Electron Microscopy, Confocal Microscopy.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:- Understand the different types of analytical methods.

CO2:- To be able to identify the suitable analytical techniques for different biological compounds.

CO3:- characterize complex structures using analytical methods

REFERENCE BOOKS

1.

XXXXXXX					General Microbiology Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- The students understand experimental microbiology with a problem-oriented approach

List of Experiments

1. Techniques for isolation of microorganisms-Pour plate technique and Spread plate technique
2. Purification of microorganisms from a mixed culture by streak plate preparation
3. Preservation of microorganisms-Glycerol stock method and Agar slant method
4. Microscopy
   i. Microscopic examination of stained cell preparation-Preparation of bacterial smears, simple staining, negative staining, gram staining
   ii. Microscopic examination of live bacterial population-Hanging drop method
5. Biochemical Activities of Microorganisms: IMViC, catalase, oxidase
6. The Fungi Cultivation and identification of unknown fungi by lactophenol cotton blue staining
7. Microbiology of food-Methylene Blue Reductase Test and Microbiological Analysis of Food products
8. Microbiology of water Standard Qualitative analysis of water: Presumptive test, Confirmed test, Completed Test

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:- Prepare basic solutions required for complex analysis.
CO2:- Employ tools in biochemistry to assess biomolecules.
CO3:- Discuss the various steps of analysis.
CO4:- Interpret the results obtained from assay methods.
CO5:- Develop different strategies for analysis of novel molecules.
CO6:- Criticize on the results and validate methods.

REFERENCE BOOKS

1. Melvyn Kay, Practical Handbook of Microbiology (2nd edition), CRC Press, 2008.

20CH302P					Chemical Reaction Engineering 1 Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- Experimentation with different ideal reactors for a homogeneous liquid phase reactions to determine kinetics
- To find the kinetic parameter using Arrhenius theory by experimentation with different ideal reactors
- Find the application of combination of ideal reactors and the change in performance with the ideal reactors

LIST OF EXPERIMENTS

1. To study a non-catalytic homogeneous liquid phase reaction in an ambient CSTR
2. To study a non-catalytic homogeneous liquid phase reaction in an ambient straight tube PFR
3. To study a non-catalytic homogeneous liquid phase reaction in an ambient semi Batch reactor
4. To study a non-catalytic homogeneous liquid phase reaction in an ambient three Cascaded CSTR
5. Evaluating kinetic parameters (k_0 and E) for a saponification reaction in an Batch Reactor
6. Evaluating kinetic parameters (k_0 and E) for a saponification reaction in an Coiled PFR
7. Evaluating kinetic parameters (k_0 and E) for a saponification reaction in an CSTR
8. To study a non-catalytic homogeneous liquid phase reaction in an ambient combined flow reactor (CSTR+PFR)

COURSE OUTCOMES

CO1 – Relate to the basics of kinetics and application of the same in practical
CO2 – Interpret and evaluate the rate data and get the kinetics parameters for different reactors
CO3 – Apply proper rate equations and compare the performance of different ideal reactors
CO4 – Examine the combinations of ideal reactors and analyze the theoretical findings
CO5 – Decide the reactor sequencing so as to optimize the volume or conversion for given combinations of reactors
CO6 – Develop an ability to work in group, learn report making, and improve soft skills in representing the findings

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: Practical Performance, Report Submission and Pre Viva	50 Marks
Part B/Question: Written Exam and Practical Viva	50 Marks

XXXXX					Pharmaceutical Technologies Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To understand techniques involved in formulation of dosage forms
- To Observe quality control tests for the common dosage forms
- To design appropriate packaging and labelling requirements
- To introduce basic concepts of pharmaceutical technologies

Experiment Sessions would be simulation based covering but not limited to following topics:

1. To formulate Liquid Oral: Simple syrup, Piperazine citrate elixir, Aqueous Iodine solution
2. To formulate Ointment: Simple ointment base, Sulphur ointment
3. To formulate Emulsion: Castor oil emulsion, Cod liver oil emulsion
4. To formulate Suspension: Calamine lotion, Magnesium hydroxide mixture
5. To formulate Cream: Cetrimide cream
6. To formulate Gel: Sodium alginate gel
7. To formulate Liniment: Turpentine liniment, White liniment
8. To formulate Sterile Injection: Normal Saline, Calcium gluconate Injection
9. To formulate granules

COURSE OUTCOMES

On completion of the course, student will be able to
CO1: Study the fundamentals of pharmaceutical technologies
CO2: Understand the working principle of pharmaceutical equipment's
CO3: Apply the technology in formulating desired dosage form
CO4: Analyse the appropriate Packaging and labelling requirements
CO5: Evaluate quality parameters of the dosage forms
CO6: Develop formulation of interest

TEXT/REFERENCE BOOKS

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopoeia.
5. British pharmacopoeia.
6. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan.
7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9.Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker,
INC, New York.
10. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

Pandit Deendayal Energy University **School of Energy Technology**

20IF201P					Industry 4.0 Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To interpret the core elements and basic technologies of Industry 4.0
- To understand how the core elements and technologies of Industry 4.0 are interconnected
- To develop a holistic approach to improve processes and products with Industry 4.0

LIST OF EXPERIMENTS

1. Basic computations using Python programming.
2. Use simulations to understand the performance/behavior of a system by (i) creating a computational environment that mimics the real world, (ii) generating (synthetic) or loading data from sources, and (iii) testing the hypothesis
3. Introduction to MATLAB programming and SIMULINK
4. 3D printing of Airfoil through rapid prototyping 3D printer
5. Dynamic simulation of drone (unmanned air vehicle) through MATLAB/SIMULINK
6. ANSYS simulation of bending of a beam in an earthquake resist-building
7. Introduction to Arduino Embedded platform.
8. Design of line follower autonomous vehicle.
9. Design of smart meter for recording the electricity consumption
10. Design of smart lighting with the help of proximity sensors.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand the concept of Industry 4.0 and its significance

CO2- Understand the resource requirements for the implementation of Industry 4.0

CO3- Learn the Simulation Packages for Industry 4.0

CO4 - Explore the concept of Smart Infrastructure through simulation studies

CO5 - Inspect embedded platform applications for Industry 4.0

CO6 - Synthesise the solution for the given Industry 4.0 related problem

TEXT/REFERENCE BOOKS

1. Ustundag Alp, and Emre Cevikcan, Industry 4.0: Managing the Digital Transformation, Springer,First Edition, 2018
2. Kaushik Kumar, Divya Zindani, and J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0., CRC Press, Taylor & Francis First Edition, 2019.
3. Antonella Petrillo, Raffaele Cioffi, and Fabio De Felice, Digital Transformation in Smart Manufacturing., IntechOpen Publisher, First Edition, 2018.
4. J. Ekanayake, K. Liyanage, J. Wu, A. Yokoyama and N. Jenkins, Smart Grid: Technology and Applications, John Wiley and Sons Ltd., First Edition, 2012

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Viva Voce Examination 50 Marks

Practical Examination 50 Marks

TP210					Industrial Orientation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	4	2	2	-	-	-	-	100	100

COURSE OBJECTIVES

- To enable the students to better visualize what they have learned in classroom to the real industrial situations.
- To provide the opportunity during the industrial visit to see large-scale industrial processes and equipments as well as real engineering practices.
- To give opportunity for active/interactive learning experiences in class as well as outside the classroom environment.
- To promote success & growth of individuals and fulfil the current requirements of industry.

CONTENT

Industrial visits offer a great source to gain practical knowledge. Students can observe and learn as to how theoretical concepts are put to into action, thereby aiding their practical learning.
More over students will gain the subject learning outcome by means of pre and post industrial visit survey. This has resulted in enhanced visibility for the students among their learning outcomes and their portfolio.
The visit generally consists of lectures about the company, the site being visited and a range of topics specific to learning outcomes. Students are exposed to real working environment and shown how things are done in an organisation.
It is expected from students to understand and relate the theoretical concepts learned in the classroom with industry. Students are required to prepare good Industrial Orientation report on industries visited and enhance technical as well as communication skills.

COURSE OUTCOMES/LEARNING OUTCOMES

On completion of the course, student will be able to

CO1 - Define the impacts of industrial processes on health, safety, environment and society.

CO2 - Illustrate the processes and products manufactured in the chemical industries.

CO3 - Develop interpersonal skills, communication technique and report writing skills.

CO4 - Classify the industry practices and regulations followed by industries.

CO5 - Prioritize engineering and technological aspects in the chemical industries.

CO6 - Build the bridge between theoretical knowledge and practical learning in a real-life environment.

Semester – 5

Pandit Deendayal Energy University

XXXXXXX					Process Dynamics and Control					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/VIVA	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To teach the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects.

Unit I Introduction to Process Dynamics and Control Plant

Process, Sensors, Transmitters, Signal Conditioning, Feedback- Process Control Terminology: Manipulated Variables, Controlled Variables, Controlling Variables, Controller Efforts, set point /target Variables, Measured and Unmeasured Variables - Block diagram, Transfer Function, Importance of Negative and Positive Feedback - Introduction to industrial automation: Distributed Control System, SCADA, A/D, D/A, Data Acquisition.

Unit II Process Modeling and Simulation

First Principle based Modeling (Conservation Laws) - Different types of mathematical representation of a process/system : Mathematical model in form of a differential equation , transfer function and state space equations - First Principle based modeling of Mechanical Systems: Rotational and Transational mechanical systems such as Spring-Mass-Damper, Suspension System etc., Electrical Systems: F-C analogy, F-V analogy, DC Motor, Electrical Systems Analogy with mechanical systems, Chemical Systems: Single Tank, Two Tank, Four Tank, CSTR etc., Electro-mechanical systems: electrically suspended ball - Linear Models and Deviation Variables - Linear Models and Deviation Variables: Taylor's series expansion and linearization, Concept of deviation variables, MATLAB exercise - Numerical Solution of linear and Non-linear Algebraic and Ordinary Differential Equations.

