JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU

B.Tech (Chemical Engineering) (R20)
Course Structure

SEMESTER – I							
S.No.	**Course No**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
1	20A15101	Linear Algebra and Calculus Common to All branches of Engineering	BS	3	0	0	3
2	20A15301	Engineering Chemistry Common to CE, MECH, CHEM	BS	3	0	0	3
3	20A10506	C-Programming & Data Structures Common to CE, MECH, CHEM	ES	3	0	0	3
4	20A15501	Communicative English Common to EEE, ECE, CSE, CHEM	HS	3	0	0	3
5	20A10303	EngineeringWorkshop Common to CE, MECH, CHEM	LC	0	0	3	1.5
6	20A10508	IT Workshop Common to CE, MECH, CHEM	LC	0	0	3	1.5
7	20A15302	Engineering Chemistry Lab Common to CE, MECH, CHEM	BS	0	0	3	1.5
8	20A10507	C-Programming & Data Structures Lab Common to CE, MECH, CHEM	ES	0	0	3	1.5
9	20A15501	Communicative English Lab Common to EEE, ECE, CSE, CHEM	HS	0	0	3	1.5
						Total	19.5

Induction Program – 3 weeks

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU

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B.Tech (Chemical Engineering) (R20)
Course Structure

SEMESTER – II							
S.No.	**Course No**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
1	20A15102	Differential Equations and Vector Calculus Common to all branches of Engineering except CSE	BS	3	0	0	3
2	20A15203	EngineeringPhysics Common to CE, MECH, CHEM	BS	3	0	0	3
3	20A10801	Basic Thermodynamics	ES	3	0	0	3
4	20A10401	Basic Electrical & Electronics Engineering Common to Mech, CSE, Chem	ES	3	0	0	3
5	20A10301	Engineering Drawing Common to CE, MECH, CHEM	LC	1	0	2	2
6	20A10302	Engineering Graphics Lab Common to CE, MECH, CHEM	LC	0	0	2	1
7	20A10802	Basic Thermodynamics Lab	ES	0	0	3	1.5
8	20A15204	Engineering Physics Lab Common to Civil, Mech, Chem	BS	0	0	3	1.5
9	20A10402	Basic Electrical & Electronics Engineering Lab Common to Mech, CSE, Chem	ES	0	0	3	1.5
10	20A19101	Universal Human Values Common to CE, MECH, CHEM	MC	3	0	0	0.0
						Total	19.5

***For 2020 Admitted batch only**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU

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B.Tech (Chemical Engineering) (R20)
Course Structure

		SEMESTER – III					
S. No.	**Course No**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
1	20A35101	Numerical Methods and Probability Theory Common to CE, CHEM	BS	3	0	0	3
2	20A30801	Chemical Process Calculations	PC/ES	3	0	0	3
3	20A30802	Momentum Transfer	PC/ES	3	0	0	3
4	20A30803	Chemical Technology	PC/ES	3	0	0	3
5	20A30804	Mechanical Operations	PC/ES	3	0	0	3
6	20A30805	Momentum Transfer Lab	PC/ES	0	0	3	1.5
7	20A30806	Mechanical Operations Lab	PC/ES	0	0	3	1.5
8	20A30807	Chemical Technology Lab	PC/ES	0	0	3	1.5
9	20A30808	Skill oriented Course – 1(Analytical Techniques for Chemical Engineers)	SC	1	0	2	2
10	20A10803	Mandatory non-credit Course-II Environmental Science Common to CE, MECH, CHEM	MC	3	0	0	0
						Total	21.5

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU

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B.Tech (Chemical Engineering) (R20)
Course Structure

		SEMESTER – IV					
S. No.		**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
1	20A45301	Organic Chemistry	BS	3	0	0	3
2	20A40801	Process Heat Transfer	PC/ES	3	0	0	3
3	20A40802	Chemical Engineering Thermodynamics	PC/ES	3	0	0	3
4	20A40803	Instrumentation & Process Control	PC/ES	3	0	0	3
5	20A49101a	Humanities Elective-1 Common to Civil, Mech, Chemical Managerial Economics & Financial Analysis	HS	3	0	0	3
	20A49101b	Entrepreneurship & Incubation					
	20A49101c	Business Ethics And Corporate Governance					
6	20A40804	Process Heat Transfer Lab	PC/ES	0	0	3	1.5
7	20A40805	Organic Chemistry Lab	BS	0	0	3	1.5
8	20A40806	Instrumentation & Process Control Lab	PC/ES	0	0	3	1.5
9	20A40807	Skill oriented Course – II(Industrial Safety and Hazard Management)	SC	1	0	2	2
10	20A49102	Mandatory non-credit Course-III Design Thinking for Innovation Common to All Branches	MC	2	1	0	0
11	20A49901	NSS/NCC/NSO Activities	-	0	0	2	0
						Total	21.5

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS), ANANTAPUR
B.TECH. – CHEMICAL ENGINEERING
Course Structure (R20)