Unit III Analysis of a Dynamic Behavior of a System

Time Response Analysis - Order and type of the system, Error, Poles, Zeros, ZPK Form, MATLAB functions, Standard Test Signals, Behavior of First Order System in response to standard test signals, Concept of time constant, Behavior of Second Order System - Time Response Specifications: Settling Time, Rise Time, peak time, Damping, dead time, speed of the response, Maximum Peak Overshoot - Special behavior of processes: Overshoot, Undershoot, Inverse Response, Integrating Process, Unstable systems, Minimum and Non-minimum Phase Behavior, Processes with dead time - Concept of Characteristic Equation, Routh-Hurwitz Criterion for stability analysis - Frequency Response Analysis - Frequency Response Specifications: Bandwidth, Gain cross-over frequency, Phase cross-over frequency, Gain Margin, phase Margin, cut off frequency, Resonance Peak etc. Stability analysis using Bode Plots, Polar Plots and Nyquist Plots

Unit IV Industrial Automation

Conventional controller such as P, PI, PID controllers, tuning of PID controllers, Introduction to programmable logic controllers

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 -Fundamental understanding of process control strategies and process design

CO2 - Describe the dynamic behavior of the first order and second order process

CO3 - Apply mathematical transformations to solve differential equations

CO4 - Analyze feed-forward and backward control system

CO5 - Evaluate the advance control strategies

CO6 - Design of SISO and MIMo models

Texts and References:

1. B. A. Ogunnaike, W. H. Ray, “Process Dynamics, Modeling and Control”, Oxford University Press, 1994.
2. Seborg, Edgar and Mellichamp, “Process Dynamics and Control”, John Wiley, 2nd Edition, 2004.
3. J.F. Franklin, J.D. Powell, A. Emami-Naeini, “Feedback control of dynamic systems”, AddisonWesley Publishing Company, 1994.
4. B. Wayne Bequette, “Process Control: Modeling, Design, and Simulation”, Prentice-Hall of India, 2006.
5. Katsuhiko Ogata, “Modern Control Engineering”, Prentice-Hall, 3rd Edition, 2006.

Pandit Deendayal Energy University

					Biomaterial & Implants					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of Biomaterial & Implants
- Understand the basic concept of bio materials that are used in medical devices.
- Acquire knowledge on Bio-materials and the Medical devices

UNIT I: Introduction to Biomaterials **10Hr.**

Biomaterial, Types of Biomaterials, Biocompatibility, Biological material, Biodegradable material, Bioresorbable material, Bio-inert material, Bio-active material, Minimum Requirements of Biomaterials, Surface Properties of Biomaterials, Desirable Properties of Biomaterial, Performance of Biomaterials, Applications of Biomaterials.

UNIT II: Different types of Biomaterials **12 Hr.**

Metallic Biomaterials: Introduction, Stainless steel, Co-Cr Alloys, Ti-Alloys, Nitinol, Dental metals, Corrosion of Metallic implants, Manufacturing of Metallic implants, Applications. Ceramic Biomaterials: Introduction, Types of Ceramics, Bio-inert ceramics: Alumina, Zirconia, Carbon, Bioresorbable ceramics: Calcium Phosphate, Bio-active ceramics: Glass ceramics, Applications.

Polymeric Biomaterials: Introduction, Basic structures of Polymers, Polymerization and its Types, Polyethylene, Polypropylene, Polyamides, Polyacrylates, Hydrogel, Bone cement, Fluorocarbon polymers, Silicon Rubber, Bioactive Polymers, Biodegradable Polymers, Applications. Composite Biomaterials: Introduction, Dental filling Composites & cement, Porous Composites, Fibrous & Particulate composites.

UNIT III: Biocompatibility Testing & Response of Biomaterial **10 Hr.**

Biocompatibility Testing: Introduction, In-Vitro Testing, In-Vivo Testing, Hypersensitivity, Haemocompatibility, Odontocompatibility, Osteocompatibility, Cytotoxicity, Genotoxicity, Carcinogenicity. Response of Biomaterial to Human Body: Blood-Biomaterial Interactions, Biomaterials-Tissue Interactions, Tissue response to Implants, Inflammation, Wound Healing, Foreign Body Response, Infection and Tumorigenesis of Biomaterials.

UNIT IV: Bio-implants **10 Hr.**

Stent, Vascular grafts, Artificial Heart valves, Contact lenses, Intra-ocular lenses, Artificial Silicon Retina, Temporary fixation Devices, Total Hip Replacement, Total Knee Replacement, Dental filling & Restoration material, Dental implants, Suture materials, Wound dressings, Tissue Adhesives.

Max. 42 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Describe biomaterials, classifications, their properties, performance specification and biological applications.

CO2: Explain the types, composition, properties, manufacturing and applications of Metallic & Ceramic biomaterials

CO3: Illustrate the types, composition, properties, manufacturing and applications of Polymeric & Composite biomaterials

CO4: Decide the testing procedure for specific biomaterial/implant and evaluate the response of biomaterial/Implant to Human body.

CO5: Apply the knowledge of biomaterials to judge which material/implant should be used for what kind of application according to nature of diseased and ill area of the body

TEXT/REFERENCE BOOKS

1) Biomaterials, By Sujata V. Bhatt, Narosa Publishing House, New Delhi, India
2) Biomaterials: An introduction, By Joon B. Park, Roderic S. Lakes, Springer.
3) Biomaterials Science: An introduction to materials in medicine, Edited by Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, Elsevier.
4) Biomedical Materials, R.Narayan (ed.), Springer Science.
5) Biomaterials: Principles and Applications, Edited by Joon B. Park, Joseph D. Bronzino, CRC Press.
6) Biomaterials Medial Devices and Tissue Engineering By Fredrick H. Silver Chapman and Hall.
7) Biomaterials science and engineering By J. B. Park Plenum press, New York.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks

XXXXXXX					Fundamentals of Genomics & Proteomics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To understand the fundamentals of genomics & proteomics.
- To teach the genome mapping and proteomic studies

UNIT I

Introduction to Genomics: Organization and main features of prokaryotic and eukaryotic genomes. Genome sequencing methods: Maxim - Gilbert and Sanger's method, automated sequencing, pyro-sequencing. Sequence assembly: Clone contig and shotgun approaches. Genome Projects: Aims and objectives, Brief outlook of various Genome Projects - Human genome Project, Plant and animal genome projects. Genome databases

Unit –II

Genome Mapping: Genetic and physical maps. RFLP, SSLP, STRs, VNTRs, EST, STS, FISH, Radiation hybrids. Sequence markers - SNPs. Determination of the functions of genes: gene inactivation (knock-out, anti-sense and RNA interference) and gene over expression. Gene expression analysis - DNA microarray approach.

Unit III

Introduction to Proteomics: Introduction, Branches of proteomics. Proteome Project. Interactions in Proteomics: Protein-Protein Interactions. Methods - Yeast Two hybrid analysis, Phage display, Databases. Protein-DNA Interactions - DNA binding Motifs.

Unit-IV

Proteomic Studies: Characterization of Proteome: Protein purification, Protein separation: 2-D gel electrophoresis and affinity chromatography, HPLC. Protein identification: Mass Spectrometry. Protein sequence analysis: N-terminal determination methods. Protein modifications. Protein expression profiling: Protein microarrays. Omics Concepts: Transcriptomics and SAGE; Pharmacogenomics, Comparative Genomics, Population genomics, Metabolomics & KEGG, Fluxomic, Glycolic, Nutrigenomics, Epigenomics

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:-Apply the concept of genetic information stored and the current genomics technologies

CO2:-Analyse the significance of mapping with respect to the structure and function of genome

CO3:-Identify the key concepts of proteomics with a mention on various aspects of proteomic studies involving the interactions of these biomolecules with other biomolecules.

CO4:-Choose and compare methods for the purification of proteins and analyaing them on a high through put platform

CO5:-Ponder on the various techniques for expression profiling including RNA through SAGE and microarrays

CO6:-Harbour the knowledge on some of latest omics concepts with respect to biological systems

REFERENCE BOOKS

1. Brown T.A, Gene Cloning, Chapman and Hall, 2004.
2. Brown T.A, Genomes, Bios Scientific Publishers Ltd 2002.
3. Greg Gibson and Spencer V. Muse, A Primer of Genome Science, 3rd Edition, Sinauer Associates, Inc., 2009

XXXXXXX					Pharmacology of Drug Action - I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- Understand the pharmacological actions of different categories of drugs
- Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
- Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
- Observe the effect of drugs on animals by simulated experiments
- Appreciate correlation of pharmacology with other bio medical sciences

UNIT 1 General Pharmacology

Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and non-competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.

UNIT- 2 Pharmacology of drugs acting on peripheral nervous system

Organization and function of ANS. Neurohumoral transmission, co-transmission and classification of neurotransmitters. Para sympathomimetics, Parasympatholytic, Sympathomimetics, sympatholytic. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anaesthetic agents. Drugs used in myasthenia gravis and glaucoma.

UNIT- 3 Pharmacology of drugs acting on central nervous system

Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. General anaesthetics and pre-anaesthetics. Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics. Alcohols and disulfiram

UNIT- 4 Pharmacology of drugs acting on central nervous system

Psychopharmacological agents: Antipsychotics, antidepressants, antianxiety agents, anti-manic and hallucinogens. Drugs used in Parkinson's disease and Alzheimer's disease. CNS stimulants and nootropics. Opioid analgesics and antagonists. Drug addiction, drug abuse, tolerance and dependence.

COURSE OUTCOMES

- Understand the fundamentals of general pharmacology
- To learn the action of drug on different body systems

TEXT / REFERENCE BOOKS

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill

XXXXXXX					Immunology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To understand the fundamental concepts of immunology and humoral immunology
- To knew the functions of immune syetm.

UNIT I

FUNDAMENTAL CONCEPTS OF IMMUNOLOGY: History and Scope of Immunology, Innate and Acquired Immunity; Haematopoiesis, Cells of the immune system, Primary and Secondary lymphoid organs, Characteristics of T and B cell receptors, T and B cell maturation, activation and differentiation.

Unit –II

HUMORAL IMMUNITY: Antigens: Characteristics and Types of Antigens, Factors affecting the immunogenicity, Haptens, Antigenic Determinants, Adjuvants, Vaccines, Routes of Immunization. Theory of clonal selection, Immunoglobulins: Basic structures, classes and sub classes; Molecular Biology of Immunoglobulin synthesis, Effector functions; Isotope, Allotype, Idiotype, Monoclonal antibodies, Complement system - Alternate, Classical and Lectin pathways

Unit III

CELL MEDIATED IMMUNITY: Structure, types and function of MHC, Phagocytosis, Exogenous and Endogenous pathways of antigen processing and presentation; Cytokines - Structure, function, application and regulation of the immune response. Immunotechnology: Antibody affinity and antibody avidity, Cross reactivity, Precipitation reactions, Agglutination reactions - Immunodiffusion and Immunoelectrophoretic techniques, Immunofluorescences, Immunoelectroscopy, RIA, ELISA. Detection of bacterial endotoxins using immunological methods (LAL Test)

Unit-IV

IMMUNE SYSTEM IN HEALTH AND DISEASES: Inflammatory mediators, Hyper-sensitivity, Immune Tolerance, Autoimmunity, Transplantation immunology - Immunosuppressive drugs, Tumour immunology, AIDS.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:- Elaborate the basics of immunity and Immunology
CO2:- Evaluate the role of B cell against extracellular pathogens
CO3:- Evaluate the role of T cell against intracellular pathogens
CO4:- Apply AgAb interactions for diagnostic purposes.
CO5:- Identify the conditions due to Immune response against self-antigens
CO6:- Assess the failures of Immune system in various disease conditions

COURSE OUTCOMES

1. Ivan M. Roitt, Brostoff J. and Male D., Essential Immunology, 6th edition, Mosby Harcourt Publishers, 2001.
2. Ian M. Roitt, Essential Immunology, 4th edition, Blacwell scientific publications, Oxford, London, 1980
3. Ivan M. Roitt, Jonathan Brostoff and David K. Male Glower,Immunology, 1st edition, Medical publishers, London, 1958.
4. Richard A.Goldsby, Thomas J. Kindt, Barsara A. Osborne, Janis Kuby, Immunology, 5th edition, WH Freeman & Company, 1991
5. Ashim K. Chakravarthy, Immunology, Tata Mcgraw-Hill, 1998.

20CH311T					Chemical Reaction Engineering II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To accustom with the concepts of non-ideality in the reactor systems and studying RTD.
- To provide details on modeling the non-ideality using zero and one parameter models
- To give a wholesome picture on catalysis, catalytic reactions and catalytic reactors
- To give detail insight on external and internal mass transfer effects in catalytic reactions

UNIT 1 NON IDEALITY AND RTD MEASURMENTS **12 Hrs.**

Basics of non-ideality, distribution of residence times for chemical reactors general characteristics, RTD measurement, reactor modeling with RTD, models for non-ideal reactors: zero-parameter models and one parameter models, research studies on modeling of real reactors

UNIT 2 CATALYSIS AND CATALYTIC REACTORS **12 Hrs.**

Basics of catalysis, catalytic reactions, steps in a catalytic reaction, synthesizing a rate law, mechanism and rate-limiting step, design of reactors for gas-solid reactions, heterogeneous data analysis for reactor design, catalyst deactivation, multiphase catalytic reactors.

UNIT 3 EXTERNAL DIFFUSION EFFECTS **08 Hrs.**

External diffusion effects on heterogeneous reactions–mass transfer fundamentals, binary diffusion, external resistance to mass transfer, correlations for the mass transfer coefficient, the shrinking core model

UNIT 4 INTERNAL DIFFUSION EFFECTS **08 Hrs.**

Internal diffusion effects on heterogeneous reactions, diffusion and reaction in catalysts, thiele modulus, Weiz-Prater criterion, Mear's criterion, internal effectiveness, overall effectiveness, falsified kinetics, estimation of mass transfer and reaction limited regimes, Hatta number

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –Relate to the basics of non ideality and characteristics of residence time distributions
CO2 –Interpret the RTD profiles and experimental data to model the non ideal reactors
CO3 – Select proper reaction mechanism and design the catalytic reactor by rate data analysis
CO4 –Compare the reactor performance with or w/o internal of external mass transfer limitations
CO5 –Appraise the performance of different reactors in multi phase systems
CO6 –Design, Develop and/or Modify reactor systems for specific purpose of real life problems

TEXT/REFERENCE BOOKS

1. H. S. Fogler, "Elements of Chemical Reaction Engineering", 3rd Ed, New Delhi-Prentice Hall, 2001
2. O. Levenspiel," Chemical Reaction Engineering" Willey Eastern, 3rd Ed., 2000
3. J. M. Smith, "Chemical Engineering Kinetics", 3rd Ed., McGraw- Hill, 1988

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: Theoretical knowledge and understanding	20-30 Marks
Part B/Question: Problem Solving, Design and Analysis	70-80 Marks

XXXXX					Biomaterial & Implants Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To understand techniques involved in formulation of dosage forms
- To Observe quality control tests for the common dosage forms
- To design appropriate packaging and labelling requirements
- To introduce basic concepts of pharmaceutical technologies

Experiment Sessions would be simulation based covering but not limited to following topics:

1. To perform polymerization reaction using Self cure resin
2. To fabricate polymer blends
3. To perform physical properties of hardening of metals
4. To perform absorption spectra of ocular biomaterial
5. Fabrication of hydroxyapatite and PEG complexes
6. To analyze the setting temperature of bone cement
7. To analyze the surface texture of the polymers
8. To analyze the tensile strength of the polymers
9. To perform cellulose biomaterial preparation

COURSE OUTCOMES

On completion of the course, student will be able to
CO1: Study the fundamentals of biomaterials and their properties
CO2: Understand the nature and characteristic features of biomaterials
CO3: Apply the technology in biomaterial fabrication
CO4: Analyse the applications of biomaterials
CO5: Evaluate quality test for biomaterials
CO6: Design and fabricate bio implants

TEXT/REFERENCE BOOKS

1) Biomaterials, By Sujata V. Bhatt, Narosa Publishing House, New Delhi, India
2) Biomaterials: An introduction, By Joon B. Park, Roderic S. Lakes, Springer.
3) Biomaterials Science: An introduction to materials in medicine, Edited by Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, Elsevier.
4) Biomedical Materials, R.Narayan (ed.), Springer Science.
5) Biomaterials: Principles and Applications, Edited by Joon B. Park, Joseph D. Bronzino, CRC Press.
6) Biomaterials Medial Devices and Tissue Engineering By Fredrick H. Silver Chapman and Hall.
7) Biomaterials science and engineering By J. B. Park Plenum press, New York

20CH311P					Chemical Reaction Engineering II - Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- Understand the non-ideality of different reactors by performing RTD studies
- To execute the homogeneous reactions with and without catalysts.
- To observe the effect of catalyst presence on the reaction performance.
- Study the effect of mass transfer with and without reaction
- Understand the modelling aspects using zero and one parameter model

LIST OF EXPERIMENTS

1. Residence time distribution studies in CSTR
2. Residence time distribution studies in PFR
3. Residence time distribution studies in PBR
4. To study non-catalytic homogeneous second order liquid phase reaction in packed bed reactor
5. To study the kinetics of dissolution of benzoic acid in water
6. To study the catalytic decomposition of hydrogen peroxide in an adiabatic reactor
7. To model the kinetics of PBR using segregation model and maximum mixedness model
8. To model the RTD of PBR by T-I-S model and dispersion model

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Relate to the basics of non ideality in reactors and application of the same in practical

CO2 – Interpret the RTD data; evaluate different parameters and interpretations for different reactors

CO3 – Utilize the catalyst for the reaction and identify the catalytic effect on the performance of reaction CO4 Examine the effect of presence/absence of mass transfer limitations on the reaction

CO5 – Choose to model the RTD of a given reactor system and estimate the performance

CO6 – Develop an ability to work in group, learn report making, and improve soft skills in representing the findings

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: Practical Performance, Report Submission and Pre Viva	50 Marks
Part B/Question: Written Exam and Practical Viva	50 Marks

Pandit Deendayal Energy University

					Biomass conversion & utilisation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of Biomass conversion procedures.
- Understand the basic concept of Biofuel and its application.
- Acquire knowledge on biomass as energy source

UNIT I: Introduction to Biomass **10 Hr.**

Overview of biomass as energy source; Availability of Biomass. Production of biomass, Photosynthesis, efficiency of plants on biomass production. Classification of biomass. Physicochemical characteristics of biomass as fuel. Biomass conversion routes: biochemical, chemical and thermo-chemical

UNIT II: Biochemical conversion of biomass for energy production **12 Hr.**

Anaerobic digestion, biogas production mechanism. Types of digesters, installation, operation and maintenance of biogas plants. Biogas plants manure-utilization and Manure values. Biogas utilization and storage. Biodiesel – Mechanism of transesterification, Fuel characteristics of biodiesel, Technical aspects of biodiesel engine utilization. Alcohol production from biomass.

UNIT III: Chemical conversion of biomass **12 Hr.**

Chemical conversion processes. Hydrolysis and hydrogenation. Modern biofuel synthesis. Bio-refinery. Thermochemical conversion of biomass. Combustion in excess oxygen and oxygen deficient atmosphere. Pyrolysis, Carbonization, Charcoal production. Biomass gasification-Different types--power generation from gasification

UNIT IV: Energy plantation **8 Hr.**

Overview on energy plantation.Basis of selecting the plants for energy plantation.Waste land utilization thro ugh energy plantation

Max. 42 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Describe process involved in conversion of the Biomass

CO2: Identify different types of digester involved in Biochemical conversion

CO3: Describe the significance of biodiesel and its application

CO4: Describe the process of Chemical and Thermochemical conversion of biomass,

CO5: Describe the process of Energy plantation and waste utilisation

TEXT/REFERENCE BOOKS

1. Mukunda HS. Understanding Clean Energy and fuels from biomass. Wiley-India Pvt. Ltd, 2011
2. Pandey A. Hand book of plant-based bio-fuel. CRC Press, Taylor & Francis, 2008
3. Mital KM. Biogas Systems, Principle and Applications. New Age International Ltd. 1996
4. Rai GD. Non-conventional energy sources. Khanna Publication, 2001
5. Ravindranath NH. Hall DO. Biomass, Energy and Environment, A developing country perspective from India. Oxford University Press, 1995

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks

Pandit Deendayal Energy University

XXXXXXX					Biological waste treatment					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/VIVA	
2	0	0	2	2	25	50	25	-	-	100

Course Objectives

- To create a system in which the results of decomposition are easily collected for proper disposal.