Semester–V						
S.No.	Course Code	Course Name	L	T	P	Credits
1.	20A50801	Chemical Reaction Engineering	3	0	0	3
2.	20A50802	Mass Transfer Operations – I	3	0	0	3
3.	20A50803	Chemical Process Equipment Design	3	0	0	3
4.	20A50804a 20A50804b 20A50804c	Professional Elective Course – I 1. Environmental Engineering 2. Process Modeling and Simulation 3. Material Science for Chemical Engineers	3	0	0	3
5.	20A50805	Open Elective Course – I* Common to All Branches Energy Conversion and storage Devices	3	0	0	3
6.	20A50806	Environmental Engineering Lab	0	0	3	1.5
7.	20A50807	Chemical Reaction Engineering Lab	0	0	3	1.5
8.	20A50808	Skill oriented course – III Computer applications in Chemical Engineering	1	0	2	2
9.	20A50809	Evaluation of Community Service Project				1.5
10	20A55401	**Mandatory Non-credit Course** Indian Constitution (CIV, ME, CHEM)	2	0	0	0
Total						21.5

Note:

1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU

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B.Tech (Chemical Engineering) (R20)
Course Structure

Semester–VI

S.No.	Course Code	Course Name	L	T	P	Credits
1.	20A60801	Chemical Plant Design & Economics	3	0	0	3
2.	20A60802	Mass Transfer Operations – II	3	0	0	3
3.	20A60803	Transport Phenomena	3	0	0	3
4.	20A60804a 20A60804b 20A60804c	**Professional Elective Course– II** 1. Fluidization Engineering 2.NumericalMethods in Chemical Engineering 3. Solid-Fluid Reactions	3	0	0	3
5.	20A60805	Open Elective Course – II* Common to All Branches Green Technology	3	0	0	3
6.	20A60806	Mass Transfer Operations Laboratory	0	0	3	1.5
7.	20A60807	Chemical Process Equipment Design &Drawing Laboratory	0	0	3	1.5
8.	20A60808	Chemical Process Simulation Lab	0	0	3	1.5
9.	20A65502	**Skill oriented course - IV** Soft Skills (CIV, ME, Chemical)	1	0	2	2
10.	20A69901	**Mandatory Non-credit Course** Intellectual Property Rights & Patents (Civil, ME, CHEM)	2	0	0	0
Total						**21.5**
Industry Internship (Mandatory) for 6 - 8 weeks duration during summer vacation						

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU

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B.Tech (Chemical Engineering) (R20)
Course Structure

Semester-VII						
S.No.	**Course Code**	**Course Name**	**L**	T	**P**	**Credits**
1.	20A70801a 20A70801b 20A70801c	**Professional Elective Course– III** 1. Petroleum & Petrochemical Technology 2. Energy Engineering 3. Basics of Nano Technology	3	0	0	3
2.	20A70802a 20A70802b 20A70802c	**Professional Elective Course– IV** 1.Corrosion Engineering 2.Optimization of Chemical Processes 3. Pharmaceutical & Fine Chemicals	3	0	0	3
3.	20A70803a	**Professional Elective Course– V** * MOOCs course offered in Swayam/ NPTEL	3	0	0	3
4.	20A75401a 20A75401b 20A75401c	Humanities Elective Common to All Branches 1. Management science 2. Business environment 3. Organizational behaviour	3	0	0	3
5.	20A70804	**Open Elective Course – III*** Common to All Branches Industrial Polluation Control Engineering	3	0	0	3
6.	20A70805	**Open Elective Course – IV*** Common to All Branches Solid Waste Management	3	0	0	3
7.	20A70806	**Skill oriented course – V** Applications of AI & ML in Chemical Engg	1	0	2	2
8.	20A70807	Evaluation of Industry Internship				3
Total						**23**

Semester-VIII							
S.No.	**Course Code**	**Course Name**	**Category**	**L**	T	**P**	**Credits**
1.	20A80101	Full Internship & Project work	PR				12
						Total	**12**

HONOURS DEGREE IN <Chemical Engineering>
Stream 1: Material Science & Engineering

S.No.	Course Code	Course Name	Contact Hours per week		Credits
			L	T	
1	20A08H11	Surface Engineering	3	1	4
2	20A08H12	Powder Metallurgy	3	1	4
3	20A08H13	Synthesis & Characterization of Materials	3	1	4
4	20A08H14	Material Production, Planning & Control	3	1	4
SUGGESTED MOOCs**					
5	20A08H15a	MOOC I* Advanced Materials and Processes	--	--	2
6	20A08H16a	MOOC II* Aluminum based Alloys and Metal Matrix	--	--	2

**** Based on the availability of courses offered by NPTEL SWAYAM with a minimum of 12 weeks duration.**

HONOURS DEGREE IN <Chemical Engineering>
Stream 2: Environment

S.No.	Course Code	Course Name	Contact Hours per week		Credits
			L	T	
1	20A08H21	Air Pollution Control Techniques	3	1	4
2	20A08H22	Solid & Hazardous Waste Management	3	1	4
3	20A08H23	Environmental Impact Assessment (EIA)	3	1	4
4	20A08H24	Environmental Biotechnology	3	1	4
SUGGESTED MOOCs					
5	20A08H25a	MOOC I* *Environment and Development	--	--	2
6	20A08H26a	MOOC II* *Environmental Modeling & Simulation	--	--	2