Unit I:

Qualitative and Quantitative characteristics of waste, waste disposal norms and regulation, Principles of biological treatment, physical and chemical methods of waste treatment.

Unit II:

Bioprocess kinetics applied to waste treatment. Operation and design features of trickling filters and rotating biological contractor (RBC).

Unit III:

Theory of activated sludge process, design, operation and control, BOD reduction and biomass relationship, modifications, stabilization ponds, operational and design aspects.

Unit IV:

Anaerobic treatment systems. Sludge digestion theory, digester design, high-rate digestion, heat transfer in digester, new developments, fixed film reactors, UASB. Nitrification - denitrification, Phosphorous removal. Treatment and disposal of waste of the industries e.g., distilling and brewing, antibiotics and sugar etc.

COURSE OUTCOMES:

On completion of this course, the students will able to
CO1. List various wastes present in solid waste
CO2. Classify the technologies for the waste upgradation
CO3. Build fundamental knowledge in waste management technologies
CO4. Distinguish the resource recovery potential from different wastes
CO5. Compare the available technologies in waste management
CO6. Provide solution to the growing urban and rural waste handling

References:

1. "Waste Water Engineering: Treatment, Disposal and Reuse", Metcalf & Eddy, Inc.; Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. "Water supply and Pollution control", Warren Viessman Jr. and Mark J. Hammer; Harper & Row Publishers; New York.
3. "Environmental Engineering", Howard & Peavy, Donald R. Rawe and George Tehobanoglousd, Mcgraw-Hill International Editions.
4. "Waste Water Treatment", Rao & Dutta.

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20HS201P					Communication Skills - III					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To understand communication and its process and effect on giving and receiving information.
- To learn and apply communication skills in different public and interpersonal contexts.
- To develop analytical, research, and organizational skills through communication skills for a fulfilling career.

UNIT 1 **7 hrs**

Technical Writing- Report Writing, Creating Lab Journals and Manuals, Portfolio of Critical Writing and Creative Writing - Essay, Story-writing, etc.

UNIT 2 **7 hrs**

Summarizing, Writing Reviews (Books/Articles/Movies/websites), Reading Skills (Advanced)

UNIT 3 **7 hrs**

Digital Literacy- Emails, Creating e-content, Editing and proofreading online, Using grammar and spell check software, Using plagiarism checkers

UNIT 4 **8 hrs**

Group Discussion, Resume Writing, Interview Skills

Max. 30 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Apply current technology for effective communication leading to better dissemination of knowledge and expertise.

CO2: Demonstrate relevant knowledge of communication skills in different settings to cater to different purposes and audiences.

CO3: A sound understanding of communication theory, practice and application to optimize career opportunities.

CO4: Dynamic communication skills to build and maintain robust and effective professional relationships.

CO5: Augmented communication skills to prepare and present messages, reports and documents in intent and to integrate different sources of information and knowledge.

CO6: Monitoring and critical reflection on communication skills for the adoption of appropriate strategy required in achieving the desired outcomes.

TEXT/REFERENCE BOOKS

1. Harmer, Jeremy. The Practice of English Language Teaching. Harlow: Pearson Longman, 2007.
2. Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
3. Maley, A. 'Literature in the Language Classroom', The Cambridge Guide to Teaching ESOL, Cambridge University Press, 2001.

4. Richards, Jack C., and Willy A. Renandya, eds. Methodology in Language Teaching: An Anthology of Current Practice. Cambridge University Press, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN Assessment Tool	**Marks**	**Assignments**
Lab Work	50	• Essay/Journal Writing – 10 • Report Writing – 10 • Creating e-content – 10 • Blog Writing – 10 • Review Writing - 10
Lab Exam/Viva	50	• Mock Interview – 15 • Group Discussion – 15 • Cover Letter/Curriculum - 20

Semester – 6

Pandit Deendayal Energy University

XXXXXXX					Enzyme Science and Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/VIVA	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVE

- To understand the working of different enzymes and applying the functions in industrial biotechnology

UNIT 1 INTRODUCTION TO ENZYMES

Nature and function of enzymes, Enzyme nomenclature, classification of enzymes, mechanisms of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis., Role of co-enzymes and co-factors.

UNIT 2 ENZYME KINETICS

Michaelis - Menton kinetics, determination of Km, Lineweaver Burke plot, Eadie - Hofstee plot, Hanes-Woolf plot. Turnover number, Enzyme inhibition -Types of enzyme inhibition, competitive inhibition, uncompetitive inhibition, non-competitive inhibition, Irreversible inhibition and inactivation kinetics. Multi substrate enzyme catalyzed reaction.

UNIT 3 ENZYME IMMOBILIZATION

Classification of enzyme immobilization, physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent bonding, advantages and disadvantages, Application of immobilized enzymes, mass transfer effect on immobilization, properties of immobilized enzymes.

UNIT 4 ENZYME SPECIFICITY, EXTRACTION & APPLICATIONS

Types of specificity, Active site- Fischer hypothesis and Koshland hypothesis, Extraction of soluble enzymes, membrane bound enzymes, purification procedures, criteria of purity. Application of enzymes in medicine and industry – Assay of plasma enzyme, enzyme biosensors, design of enzyme electrodes, Synzymes, Abzymes, Enzymes in genetic engineering.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - The knowledge on enzyme and enzyme reactions will be the helpful to understand various concepts in biotechnology.

CO2 - Enzyme kinetics will give inputs to use enzyme in research and industry.

CO3 - Methods of enzyme immobilization help in food, pharmaceutical and chemical industries to innovate a useful product to society.

CO4 - Concepts on Isolation, Purification and characterization of enzymes will be helpful to work technologically.

CO5 - Application of enzymes in industry.

CO6 - Identify novel applications of enzymes in bioengineering.

TEXT / REFERENCE BOOKS

1. Palmer, Enzyme, Horwood Publishing Series, 2001.
2. Price and Stevens, Fundamental of Enzymology, Oxford University Press, 2002.
3. Prasad N.K., Enzyme Technology: Pacemaker of Biotechnology Paperback, 2011. 2. Khan M.Y. and Farha Khan, Principles of Enzyme Technology, 2015.
4. Helmut Uhling, Enzyme technology, John Wiley, 1998

XXXXXXX					Structural Bioinformatics and Computational Methods					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- To ensure that a student learns advanced concepts in Bioinformatics.
- To ensure that student learns that basic of UNIX and LINUX programming.
- To understand molecular mechanics and how it is implemented into chemistry.
- To ensure that student understand the role of cheminformatics in drug design process.
- TO understand the basics of electronic structure calculations and their applications.

UNIT I

Types of Biological Database, Nucleic acid and protein structure database, Bioinformatics resource and tools, Protein databank. Sequence analysis: DNA, RNA and Peptide, Principles and Method of Sequence analysis tools (blast, fasta, HMMer).

Unit –II

Insight into Protein sequence by using different bioinformatics tools, Visual analysis of protein structure, sequence and feature data, Homology modelling, Energy minimization approaches for structure refining (Steepest descent, Conjugate gradient etc.), Basis of Molecular dynamics simulation and its application. A perspective of Molecular dynamics simulations and algorithms (leapfrog algorithm, Verlet algorithm), Boltzmann velocity, time steps, duration of the MD run, implementation in drug designing. Various methods of MD.

Unit III

Introduction to the LINUX and UNIX operating system, LINUX/UNIX commands, Difference in UNIX and LINUX operating systems and Comparison of LINUX operating system with windows. Schrodinger equation and postulates of Quantum Mechanics, Application of Schrodinger equation: particle in a 1D and 3D box, Quantum tunnelling, One-dimensional harmonic oscillator and rigid rotor.

Unit-IV

Review of molecular structure calculations, Hartree-Fock Theory, Basis set and Electron Correlation. DFT and Force Field methods – Energy as a functional of charge density, Kohn-Sham equations. Molecular mechanics methods, minimization methods, QSAR.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: - Understand the types of biological databases.
CO2: - Explain the different methods of protein/DNA/RNA sequence analysis.
CO3: - Describe the structure of protein by using visualization software.
CO4: - TO get familiar with advanced concepts in Bioinformatics.
CO5: - To understand the basics of energy minimization simulation methods.

REFERENCE BOOKS

1. Andrew R.Leach Molecular Modelling Principles and applications. (2001) II ed. Prentice Hall.
2. A.D. Baxevanis et. Al., Current Protocols in Bioinformatics, (2005) Wiley Publishers
3. Introduction to Computational Chemistry, F. Jensen, Wiley-Blackwell (2006).
4. Quantum Chemistry, I.N. Levine, (2000), Pearson Educ., Inc., New Delhi.

XXXXXXX					MOLECULAR BIOLOGY AND GENETICS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- The course aims to give an understanding on the fundamentals of conventional genetics and the intricate molecular mechanisms of heredity and variations.
- To understand storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems.

UNIT I

Classical Genetics: Fundamental principles of genetics- Mendel's principles and experiments, gene interaction, multiple alleles, complementation, linkage, sex linked, sex limited and sex influenced inheritance; Chromosomes basis of heredity- extrachromosomal inheritance; Linkage and crossing over; Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium.

Unit –II

Structure and Properties of Nucleic acids: Introduction to nucleic acids: Evidence for DNA & RNA as a genetic material; Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule; DNA replication- Overview of differences in prokaryotic and eukaryotic DNA replication, D-loop and rolling circle mode of replication, Telomere replication in eukaryotes; Okazaki fragments, Fidelity of DNA replication, Inhibitors of DNA replication, DNA repair- Mutagens, DNA mutations and various types of repair mechanisms.

Unit III

Transcription: Central Dogma in molecular biology -Structure and function of mRNA, rRNA tRNA and micro RNAs. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.

Unit-IV

Translation: Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications and its importance. Regulation of gene expression: Organization of genes in prokaryotic and eukaryotic chromosomes- operon concept; Gene expression and regulation Hierarchical levels of gene regulation, Prokaryotic gene regulation –lac and trp operon, Eukaryotic gene regulation- gene silencing.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain the foundations of Mendelian genetics and chromosomal theory and apply these, with appropriate terminology, to contemporary concepts in genetics.

CO2 - Emphasize the molecular mechanism of DNA replication and repair in various organisms.

CO3 - Explain the properties of genetic materials and storage and processing of genetic information.
CO4 - Analyse the processes of transcription and translation in both prokaryotes and eukaryotes at molecular level.
CO5 - Understand the redundant and universal qualities of the genetic code and how it is used to determine the amino acid sequence of a polypeptide.
CO6 - Compare the mechanisms of gene regulation in prokaryotes and eukaryotes.

TEXT / REFERENCE BOOKS

1. Lewin B., Genes XI, International Edition, Jocelyn Krebs, Stephen Kilpatrick and Elliott Goldstein, Jones & Bartlett Learning, 2017, ISBN 978-1-4496-5985-1
2. Tropp, Burton E., Molecular Biology: Genes to Proteins, 3 rd Edition, Jones and Bartlett, 2008.
3. Glick B.R. and Pasternak J.J., Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4 th Edition. ASM, 2010.
4. Weaver, Robert F., Molecular Biology, 2 nd Edition, Tata McGraw Hill, 2003.
5. Karp, Gerald, Cell and Molecular Biology: Concepts and Experiments, 4th Edition, John Wiley, 2005. SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY SCHOOL OF BIO AND CHEMICAL ENGINEERING B.E. / B.Tech. - Regular 23 REGULATIONS 2019
6. De Robertis E.D.P. and De Robertis, E.M.F., Cell and Molecular Biology. 8 th Edition, Lippincott Williams and Wilkins, Philadelphia, 2006.
7. Watson J.D., Baker T.A., Bell S.P., Gann A., Levine M. and Losick R., Molecular Biology of the Gene, 6 th Edition, Cold Spring Harbour Lab. Press, Pearson Publication, 2008.
8. Primrose S.B. and Twyman R.M., Principles of Gene Manipulation and Genomics, Blackwell Publishing, 7 th Edition, 2006, ISBN 1-4051-3544-1
9. Gardner E.J., Simmons M.J. and Snustad D.P., Principles of Genetics, 8 th Edition, John Wiley & Sons, Singapore, 2003.
10. Strickberger M.W., Genetics, 3rd Edition, Prentice Hall of India, New Delhi, 2008.

XXXXXXX					Pharmacology of Drug Action - II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

- Understand the mechanism of drug action and its relevance in the treatment of different diseases
- Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
- Demonstrate the various receptor actions using isolated tissue preparation
- Appreciate correlation of pharmacology with related medical sciences

UNIT 1 Pharmacology of drugs acting on cardio vascular system

Introduction to hemodynamic and electrophysiology of heart. Drugs used in congestive heart failure. Anti-hypertensive drugs. Anti-anginal drugs. Anti-arrhythmic drugs. Anti-hyperlipidaemic drugs.

UNIT- 2 Pharmacology of drugs acting on cardio vascular system & urinary system

Drug used in the therapy of shock. Haematinics, coagulants and anticoagulants. Fibrinolytics and anti-platelet drugs. Plasma volume expanders. Diuretics. Anti-diuretics.

UNIT- 3 Autocoids and related drugs

Introduction to autacoids and classification Histamine, 5-HT and their antagonists. Prostaglandins, Thromboxane's and Leukotrienes. Angiotensin, Bradykinin and Substance P. non-steroidal anti-inflammatory agents. Anti-gout drugs. Antirheumatic drugs

UNIT- 4 Pharmacology of drugs acting on endocrine system & Bioassay

Basic concepts in endocrine pharmacology. Anterior Pituitary hormones- analogues and their inhibitors. Thyroid hormones- analogues and their inhibitors. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. Insulin, Oral Hypoglycaemic agents and glucagon. ACTH and corticosteroids. Androgens and Anabolic steroids. Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus. Principles and applications of bioassay. Types of bioassays. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT.

COURSE OUTCOMES

- To learn the action of drug on different body systems
- To get idea about bioassays and their types

TEXT / REFERENCE BOOKS

1. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews, Pharmacology.
2. K.D. Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
3. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan

XXXXX					Bioinformatics and computational methods Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To view and use the various biological databases available on the World Wide Web.
- To retrieve the gene sequence in FASTA format
- To identify the Genes present if any in the given genomic sequence
- To predict primary, secondary and tertiary structure of the give protein sequences

Experiment Sessions would be simulation based covering but not limited to following topics:

1. Exploration of the resources available in NCBI and PUBMED
2. Retrieval of a Genbank Entry using an accession number
3. Retrieval and analysis of a gene sequence in FASTA format
4. Finding the official Symbol, alias name, chromosome number and ID for gene using NCBI
5. Retrieval and analysis of a protein sequence from protein database
6. Primary structure analysis of a protein
7. Secondary structure analysis of a protein
8. Tertiary protein structure analysis using RASMOL
9. Pair-wise and multiple sequence alignment using ClustalW
10. Pair-wise and multiple sequence alignment using BLAST

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Retrieve a nucleotide sequence of interest from Genbank and NCBI database

CO2: Analyse the NCBI web site and find the official gene symbol, its alias name, chromosome number and its ID

CO3: Analyse and retrieve the protein sequence of a protein from the Protein Data Bank (PDB) database

CO4: Explore the site map of NCBI and PUBMED and to study the resources available on NCBI and PUBMED

CO5: Perform pair wise and multiple sequence alignment using clustalw for given sequences

TEXT/REFERENCE BOOKS

1) Bioinformatics: Experiments, Tools, Databases, and Algorithms (Oxford Higher Education) by Orpita Bosu.

2) Bioinformatics: Methods and Applications 1st Edition by Dev Bukhsh Singh (Editor), Rajesh Kumar Pathak.

3) Introduction to Bioinformatics Using Action Labs by Jean-Louis Lassez

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XXXXXXX					Publication Ethics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/VIVA	
2	0	0	2	2	25	50	25	-	-	100

Objectives:

The objective of this course is to instruct the research candidates about the philosophy of research; research and publication ethics; accessibility of .publications and the publication misconduct.

Unit 1. Philosophy and Ethics

Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgements and reactions

Unit 2. Scientific Conduct

Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific Misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publication, salami slicing. Selective reporting and misrepresentation of data

Unit 3. Publication Ethics

Publication Ethics: definition, introduction and importance. Best practices – standards setting initiatives and guidelines: COPE, WAME, etc. Conflict of interest. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice-versa, types. Violation of publication ethics, authorship and contributiorship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journal

Unit 4. Databases and Research Metrics

Software tools: Use of plagiarism software like Turnitin, Urkund and other open-source software tools Databases: Indexing databases. Citation databases: Web of Science, Scopus, etc. Research Metrics Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, i10 index, altimetric

Course Outcome:

CO1. Learn philosophy of research.
CO2. Understand the research ethics.
CO3. Understand the scientific conduct in research.
CO4. Learn publication ethics.
CO5. Become aware of the open access publishing.
CO6. Familiarize with publication misconduct
CO7. Learn publication database and research metrics

TEXT/REFERENCE BOOKS

1. Bird, A. (2006). Philosophy of Science. Routledge.
2. Chaddah, P. (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarised.
3. Deakin, L. (2014). Best practice guidelines on publishing ethics: A publisher's perspective. Wiley.
4. Indian National Science Academy. 2019. Ethics in Science Education, Research and Governance.
5. Israel, M. (2015). Research ethics and integrity for social scientists: Beyond regulatory compliance. SAGE Publications.
6. Israel, M., & Hay, I. (2009). Research ethics for social scientists: Between ethical conduct and regulatory compliance. Sage.
7. Kimmel, A. J. (1988). Ethics and values in applied social research. Sage Publications.
8. MacIntyre, A. (198). A short history of ethics. Routledge.
9. Mertens, D. M., & Ginsberg, P. E. (2009). The handbook of social research ethics. Sage Publications.
10. Resnik, D.B. 2011. What is Ethics in Research and why it is important? National Institute of Environmental Health Sciences.
11. Yadav, Santosh Kumkar. 2000. Research and Publications Ethics. Ishwar Books.

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Teaching Scheme					Bioentrepreneur ship Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of Entrepreneurship
- Understand the basic concept of Business plan and Financial Aspect.
- Acquire knowledge on Biotech enterprises

UNIT I: Introduction to Entrepreneurship **10Hr.**

Introduction to Biotechnology Industry. Bio-business opportunities. Entrepreneur, Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology, pillars of bio-entrepreneurship and major start-ups in Biotechnology, Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Government schemes for commercialization of technology (e.g., Biotech Consortium India Limited)

UNIT II: Business plan and Management **12 Hr.**

Search for a business idea, concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal. Process involved in Business plan development, Product development in Biomedical Industry. Market Analysis.