**** Based on the availability of courses offered by NPTEL SWAYAM with a minimum of 12 weeks duration.**

MINORS

Stream 1: Green Technology & Sustainable Engineering

S.No.	Course Code	Course Title	Contact Hours per week			Credits
			L	T	P	
1.	20A08M11	Solar Energy Engineering	3	1	0	4
2.	20A08M12	Renewable Energy Systems	3	1	0	4
3.	20A08M13	Energy Conversion	3	1	0	4
4.	20A08M14	Technology Economics	3	1	0	4
5.	20A08M15a	MOOC I**Challenges to Sustainable Development	--	--		2
6.	20A08M16a	MOOC II**Sustainable Management of Biodiversity	--	--		2

**** Based on the availability of courses offered by NPTEL SWAYAM with a minimum of 12 weeks duration.**

MINORS

Stream 2: Waste Management Technology

S.No.	Course Code	Course Title	Contact Hours per week			Credits
			L	T	P	
1.	20A08M21	Integrated Waste Management for a Smart City	3	1	0	4
2.	20A08M22	Municipal Solid Waste Management	3	1	0	4
3.	20A08M23	Plastic Waste Management	3	1	0	4
4.	20A08M24	Solid and Hazardous Waste Management	3	1	0	4
5.	20A08M25a	MOOC I* Energy Conservation & Waste Heat Recovery	--	--		2

6.	20A08M26a	MOOC II* Wastewater Treatment & Recycling	--	--		2

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS), ANANTAPUR

Chemical Engineering

		Open Elective Course – I*				
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	20A50105	Experimental Stress Analysis	3	0	0	3
2.	20A50205	Electric Vehicle Engineering	3	0	0	3
3.	20A50305	Optimization Techniques	3	0	0	3
4.	20A50405	Basics of Electronics and Communication	3	0	0	3
5.	20A50505	Introduction to Java Programming	3	0	0	3
6.	20A50805	Energy Conversion and Storage Devices	3	0	0	3
7.	20A55101	Optimization Methods (Mathematics)	3	0	0	3
8.	20A55201	Material Characterization	3	0	0	3
9.	20A55401	E-Business (H & SS)	3	0	0	3
10.	20A55301	Chemistry Of Energy Materials (Chemistry)	3	0	0	3

***It is mandatory that the candidate should select any subject other than parent branch subject.**

		Open Elective Course – II				
S.No.	**Course**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	20A60105	Disaster Management(CIVIL)	3	0	0	3
2.	20A60205	Renewable Energy Systems(EEE)	3	0	0	3

3.	20A60305	Solar Energy Systems(MECH)	3	0	0	3
4.	20A60405	Basics of Integrated Circuits Applications(ECE)	3	0	0	3
5.	20A60505	Introduction to Linux Programming (CSE) (CSE)	3	0	0	3
6.	20A60805	Green Technology(CHEM)	3	0	0	3
7.	20A65101	Mathematical Modelling & Simulation (Common for CIVIL,MECH &CHEM)(Mathemtics)	3	0	0	3
8.	20A65102	Wavelet transforms and its Applications (Common for EEE&ECE) (Mathemtics)	3	0	0	3
9.	20A65103	Statistical Methods for Data Science CSE (Data Science) (Mathemtics)	3	0	0	3
10.	20A65201	Physics Of Electronic Materials And Devices (Physics)	3	0	0	3
11.	20A65501	Academic Writing and Public Speaking(H & SS)	3	0	0	3
12.	20A65301	Chemistry Of Polymers And Its Applications (Chemistry)	3	0	0	3

***It is mandatory that the candidate should select any subject other than parent branch subject.**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS), ANANTAPUR

Chemical Engineering

		Open Elective Course – III*				
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	20A70103	Building Technology for Engineers (CIVIL)	3	0	0	3
2.	20A70204	Battery Management Systems (EEE)	3	0	0	3
3.	20A70304	Modern Manufacturing Methods (MECH)	3	0	0	3
4.	20A70404	Digital Electronics (ECE)	3	0	0	3
5.	20A70504	CyberSecurity (CSE)	3	0	0	3
6.	20A70804	Industrial Pollution Control Engineering (CHEM)	3	0	0	3
7.	20A75101	Numerical Methods for Engineers	3	0	0	3
8.	20A75201	SMART MATERIALS AND DEVICES (Physics)	**3**	**0**	**0**	**3**
9.	20A75501	Employability Skills (H&SS)	**3**	**0**	**0**	**3**
10.	20A75301	GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT (Chemistry)	**3**	**0**	**0**	**3**