UNIT III: Financial Aspect of Business **10 Hr.**

Funding of biotech business (Financing alternatives, Venture Capital funding, funding for biotech in India, exit strategy, licensing strategies, valuation), support mechanisms for entrepreneurship (Bioentrepreneur ship efforts in India, difficulties in India experienced, organizations supporting biotech growth, areas of scope, funding agencies in India, biotech policy initiatives)

UNIT IV: Biotech enterprises **10 Hr.**

Biotech enterprises: Desirables in start-up, setting up Small, Medium & Large-scale industry, Quality control in Biotech industries, Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities

Max. 42 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Describe biotechnology and bio entrepreneurship, their components and forms

CO2: Identify business opportunities in the life science sector

CO3: Develop and explain a business idea

CO4: Develop and write a complete business plan based on a new idea

CO5: Describe the process of launching a venture, its context and common bottlenecks

TEXT/REFERENCE BOOKS

1. The Business of Biotechnology: From the Bench of the Street: By Richard Dana Ono Published Butterworth- Heinemann, 1991.
2. Entrepreneurship in Biotechnology: Managing for growth from start-up By Martin Gross Mann, 2003
3. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases by D. Hyne & John Kapeleris, 2006
4. Dynamics of Entrepreneurial Development and Management by Vasant Desai, Himalaya Publishing House, 2005.
5. Projects Planning Analysis, Selection, Implementation & Review by Prasannan.
6. Best Practices in Biotechnology Education: By Yali Friedman, Published by Logos Press, 2008.
7. Business model generation: a handbook for visionaries, game changers, and challengers Clark, Tim Hoboken, N. J.: Wiley, cop. 2010
8. Entrepreneurship Ideas in Action—South-Western, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks

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XXXXXXX					Pharmacokinetics & Pharmacodynamics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/VIVA	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

- Pharmacokinetic/Pharmacodynamic (PK/PD) modelling is the prediction of the time course of the drug effect and its relation to dose and exposure. PK/PD modelling has become a key success factor in drug research & development

Unit 1 OVERVIEW OF MEDICINAL CHEMISTRY

Defining, Drug, Sources of drugs-plant, animal, synthetic, Recombinant technology, History and their role in formulation development & therapeutics and clinical setting, Route of Administration-Oral, parenteral, Rectal, Topical administration, Inhalation

Unit 2

Absorption - Introduction, Mechanisms of Drug Absorption, Factors Influencing Drug Absorption, Drug Absorption from All Non-oral Extravascular
Distribution - Introduction, Factors Affecting Distribution of Drug, Volume of Distribution and its Significance

Unit 3

Drug Metabolism - Introduction, Drug Metabolism, Metabolic Pathways, Factors Affecting Drug Metabolism
Excretion -Introduction, Renal Excretion of Drugs, Factors Affecting the Renal Excretion of Drugs, Clearance, Renal Clearance, Non-renal Routes of the Drug Excretion

UNIT 4

Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action

Course outcomes

At the end of the course the students will
CO1 –Describe metabolic pathways
CO2 –Explain the steps involved in pharmacokinetics
CO3 –Explain key theoretical concepts of stereochemistry of drug molecules
CO4 – understand types of receptors
CO5 – understand how drug react to the body.

REFERENCES:

1. An Introduction to Medicinal Chemistry-Graham L.Patrick, 2009.
2. Camille.G.Wermuth, The Practice of Medicinal Chemistry- Prestwick Chemical Inc, 2003
3. Wilson & Gisvold's, Text book of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams, 2003
4. Frank.D.king, Medicinal Chemistry- Principles and Practice, Marcell Dekker, 2002
5. K.D.Tripathi, Essentials of Medicinal Pharmacology, Jaypee Brothers, 2004 6. S.D Seth, Text book of pharmacology, Elsevier India Pvt Ltd., 2008

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XXXXXXX					Next Generation Sequence Analysis					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/VIVA	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

- This course will provide an introduction to the technology, data analysis, tools and resources for next generation sequencing data. The content is intended to provide a broad overview of the subject areas, and to highlight key resources, approaches and methodologies.

Unit I Introduction to NGS
NGS Platforms: Introduction to NGS, Roche/454 FLX, Illumina/Solexa Genome Analyzer, Applied Biosystems SOLiD system, Helicos Helioscope, Pacific Biosciences/single molecule real time (SMRT) sequencing.

Unit II Sequence data
Genome assembly algorithms: Alignment of short-reads to reference genome using spaced seed (ELAND, SOAP), index filtering algorithm (SeqMap), quality-score (RMAP), q-filter algorithm (SHRiMP), FM-index (Bowtie, BWA, SOAP2), suffix tree (MUMmer). Sequence Alignment formats: Sequence Alignment/Map (SAM) format, Binary Alignment/Map (BAM) format, Tools for conversion (SAM tools), Alignment viewers (IGV, MagView).

Unit III Sequence data assembly
De-novo assembly: Overlap-layout-consensus (OLC) approach (Arachne, Phusion), de Bruijn and Euler path approach (Euler, SOAPdenovo), string graph assembler (SGA). Scaffolding: Super contig, contig orientation, contig ordering, contig distancing and gap closing using SOAPdenovo, ABySS, OPERA and RACA.

Unit IV Softwares in NGS analysis\
Application of R in NGS analysis: Introduction to Bioconductor, Reading of RNA-seq data (ShortRead, Rsamtools, GenomicRanges), annotation (biomaRt, genomeIntervals), reads coverage and assign counts (IRanges, GenomicFeatures), differential expression (DESeq), Biological applications of NGS: Whole-genome sequencing, Exome sequencing, Transcriptome sequencing, Epigenome sequencing, Interactome sequencing, methylome sequencing.

Course outcomes

At the end of the course the students will
CO1 –Describe the applications of the different NGS technologies, including the weakness and strengths of the approaches.
CO2 –Explain the steps involved in a general NGS data analysis.
CO3 –Explain key theoretical concepts of alignment and de novo assembly.
CO4 –Synthesize and formulate a project and relevant question within the field.
CO5 – Independently perform a basic NGS data analysis.

CO6 –Apply analytical and reflective skills in analyzing results from individual steps and the final project.

Text / Reference Books:

1. Next-generation DNA sequencing Informatics by Stuart M. Brown, Cold Spring Harbor Laboratory, 2013.
2. RNA-seq Data Analysis: A Practical Approach by Eija Korpelainen, Jarno Tuimala, Panu Somervuo, Mikael Huss, Garry Wong. Chapman & Hall/CRC, 2014.
3. Next generation sequencing: Translation to Clinical Diagnostics by Wong Lee-Jun C. (ed.), Springer, 2013.
4. Next-generation genome sequencing: Towards Personalized Medicine by Michal Janitz, WileyVCH, 2008

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Novel separation Processes										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

➢ Students will understand fundamental of separation processes

➢ Students will understand the principles and applications of super critical fluid extractions.

➢ Students will learn about the different types of membrane separation processes.

➢ Students will acquire knowledge of surfactant based and other separation processes.

UNIT 1 SUPER CRITICAL FLUID EXTRACTION

Fundamentals of separation processes, Separation factor, various separation processes and identification of novel separation process,
Introduction of Supercritical Fluid Extraction (SFE), Physiochemical principles, thermodynamics modelling, process synthesis and
energy analysis.

UNIT 2 MEMBRANE PROCESSES

Brief review, module design and module characteristics, plant design and operation, Reverse osmosis, ultrafiltration and
microfiltration, pervaporation.

UNIT 3 SURFACTANT BASED SEPARATION

Fundamentals of surfactants at surfaces and in solution, liquid membrane permeation, foam separations, micellar separations.

UNIT 4 OTHER SEPARATION PROCESSES

Chromatographic separation and ion exchange techniques, Centrifugal separation processes and their calculations, Electrophoretic
separation processes.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Define the basic principles of different separation processes.

CO2 - Explain the complete details including problem-solving approach and the applications of theory learned regarding SFE,
Membrane Separation, Surfactant Based separation and other separation processes.

CO3 - Apply the principles of separation processes like SFE, Membrane Separation, Surfactant Based separation and other
separation processes.

CO4 - Analyze the problems related to SFE, Membrane Separation, Surfactant Based separation and other separation processes.

CO5 - Estimate desired separation from the give separation processes.
CO6 - Design separation modules based upon the conditions given in the problem statement.

TEXT/REFERENCE BOOKS

1. R. Rautenbach, and R. Albercht, Membrane Processes, John Wiley & Sons, 2004
2. R W Rousseau, Handbook of Separation Process Technology, John Wiley & Sons
3. M. A. McHugh and V. J. Krukonis, Supercritical Extraction, Butterworths, 2005
4. R. G. Gutman, Membrane Filtration, Adam Hilger, Bristol, 1997.
5. J. F. Scamehorn, and J. H. Harwell, Surfactant Based Separation Processes, Surfactant Science Series, Vol. 33, Marcel –
Dekkar Inc., New York.

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					Dyes and Pigment					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

➢ To make the students understand chemistry of several intermediates used for chemical industry in particular to Dyestuff industry

➢ To make them understand the unit processes and relevance in chemical industries

➢ To enable to analyses and identify the suitable manufacturing method and accordingly choose the supplementary processes to produce intermediates

➢ To develop capacity to understand proper selection of the chemical processes based on economy and ecological aspects

UNIT 1 BASICS OF DYES AND PIGMENTS

History of colorants; Definition and function: Dyes, Pigments, fillers, toner and lakes, classifications of organic and inorganic pigments,

characterization and properties; concept of color mixing theory

UNIT 2 RAW MATERIALS AND PROCESSING

Feedstock for organic pigments, synthesis of organic pigments and applications, Processing and synthesis of inorganic pigments, Fillers

pigments: Sources, manufacture, properties and applications

UNIT 3 PIGMENTS

Manufacturing, sources, properties and compositions, applications and economic aspects of industrially important pigments: White

pigment, black pigment, blue pigments and green pigments

UNIT 4 DYES

Manufacturing, sources, types, properties, commercial applications of industrially important organic dyes and pigments: Azo

pigments, polycyclic pigments

Health and Safety Aspects

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To define the basics of dyestuff industry and name the terms like types and classifications

CO2 - To understand basic raw materials utilized and processes used

CO3 - To utilize the basic understanding to select suitable processes for production

CO4 - To analyses the various aspects of synthesis of different intermediates used in dyes and pigment industries

CO5 - To compare the various technology for dyes and pigment production process

CO6 - To discuss economic and safety aspects of dyes and pigment production process

TEXT/REFERENCE BOOKS

1. R M Christie, Color Chemistry, Royal Society of Chemistry, 2001
2. A Gürses, M Açıkyıldız, K Güneş, M. S Gürses, 'Dyes and Pigments', Springer Briefs in Molecular Science: Green Chemistry For
Sustainability, Edited by Sanjay Sharma, Springer, 2016
3. G Buxbaum, Industrial Inorganic Pigments, Third Edition, Wiley-Vch, 2005
4. W. Herbst, K. Hunger, Industrial Organic Pigments, Wiley-Vch, 2004
5. K. Hunger, Industrial Dyes: Chemistry, Properties, Applications, WILEY-VCH, 2003

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

Part A/Question: < Question with no choice > <40> Marks

Part B/Question: < Question with choice > <60> Marks

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Industrial Training/IEP										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hours/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**3**	**6**	**6**	**9**	**-**	**-**	**-**	**--**	**100**	**100**

COURSE OBJECTIVES

➢ To provide comprehensive learning platform to students where they can enhance their ability skills and become job ready along with real corporate exposure.