***It is mandatory that the candidate should select any subject other than parent branch subject.**

		Open Elective Course – IV*				

S.No.	Course Code	Course Name	L	T	P	Credits
1.	20A70104	Environmental Impact and Assessment (CIVIL)	3	0	0	3
2.	20A70205	IOT Applications in Electrical Engineering	3	0	0	3
3.	20A70305	Material Handling Equipment (MECH)	3	0	0	3
4.	20A70405	Principles of Digital Signal Processing (ECE)	3	0	0	3
5.	20A70505	Introduction to DBMS (CSE)	3	0	0	3
6.	20A70805	Solid Waste management (CHEM)	3	0	0	3
7.	20A75102	Number theory and its Applications (Mathematics)	3	0	0	3
8.	20A75202	Sensors and Actuators For Engineering Applications (Physics)	**3**	**0**	**0**	**3**
9.	20A79102	English Literary Spectrum (H & Ss)	**3**	**0**	**0**	**3**
10.	20A75302	Chemistry Of Nanomaterials And Applications (Chemistry)	**3**	**0**	**0**	**3**

***It is mandatory that the candidate should select any subject other than parent branch subject.**

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous)::ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem

L	P	T	C
3	0	1	3

20A15101 Linear Algebra & Calculus
Common to all branches of Engineering

Course Objectives:

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Bridge Course: Limits, continuity, Types of matrices

Unit 1: Matrices

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Learning Outcomes:

At the end of this unit, the student will be able to

- Solving systems of linear equations, using technology to facilitate row reduction

determine the rank, eigenvalues and eigenvectors, diagonal form and different factorizations of a matrix;

- Identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics.

Unit 2: Mean Value Theorems

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof)

Learning Outcomes:

At the end of this unit, the student will be able to

- Translate the given function as series of Taylor's and Maclaurin's with remainders
- Analyze the behaviour of functions by using mean value theorems

Unit 3: Multivariable calculus

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes:

At the end of this unit, the student will be able to

- Find partial derivatives numerically and symbolically and use them to analyze and interpretthe way a function varies.
- Acquire the Knowledge maxima and minima of functions of several variable
- Utilize Jacobian of a coordinate transformation to deal with the problems in change of variables

Unit 4: Multiple Integrals

Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves. Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates.

Learning Outcomes:

- At the end of this unit, the student will be able to
- Evaluate double integrals of functions of several variables in two dimensions usingCartesian and polar coordinates
- Apply double integration techniques in evaluating areas bounded by region
- Evaluate multiple integrals in Cartesian, cylindrical and spherical geometries

Unit 5: Special Functions

Beta and Gamma functions and their properties, relation between beta and gamma functions, evaluation of definite integrals using beta and gamma functions.

Learning Outcomes:

At the end of this unit, the student will be able to

- understand beta and gamma functions and its relations
- Conclude the use of special function in evaluating definite integrals

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

JNTUACEA **R 20**
2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous)::ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem **L T P C**
2 10 3

20A15301 Engineering Chemistry
Common to Civil, Mech & Chem

Subject Code	Title of the Subject	L	T	P	C
19A53101	Engineering Chemistry	2	1	-	3

COURSE OBJECTIVES	
1	To familiarize engineering chemistry and its applications
2	To impart the concept of soft and hard waters, softening methods of hard water
3	To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement

COURSE OUTCOMES	
CO1	**list** the differences between temporary and permanent hardness of water, **explain**the principles of reverse osmosis and electrodialysis. **compare**equality ofdrinking water with BIS and WHO standards. **illustrate**problems associated with hard water - scale and sludge**. explain** the working principles of different Industrial water treatment processes
CO2	**apply** Nernst equation for calculating electrode and cell potentials, **apply** Pilling Bedworth rule for corrosion and corrosion prevention, **demonstrate** the corrosion prevention methods and factors affecting corrosion, **compare** different batteries and their applications
CO3	**explain** different types of polymers and their applications, **Solve the numerical problems based on Calorific value, select** suitable fuels for IC engines, **explain** calorific values, octane number, refining of petroleum and cracking of oils
CO4	explain the constituents of Composites and its classification Identify the factors

	affecting the refractory material, Illustrate the functions and properties of lubricants, demonstrate the phases and reactivity of concrete formation, identify the constituents of Portland cement, enumerate the reactions at setting and hardening of the cement
CO5	**summarize** the applications of SEM, TEM and X-ray diffraction in surface characterization, **explain** the synthesis of colloids with examples, **outline** the preparation of nanomaterials and metal oxides **identify** the application of colloids and nanomaterials in medicine, sensors and catalysis

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

Unit 1: Water Technology **(8 hrs)**

Introduction –Soft Water and hardness of water, Estimation of hardness of water by EDTA Method - Boiler troubles **-** scale and sludge, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, zeolite and ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

Unit 2: Electrochemistry and Applications: (10 hrs)

Electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zn-MnO_2 (Leclanche cell), Li Battery

Secondary cells – lead acid and lithium ion batteries- working of the batteries including cell reactions.

Fuel cells- Basic Principles and Working Principles of hydrogen-oxygen, methanol fuel cells

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion,cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Unit 3: Polymers and Fuel Chemistry:(12 hrs)

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth and coordination polymerization,

Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of PVC and Bakelite

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol

Fuels – Types of fuels, calorific value, numerical problems based on calorific value; Analysis of coal, Liquid Fuels refining of petroleum, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio fuels.

UNIT-4 Advanced Engineering Materials (8 hrs)

(i)Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications
(ii)Refractories- Classification, Properties, Factors affecting the refractory materials and Applications
(iii)Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils and Applications
(iv)Building materials- Portland Cement, constituents, phases and reactivity of clinker, Setting and Hardening of cement.

Unit 5: Surface Chemistry and Applications: (10 hrs)

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (any two methods with examples), chemical and electrochemical methods (not more than two methods) of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, solid-gas interface, solid-liquid interface, adsorption isotherm, applications of colloids and nanomaterials – catalysis, medicine, sensors.

Text Books:

1. Engineering Chemistry by KNJayaveera, GVSubba Reddy and C. Ramachandraiah, McGraw Hill Higher Education, Foruth Edition, New Delhi
2. A Text Book of Enigneering Chemistry, Jain and Jain, Dhanapathi Rai Publications, New Delhi

References:

1.A Text book of Engineering Chemistry by SS Dhara, S. Chand Publications, New Delhi

2. Engineering Chemistry by K.B.Chandra Sekhar, UN.Das and Sujatha Mishra, SCITECH Pubblications India Pvt Limited.
3. Concepts of Engineering Chemistry- Ashima Srivastavaf and N.N. Janhavi
4. Text Book of Engineering Chemistry – C. Parameswara Murthy, C.V.Agarwal and Andra Naidu
5. Chemistry of Engineering Materials, C.V.Agarwal, C.Parameswaramurthy and Andranaidu
6. Text Book of Engineering Chemistry, Shashichawla, Dhanapathirai Publications.

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous)::ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

20A10506 C-Programming & Data Structures

Common to Civil, Mech & Chem

Course Objectives:

- To illustrate the basic concepts of C programming language.
- To discuss the concepts of Functions, Arrays, Pointers and Structures.
- To familiarize with Stack, Queue and Linked lists data structures.
- To explain the concepts of non-linear data structures like graphs and trees.
- To learn different types of searching and sorting techniques.

Course Outcomes:

1. Analyse the basicconcepts of C Programming language. (L4)
2. Design applications in C, using functions, arrays, pointers and structures. (L6)
3. Apply the concepts of Stacks and Queues in solving the problems. (L3)
4. Explore various operations on Linked lists. (L5)
5. Demonstrate various tree traversals and graph traversal techniques. (L2)
6. Design searching and sorting methods L3)

Unit-1

Introduction to C Language - C language elements, variable declarations and data types, operators and expressions, decision statements - If and switch statements, loop control statements - while, for, do-while statements, arrays.

At the end of the Unit, students should be able to:

- Use Cbasic concepts to write simple C programs. (L3)
- Use iterative statements for writing the C programs (L3)
- Use arrays to process multiple homogeneous data. (L3)
- Test and execute the programs and correct syntax and logical errors. (L4)
- Translate algorithms into programs. (L4)
- Implement conditional branching, iteration and recursion. (L2)

Unit – 2

Functions, types of functions, Recursion and argument passing, pointers, storage allocation, pointers to functions, expressions involving pointers, Storage classes – auto, register, static, extern, Structures, Unions, Strings, string handling functions, and Command line arguments.

At the end of the Unit, students should be able to:

- Writing structured programs using C Functions. (L5)
- Writing C programs using various storage classes to control variable access. (L5)
- Apply String handling functions and pointers. (L3)
- Use arrays, pointers and structures to formulate algorithms and write programs.(L3)

Unit-3

Data Structures, Overview of data structures, stacks and queues, representation of a stack, stack related terms, operations on a stack, implementation of a stack, evaluation of arithmetic expressions, infix, prefix, and postfix notations, evaluation of postfix expression, conversion of expression from infix to postfix, recursion, queues - various positions of queue, representation of queue, insertion, deletion, searching operations.

At the end of the Unit, students should be able to:

- Describe the operations of Stack. (L2)
- Explain the different notations of arithmetic expression. (L5)
- Develop various operations on Queues. (L6)

Unit – 4

Linked Lists– Singly linked list, dynamically linked stacks and queues, polynomials using singly linked lists, using circularly linked lists, insertion, deletion and searching operations, doubly linked lists and its operations, circular linked lists and its operations.

At the end of the Unit, students should be able to:

- Analyze various operations on singly linked list. (L4)
- Interpret operations of doubly linked lists. (L2)
- Apply various operations on Circular linked lists. (L6)

Unit-5

Trees- Tree terminology, representation, Binary trees, representation, binary tree traversals. binary tree operations, **Graphs**- graph terminology, graph representation, elementary graph operations, Breadth First Search (BFS) and Depth First Search (DFS), connected components, spanning trees. **Searchingand Sorting**– sequential search, binary search, exchange (bubble) sort, selection sort, insertion sort.