➢ To enhance students' knowledge in one particular technology

➢ To increase self-confidence of students and help in finding their own proficiency

➢ To cultivate students' leadership ability and responsibility to perform or execute the given task

➢ To provide learners hands on practice within a real job situation

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Relate greater clarity about academic and career goals, lifelong learning skills, make a gradual transition from academia to career

CO2 – Demonstrate understanding of administrative functions and company culture

CO3 – Develop the ethical basis of professional practise in relevant industry and become updated with all the latest changes in technologies in world

CO4 – Examine the role of the professional/ specialist/manager/supervisor confidently in the chemical industry

CO5 – Support the work in industrial training in formatted report explaining and describing the experience

CO6 – Construct the adequacy of training and have ability to identify, formulate and model problems and find engineering solution based on a systems approach.

Max. Marks: 100	Exam Duration: 3 Hrs
Viva Voce Examination	50 Marks
Practical Examination	50 Marks

Semester – 7

Pandit Deendayal Energy University

					Recombinant DNA Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	IA	EA	LW	LE/Viva	
3	0	0	3	3	25	25	50	--	--	100

COURSE OBJECTIVES

- The purpose of this course is to give students a broad foundation in DNA technology.
- The advancement of recombinant DNA technology adds a new dimension to life science and provides a powerful tool for genetic engineering.
- By encountering the molecular biology of the gene and the cell, students learn to analyze problems encountered in medicine and other related biomedical disciplines at the molecular level.

Unit-I

Characterization of Nucleic acid (DNA and RNA), Quantification, radiolabeling of nucleic acids, labelling by primer extension, DNA sequencing: Maxam-Gilbert (Chemical) and Sanger- Nicolson (dideoxy/ enzymatic) sequencing method, Pyrosequencing.

Unit-II

Restriction Enzymes: Types and uses of restriction endonuclease, classification Restriction mapping. DNA modifying enzymes: Nucleases, Polymerases, Phosphatases and ligases.

Unit-III

Vectors. Plasmid vectors, Bacteriophage, expression vectors, other vectors, Construction of genomic and c-DNA libraries, Joining of DNA Fragments to vectors, cohesive and blunt end Ligation, adaptors, and linkers.

Unit-IV

Principal and applications in analysis of recombinants: Principle of hybridization. Northern blotting, Southern blotting, Western blotting. Polymerase chain reaction, selection and screening of recombinants, Restriction fragments length polymorphism, RAPD, AFLP, MAP.

COURSE OUTCOMES

On completing this course, the student will be able to do the following:

CO1: Give experimental evidence demonstrating that DNA is the molecule of heredity in all organisms.

CO2: Explain the flow of genetic information from DNA to RNA to protein.

CO3 Describe the functions of topoisomerase, DNA polymerase I, DNA polymerase III, DNA ligase, helicase, and rep protein in DNA replication.

CO4: Discuss the current concepts of DNA replication, transcription, and translation in prokaryotes and eukaryotes.

CO5: List the difference between prokaryotes and eukaryotes in regulation of gene expression.

CO6: Contribute to the ethical discussion of the impact of modern DNA technologies on society

Reference

1. Principles of Gene manipulation (1994) Old R.N. and Primrose S.B.
2. From Genes to Clones (1987) Wenneker E.L.
3. Recombinant DNA (1992) Watson J.D., Witreowski J., Gilman M. and Zooller M.
4. An Introduction to Genetic Engineering: Nicholl, D.S.T.
5. Molecular Biotechnology (1996) Pasternak
6. The Biochemistry of Nucleic acid (1996) Adam et al

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XXXXXXX					Bioprocessing Plant Design					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	IA	ES	LW	LE/VIVA	
3	0	0	3	3	25	25	50	-	-	100

COURSE OBJECTIVES

- Plant design involves modifications and additions to existing plants or creating design layouts of plant / equipment with rapid rate of increase in the advancement of knowledge, it is important that the students should know the relevant application for equipment design.
- It has been observed conclusively that practice in using the reference literature and software has helped the students to secure jobs and also to perform better in profession.

Unit I:

General design principles, yield stress, GMPs guidelines, validation, safety in bioprocess plant. Stress analysis: static and dynamic loads, Elastic instability, combined stresses, theories of failure, Design considerations for maintaining sterility of process streams and process equipment, Design wall thickness, Design pressure, Design temperature, Design stress, corrosion allowance, design loads, minimum wall thickness, Pressure vessels: classification, design of vessels under internal and external pressure.

Unit II: Bioreactor Design and Scale-up:

Ideal and non-ideal bioreactor. Criteria for bioreactors design, chemostat bioreactors, power requirements for Newtonian /non-Newtonian broths and gassed fluids, Bioreactor scale-up based on constant power consumption per volume (P/V), mixing time, shear, mass transfer coefficients, Effect of variables on bioreactor scale up: aeration and agitation, mixing, sterilization of media and bioreactor, inoculum development, nutrient availability, shear, pH, and Temperature.

Unit III: Bioprocess Economics:

Control systems in bioreactors, process unit's symbology, stream numbering and drawings, basic control loop, instrumentation symbology, developing PFD for various bioprocesses, Process economics, Capital cost, operating cost estimation, profitability analysis, Case studies.

Unit IV: Analysis in Bioprocess Engineering:

Estimation of capital investment and operating cos

Course Outcomes:

After learning the course, the students should be able to:

CO1: Understand the concepts of designing various chemical and biochemical equipment and devices

CO2: They will be able to select the right ancillaries or equipment's for the industrial units

CO3: Calculate the required parameters for different vessels and parts they're of

Textbooks

1. L. E. Brownell and E. H. Young- Process Equipment Design, Wiley India Pvt. Ltd. (2015)

2. M.V. Joshi and V.V. Mahajani- Process Equipment Design, MacMillan Company of India Ltd. (2009)

3. R. K. Sinnott- Chemical Engineering Series: An Introduction to Chemical Engineering Design (Vol. 6), Maxwell Macmillan Pergamon Publishing Corporation (2005)

Reference Books

1. K. Van't Riet and J. Tramper-Basic Bioreactor Design, Taylor & Francis Inc, New York, United States (1991)

2. Max Peters & Klans D Timmerhauss-Plant Design & Economics for Chemical Engineers", 4th Edition; Mc Graw Hill Book Co (1991)

3. Tapabrata Panda-Bioreactors Analysis and Design, Tata McGraw Hill Education Pvt. Ltd, (2011)

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XXXXXXX					Nanotechnology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	IA	ES	LW	LE/VIVA	
3	0	0	3	3	25	25	50	-	-	100

COURSE OBJECTIVES

- To understand the fundamentals of Nanotechnology.
- Explain the nanoscale paradigm in terms of properties at the nano scale dimension.
- Identify current nanotechnology solutions in design, engineering and manufacturing.
- To understand and learn about the applications of nanoscale materials and the application of the principles of nano chemistry in real world problems.

UNIT I

Introduction and History of Nanotechnology, Nano-materials and their properties: physical, chemical and biological properties from their constituent atoms or molecules and from the bulk materials. Case studies demonstrating non-classical behaviour at nanoscale in successful and emergent nanotechnologies.

Unit –II

Synthesis of nano materials, bottom-up approach: self-assembly and self-organization, vapor phase deposition, plasma assisted deposition processes, colloidal, sol-gel, or simple pyrolysis, top-down approach: miniaturization of smaller structures from larger ones like milling, lithography, machining will be presented with suitable examples.

Unit III

Detailed characterization technique based on radiation matter interactions and their analytical applications like Transmission electron microscope (TEM), Scanning electron microscope (SEM), Atomic force microscope (AFM), scanning tunnelling microscope (STM), Dynamic light scattering (DLS), Spectroscopy. The safety and storage issues and the impact of nanotechnology on the environment will be stressed at the end.

Unit-IV

Applications of Nanoscale materials: Catalysis, Sensing, Energy storage, Environmental remediation, etc.; Energy Conversion and Storage (solar cells, Fuel Cells, Li/Na-ion Batteries); Nanoscale materials for waste reduction and improved energy efficiency, nanotechnology-based water treatment strategies. Nano sensors and Devices.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: - Tell the basics of Nanotechnology along with properties.

CO2: - Explain the chemical methods for synthesis of nanoparticles.

CO3: - Develop various nanomaterials and basic understanding in the relevant analytical techniques.

CO4: - Categorize the various techniques for nano-materials characterization.

CO5: - Explain the physical methods for synthesis of nanoparticles.

CO6: - Discuss the different applications of nano scale materials.

Textbooks

1. "Nanostructures and Nanomaterials: Synthesis, Properties and Applications" by Cao G
2. "Carbon Nanotubes – Basic Concepts and Physical Properties" by Reich S and Maultzsch J
3. "Introduction to Nanoscience and Nanotechnology" by Chattopadhyay K K

4. "Introduction to Nanoscience and Nanotechnology" by Gabor L Hornyak and H F Tibbals
5. "Nanotechnology: Principles and Practices" by Sulabha K Kulkarni
6. "Introduction to Nanoscience" by Gabor L Hornyak and Joydeep Dutta

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					Nanotechnology lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- ➢ To understand physical methods for synthesis of nanoparticles.
- ➢ To understand the limitations of the synthesis techniques.
- ➢ To understand various advancement in Techniques for synthesis at nanoscale.
- ➢ To understand the use of nanotechnology in Energy Storage.

LIST OF EXPERIMENTS

1. Ball milling route for making nanoparticles and particle size distribution estimation.
2. Sol-gel synthesis and characterization of CdS nanocrystals.
3. Preparation and characterization of ZnO nanoparticles embedded in silica matrix
4. Microwave assisted synthesis of ZnO nanoparticles.
5. Eco-Friendly Bio-Chemical synthesis of nanomaterials.
6. Synthesis and Characterization of carbon nanotubes by cracking of gas mixture
7. Physical vapor deposition and chemical vapor deposition techniques for thin film deposition.
8. Fabrication of suitable structures on thin films for device applications.
9. To investigate refluxing and distillation techniques for synthesis of II-VI ceramic nanostructures.
10. To study solvothermal synthesis method of nanoparticles

COURSE OUTCOMES

On completion of the course, student will be able to

CO1:- Tell the basics of Nanotechnology along with properties.