At the end of the Unit, students should be able to:

- Develop the representation of Tress. (L3)
- Identify the various Binary tree traversals. (L3)
- Illustrate different Graph traversals like BFS and DFS. (L2)
- Design the different sorting techniques (L6)
- Apply programming to solve searching and sorting problems. (L3)

Text Books:

1. The C Programming Language, Brian W Kernighan and Dennis M Ritchie, Second Edition, Prentice Hall Publication.

2. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, Susan Anderson-Freed, Computer Science Press.
3. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. AnandaRao, Pearson Education.
4. B.A.Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016.
5. Richard F. Gilberg&Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Second Edition, CENGAGE Learning, 2011.

Reference Books:

1. PradipDey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011.
2. E.Balaguruswamy, "C and Data Structures", 4th Edition, TataMcGraw Hill.
3. A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press.
4. M.T.Somashekara, "Problem Solving Using C", PHI, 2nd Edition 2009.

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I-YearB.Tech. I-Sem

L	T	P	C
3	0	0	3

20A15501 Communicative English 1

Common to EEE,ECE, CSE & CHEM

Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

Course Objectives

- ➢ Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- ➢ Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- ➢ Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- ➢ Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- ➢ Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Unit 1

Lesson: On the Conduct of Life: William Hazlitt

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. **Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. **Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information. **Reading for Writing :**Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar**

and Vocabulary: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.

Learning Outcomes

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

Unit 2

Lesson: The Brook: Alfred Tennyson

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts. **Speaking:** Discussion in pairs/small groups on specific topics followed by short structured talks. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

Learning Outcomes

At the end of the module, the learners will be able to

- comprehend short talks on general topics
- participate in informal discussions and speak clearly on a specific topic using suitable discourse markers
- understand the use of cohesive devices for better reading comprehension
- write well structured paragraphs on specific topics
- identify basic errors of grammar/ usage and make necessary corrections in short texts

Unit 3

Lesson: The Death Trap: Saki

Listening: Listening for global comprehension and summarizing what is listened to. **Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed **Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.**Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. **Grammar and Vocabulary:** Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Learning Outcomes

At the end of the module, the learners will be able to

- comprehend short talks and summarize the content with clarity and precision
- participate in informal discussions and report what is discussed
- infer meanings of unfamiliar words using contextual clues
- write summaries based on global comprehension of reading/listening texts
- use correct tense forms, appropriate structures and a range of reporting verbs in speech and writing

Unit4

Lesson: Innovation: Muhammad Yunus

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video. **Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. **Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. **Grammar and Vocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Learning Outcomes

At the end of the module, the learners will be able to

- infer and predict about content of spoken discourse
- understand verbal and non-verbal features of communication and hold formal/informal conversations
- interpret graphic elements used in academic texts
- produce a coherent paragraph interpreting a figure/graph/chart/table
- use language appropriate for description and interpretation of graphical elements

Unit 5

Lesson: Politics and the English Language: George Orwell

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension. **Speaking:** Formal oral presentations on topics from academic contexts - without the use of PPT slides. **Reading:** Reading for comprehension. **Writing:** Writing structured essays on specific topics using suitable claims and evidences. **Grammar and Vocabulary:** Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Learning Outcomes

At the end of the module, the learners will be able to

- take notes while listening to a talk/lecture and make use of them to answer questions
- make formal oral presentations using effective strategies
- comprehend, discuss and respond to academic texts orally and in writing
- produce a well-organized essay with adequate support and detail
- edit short texts by correcting common errors

Prescribed Text:

Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

Reference Books

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.
- Oxford Learners Dictionary, 12th Edition, 2011

Course Outcomes

At the end of the course, the learners will be able to

- Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
- Apply grammatical structures to formulate sentences and correct word forms
- Analyze discourse markers to speak clearly on a specific topic in informal discussions
- Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
- Create a coherent paragraph interpreting a figure/graph/chart/table

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU

DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem

L	T	P	C
0	0	3	1.5

20A10303 Engineering Workshop

Common to CIVIL, MECH & CHEM

Course Objective:	
1	To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills.

Wood Working:

Familiarity with different types of woods and tools used in wood working and make following joints

a) Half – Lapjoint
b) Mortise and Tenonjoint
c) Corner Dovetail joint or Bridlejoint

Sheet Metal Working:

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

a)Taperedtray b)Conicalfunnel
c)Elbowpipe d)Brazing

Fitting:

Familiarity with different types of tools used in fitting and do the following fitting exercises

a) V-fit b)Dovetailfit c) Semi-circularfit
d) Bicycle tyre puncture and change of two wheeler tyre

Electrical Wiring:

Familiarities with different types of basic electrical circuits and make the following connections

a) Parallelandseries b) Twowayswitch c)Godownlighting
d) Tubelight e) Threephasemotor f) Soldering ofwires

Power tools:

Demonstration of a) Circular Saw b) Power Planer
c) Zig Saw d) Buffing Machine

After completion of t lab the student will be able to

COURSE OUTCOMES	
At the end of this course the student will be able to	
CO1	Apply wood working skills in real world applications.(L3)
CO2	Build different objects with metal sheets in real world applications.(L3)
CO3	Apply fitting operations in various applications.(L3)
CO4	Apply different types of basic electric circuit connections.(L3)
CO5	Understand the operation of power tools.(L2)

Note: In each section a minimum of three exercises are to be carried out.

JNTUA College of Engineering (Autonomous) Ananthapuramu
Department of Computer Science and Engineering
B.Tech I (R20) I Year
20A10508 IT Workshop
(Common to CE, MECH & CHEM)

L-T-P-C

0-0-3-1.5

Note: Use open source tools for implementation of the following exercises.

Course Objectives:

- To make the students know about the internal parts of a computer, assembling and dissembling a computer from the parts, preparing a computer for use by installing the operating system
- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations and LAteX
- To learn about Networking of computers and use Internet facility for Browsing and Searching
- To learn about Google Forms and Google Sites

Preparing your Computer

Task 1: Learn about Computer: Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

Task 2: Assembling a Computer: Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods

Task 3: Install Operating system: Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

Task 4: **Operating system features**: Students should record the various features that are supported by the operating system(s) installed. They have to submit a report on it. Students should be able to access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Students should install new application software and record the installation process.

Networking and Internet

Task 5: Networking: Students should connect two computers directly using a cable or wireless connectivity and share information. Students should connect two or more computers using switch/hub and share information. Crimpling activity, logical configuration etc. should be done by the student. The entire process has to be documented.

Task 6: Browsing Internet: Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email. They should get acquaintance with applications like Facebook, skype etc. If Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating e-mail account.

Task 7: Antivirus: Students should download freely available Antivirus software, install it and use it to check for threats to the computer being used. Students should submit information about the features of the antivirus used, installation process, about virus definitions, virus engine etc.

Productivity tools

Task 8: Word Processor: Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content

sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered, Image Manipulation tools.

Task 9: Presentations: creating, opening, saving and running the presentations, selecting the style for slides, formatting the slides with different fonts, colours, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show.

Task 10: Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet

Task 11: LateX: Introduction to Latex and its installation and different IDEs. Creating first document using Latex, using content into sections using article and book class of LaTeX. Styling Pages: reviewing and customizing different paper sizes and formats. Formatting text (styles, size, alignment, colors and adding bullets and numbered items, inserting mathematical symbols, and images, etc.). Creating basic tables, adding simple and dashed borders, merging rows and columns. Referencing and Indexing: cross-referencing (refer to sections, table, images), bibliography (references).

References:

1. Introduction to Computers, Peter Norton, McGraw Hill
2. MOS study guide for word, Excel, Powerpoint& Outlook Exams, Joan Lambert, Joyce Cox, PHI.
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
4. Networking your computers and devices, Rusen, PHI
5. Trouble shooting, Maintaining & Repairing PCs, Bigelows, TMH
6. Lamport L. LATEX: a document preparation system: user's guide and reference manual. Addison-wesley; 1994.

Course Outcomes:

- Disassemble and Assemble a Personal Computer and prepare the computer ready to use.
- Prepare the Documents using Word processors and Prepare spread sheets for calculations .using excel and also the documents using LAteX.
- Prepare Slide presentations using the presentation tool.
- Interconnect two or more computers for information sharing.
- Access the Internet and Browse it to obtain the required information.

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous)::ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem **L T PC**

0 0 3 1.5

20A15302 Engineering Chemistry Lab
Common to CIVIL, MECH & CHEM

COURSE OBJECTIVES	
1	Verify the fundamental concepts with experiments

COURSE OUTCOMES	
CO1	**determine** the cell constant and conductance of solutions (L3)
CO2	**prepare** advanced polymer materials (L2)
CO3	**determine** the physical properties like surface tension, adsorption and viscosity (L3)
CO4	**estimate** the Iron and Calcium in cement (L3)
CO5	**calculate** the hardness of water (L4)

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

LIST OF EXPERIMENTS

1. Determination of Hardness of a groundwater sample.
2. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base
3. Determination of cell constant and conductance of solutions
4. Potentiometry - determination of redox potentials and emfs
5. Determination of Strength of an acid in Pb-Acid battery
6. Preparation of a polymer
7. Determination of percentage of Iron in Cement sample by colorimetry
8. Estimation of Calcium in port land Cement
9. Adsorption of acetic acid by charcoal
10. Determination of percentage Moisture content in a coal sample
11. Determination of Viscosity of lubricating oil by Red Viscometer 1
12. Determination of Flash and Fire points of fuels
13. Determination of Calorific value of gases by Junker's gas Calorimeter

TEXT BOOKS:

1. Vogel's Text book of Quantitative Chemical Analysis, Sixth Edition – J. Mendham et al, Pearson
Education.
2. Chemistry Practical – Lab Manual by Chandra Sekhar, GV Subba Reddy and Jayaveera

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous)::ANANTAPURAMU

DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem	**L**	**T**	**PC**	
	0	**0**	**3**	**1.5**

Common to CE, MECH & CHEM

20A10507 C-Programming & Data Structures Lab

Course Objectives:

- To get familiar with the basic concepts of C programming.
- To design programs using arrays, strings, pointers and structures.
- To illustrate the use of Stacks and Queues
- To apply different operations on linked lists.
- To demonstrate Binary search tree traversal techniques.
- To design searching and sorting techniques.