CO2:- Explain the chemical methods for synthesis of nanoparticles.

CO3:- Develop various nanomaterials and basic understanding in the relevant analytical techniques.

CO4:- Categorize the various techniques for nano-materials characterization.

CO5:- Explain the physical methods for synthesis of nanoparticles.

CO6:- Discuss the use of nanotechnology in Energy Storage.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3 Hrs.
Viva Voce Examination	50 Marks
Practical Examination	50 Marks

Pandit Deendayal Energy University

XXXXXXX					IPR values					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	IA	ES	LW	LE/VIVA	
2	0	0	1	2	25	25	50	-	-	100

COURSE OBJECTIVES

- To understand the basics importance of Intellectual property rights.
- To understand the concept of writing paper developing a Research Proposal and patent.
- To learn about the basic knowledge for Process of Patenting and Development.
- Learn to understand the Scope of Patent Rights, Licensing and transfer of technology

UNIT – 1: INTELLECTUAL PROPERTY RIGHTS (IPR) – AN INTRODUCTION
Basic concept of Intellectual Property, Characteristics and Nature of Intellectual Property right, Justifications for protection of IP, IPR and economic development

UNIT – 2: PUBLICATIONS & PATENTS
Effective technical writing: how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT – 3: UNDERSTANDING INTELLECTUAL PROPERTY RIGHTS (IPR)
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT – 4: PATENTS & COPYRIGHTS
Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, Traditional knowledge Case Studies, IPR and IITs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Find the importance of Intellectual property.
CO2: Show the ability to write paper developing a Research Proposal and patent.
CO3: Apply the knowledge for Process of Patenting and Development
CO4: Distinguish between the Scope of Patent Rights, Licensing and transfer of technology.
CO5: Access and understand of New Developments in IPR.
CO6: - Develop the technique for IPR protection provides and follow the research ethics.

TEXT/REFERENCE BOOKS

1. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
2. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
3. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

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XXXXXXX					Biomedical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	IA	EA	LW	LE/VIVA	
2	0	0	1	2	25	25	50	-	-	100

COURSE OBJECTIVES

- To understand the basics of biomedical engineering in healthcare.
- To gain knowledge in the various fields of biomedical engineering.

UNIT 1 INTRODUCTION

Evolution of modern health care system, Engineering in modern medicine, Role of Biomedical Engineering, Roles played by Biomedical Engineers, Professional status of Biomedical Engineering, History of Biomedical Devices

UNIT 2 BIOLOGY AND ENGINEERING

Characteristics of human anatomy and physiology related to biomedical devices, Engineering of immunity and pathology, Communication systems in the body and its connection to biomedical engineering.

UNIT 3 ELECTRONICS AND MEDICINE

Medical Electronics, Basis of Bioelectric potential Bio potential electrodes, Biomedical amplifiers, Characteristics of recording systems, Computer applications in medicine, Design of electromedical equipment

UNIT 4 RESEARCH IN BIOMEDICAL

Medical devices and Robotics, Bio fabrication and Biomanufacturing, Biomedical Imaging, Biomolecular Science and Engineering, Musculoskeletal Biomechanics and Mechanobiology, Systems Biology, Tissue Engineering, Rehabilitation Engineering, Biomaterials and Nanotechnology, Neural Engineering- Case Studies.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Understand his/her role as a biomedical engineer.

CO2 - Interpret the application of biology in engineering.

CO3 - Assimilate the role of electronics in medicine.

CO4 - Examine his/her responsibility as a clinical engineer.

CO5 - Apply his/her knowledge to research in different areas of biomedical engineering

CO6 - Implement the knowledge gained in understanding the concepts better in forthcoming semesters

TEXT / REFERENCE BOOKS

1. C. Raja Rao, Sujoy K. Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press, 2001.

2. W. Mark Saltzman, Biomedical Engineering: Bridging Medicine and Technology, Cambridge University Press, 2015.

3. Sundararajan V. Madihally, Principles of Biomedical Engineering, Artech House Publishers, 2010.
4. Azzam F.G. Taktak, Paul Ganney, David Long, Clinical Engineering: A Handbook for Clinical and Biomedical Engineers, Elsevier, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice 20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks 80 Marks

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Teaching Scheme					Catalysis and Surface Sciences Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	2	3	25	50	25	--	--	100

COURSE OBJECTIVES

- ➢ To provide a brief review to chemical kinetics, catalysis and applications
- ➢ To provide insight to the surface chemistry and diffusion fundamentals in catalytic reactions
- ➢ To give a wholesome picture on catalytic reactions and catalytic reactors and modelling
- ➢ To give details on catalyst synthesis, characterization and instrumentation involved

UNIT 1 INTRODUCTION TO CATALYSIS AND REVIEW OF CHEMICAL KINETICS 07 Hrs.
Review of chemical kinetics, ideal reactors and non-ideality, rate equations and design, review on catalysis, catalytic processes, industrial catalysis, acid base catalysis, homo-hetero catalysis, catalysts in pollution control abatement, bio catalysis, bio-mimetic catalysts

UNIT 2 SURFACE CHEMISTRY AND DESIGN OF CATALYSTS 07 Hrs.
Surfaces as defects in crystalline materials, adsorption and chemisorption, desorption, structure of solid surfaces, electronic properties of structures, acid base properties. redox properties, surface analysis: techniques and methods, design of catalysts – effect of metal, effect of support, morphology of catalyst, strong metal support interaction (SMSI)

UNIT 3 CATALYST PREPARATION AND CHARACTERIZATION 08 Hrs.
Synthesis methods; conventional methods, novel techniques for micro porous and meso porous material, soft and hard templating methods, analytical equipments to study the properties of catalytic surfaces: temperature-programmed methods, spectroscopic methods; surface area analysis, microscopic techniques, crystallographic study

UNIT 4 CATALYTIC REACTORS AND MODELING 08 Hrs.
Multiphase catalytic reactors; fixed bed reactor, trickle bed reactor, fluidized bed reactor, slurry reactor, deactivation of catalysts, Fundamental modeling for catalytic processes, modelling with deactivation, design of reactors for gas-solid reactions, heterogeneous data analysis for reactor design, research case studies on modelling and catalytic reactor.

COURSE OUTCOMES

CO1 – Recall the basics of kinetics and catalysis
CO2 – Illustrate and Interpret surface phenomenon of catalytic properties
CO3 – Utilize proper synthesis method and characterize the catalysts by different instrumental analysis
CO4 – Compare the reactor performance with or w/o internal of external mass transfer limitations
CO5 – Appraise the performance of different reactors in multi-phase systems
CO6 – Design and Develop catalytic systems for specific purpose of real-life problems

TEXT/REFERENCE BOOKS

1. H. S. Fogler, “Elements of Chemical Reaction Engineering”, 3rd Ed, New Delhi-Prentice Hall, 2001
2. O. Levenspiel, “Chemical Reaction Engineering” Willey Eastern, 3rd Ed., 2000
3. J. M. Smith, “Chemical Engineering Kinetics”, 3rd Ed., McGraw- Hill, 1988
4. Krijn P. de Jong, “Synthesis of Solid Catalysts”, Wiley, 2009

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3 Hrs.
Part A/Question: Theoretical knowledge and understanding	40 Marks
Part B/Question: Problem Solving, Design and Analysis	60 Marks

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Computer Aided Process Design										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	1	2	25	50	25	--	--	100

COURSE OBJECTIVES

- Create, select, and apply appropriate modern software tools including modelling to complex chemical engineering processes with an understanding of the limitations
- Identify the components of physical and thermodynamic property models and Learn software aspects of rapid solution.
- Learn application and solve chemical process flow sheeting problems more quickly, efficiently and successfully using computer aided tools
- Learn concepts of process integration and to solve heat exchanger network problems.

UNIT 1 BASICS OF COMPUTER AIDED PROCESS DESIGN

Integrated process plant design with computer aided tools, BFD, PFD, P&ID, pre-FEED, FEED stages. Commercial Process simulators: components and architecture, blocks and streams library, CAPD problem formulation and solvers, model equations and Degrees of freedom, Design, rating, specification and optimization formulation; sequential modular and Equation oriented approach, tearing of stream, scopes of Aspen Plus/hysis simulator, flow sheeting problem solving using design specifications, sensitivity analysis

UNIT 2 PHYSICAL PROPERTY, METHODS AND MODELS

Computerized physical property, methods and models, ideal and non-ideal model selection criteria, Thermodynamics databanks; estimation of activity coefficient and EOS model parameters using data regression system, Case studies and flow sheeting problem solving of mass and energy balance, phase equilibrium, chemical equilibrium and reactor design using commercial software (Aspen Plus).

UNIT 3 COMPUTER SIMULATION OF MASS AND HEAT TRANSFER EQUIPMENT'S

Design and simulation of distillation and absorption column, equilibrium and rate-based approach; design, rating and simulation of heat exchangers, Petroleum fractionation columns, Various unit models available in Aspen Plus library and their usage.

UNIT 4 INTRODUCTION TO PROCESS INTENSIFICATION

Process Integration, Heat Exchanger networks (HEN), cold, hot composite and Utility curves, pinch point analysis, Solving HEN problems using Aspen Plus

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1 - Understand, create, select, and Describe computer tools for chemical process simulation

CO2 - CHOOSE AND apply blocks and streams from a simulators library to make a process flow sheet

CO3 - apply stream and block parameters to a chemical unit operation for computer simulation

CO4 - determine flow sheeting solution by using design specification and sensitivity analysis approach

CO5 - solve process design and simulation calculations of various unit operations using Aspen software

CO6 – Outline process intensification and construct Heat exchanger networks

TEXT/REFERENCE BOOKS

1. Chemical Process design and Simulation by Juma Haydary, 2019 John Wiley &sons, Inc
2. Introduction to Chemical Engineering Computing" by Bruce A. Finlayson Wiley Interscience
3. Process Simulation and Control using Aspen by Amiya K. Jena. PHI Learning PVT LTD

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3 Hrs.
Part A/Question: Theoretical Questions	50 Marks
Part B/Question: Analytical Questions	50 Marks