Week l

Write C programs that use both recursive and non-recursive functions

i) To find the factorial of a given integer.
ii) To find the GCD (greatest common divisor) of two given integers.
iii) To solve Towers of Hanoi problem.

Week 2

a) Write a C program to find both the largest and smallest number in a list of integers.
b) Write a C program that uses functions to perform the following:
i) Addition of Two Matrices ii) Multiplication of Two Matrices

Week 3

a) Write a C program that uses functions to perform the following operations:
i) To insert a sub-string in to a given main string from a given position.
ii) To delete n characters from a given position in a given string.

Week 4

a) Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn‘t contain T.

b) Write a C program to count the lines, words and characters in a given text.

Week 5

a) Write a C Program to perform various arithmetic operations on pointer variables.

b) Write a C Program to demonstrate the following parameter passing mechanisms:

i) call-by-value ii) call-by-reference

Week 6

Write a C program that uses functions to perform the following operations:

i) Reading a complex number
ii) Writing a complex number
iii) Addition of two complex numbers
iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.)

Week 7

Write C programs that implement stack (its operations) using

i) Arrays
ii) Pointers

Week 8

Write C programs that implement Queue (its operations) using

i) Arrays
ii) Pointers

Week 9

Write a C program that uses Stack operations to perform the following:

i) Converting infix expression into postfix expression
ii) Evaluating the postfix expression

Week 10

Write a C program that uses functions to perform the following operations on singly linked list.

i) Creation ii) Insertion iii) Deletion iv) Traversal

Week 11

Write a C program that uses functions to perform the following operations on Doubly linkedlist.

i) Creation ii) Insertion iii) Deletion iv) Traversal

Week 12

Write a C program that uses functions to perform the following operations on circular linkedlist.

i) Creation ii) Insertion iii) Deletion iv) Traversal

Week 13

Write a C program that uses functions to perform the following:

i) Creating a Binary Tree of integers

ii) Traversing the above binary tree in preorder, inorder and postorder.

Week 14

Write C programs that use both recursive and non-recursive functions to perform the following searching operations for a key value in a given list of integers:

i) Linear search
ii) Binary search

Week 15

Write a C program that implements the following sorting methods to sort a given list of integers in ascending order

i) Bubble sort
ii) Selection sort
iii) Insertion sort

Text Books:

1. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. Ananda Rao, Pearson Education.
2. B.A.Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016.
3. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Second Edition, CENGAGE Learning, 2011.

Reference Books:

1. PradipDey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011.
2. E.Balaguruswamy, "C and Data Structures", 4th Edition, Tata Mc Graw Hill.
3. A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press.
4. M.T.Somashekara, "Problem Solving Using C", PHI, 2nd Edition 2009.

Course Outcomes

- Demonstrate basic concepts of C programming language. (L2)
- Develop C programs using functions, arrays, structures and pointers. (L6)
- Illustrate the concepts Stacks and Queues. (L2)
- Design operations on Linked lists. (L6)
- Apply various Binary tree traversal techniques. (L3)
- Develop searching and sorting methods. (L6)

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU

DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem

20A15501 Communicative English Lab	**L**	**T**	**P**	**C**
Common to EEE, ECE, CSE & CHEM	**0**	**0**	**3**	**1.5**

Course Objectives

- ➢ students will be exposed to a variety of self instructional, learner friendly modes of language learning
- ➢ students will cultivate the habit of reading passages from the computer monitor. Thus providing them with the required facility to face computer based competitive exams like GRE, TOEFL, and GMAT etc.
- ➢ students will learn better pronunciation through stress, intonation and rhythm
- ➢ students will be trained to use language effectively to face interviews, group discussions, public speaking
- ➢ students will be initiated into greater use of the computer in resume preparation, report writing, format making etc

Course Outcomes

- ➢ CO1: Remember and understand the different aspects of the English language proficiency with emphasis on LSRW skills
- ➢ CO2: Apply communication skills through various language learning activities
- ➢ CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
- ➢ CO4: Evaluate and exhibit acceptable etiquette essential in social and professional settings
- ➢ CO5: Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

Unit 1

1. Phonetics for listening comprehension of various accents
2. Reading comprehension
3. Describing objects/places/persons

Learning Outcomes

At the end of the module, the learners will be able to

- understand different accents spoken by native speakers of English
- employ suitable strategies for skimming and scanning on monitor to get the general idea of a text and locate specific information
- learn different professional registers and specific vocabulary to describe different persons, places and objects

Unit 2

1. JAM
2. Small talks on general topics
3. Debates

Learning Outcomes

At the end of the module, the learners will be able to

- produce a structured talk extemporarily
- comprehend and produce short talks on general topics
- participate in debates and speak clearly on a specific topic using suitable discourse markers

Unit 3

1. Situational dialogues – Greeting and Introduction
2. Summarizing and Note making
3. Vocabulary Building

Learning Outcomes

At the end of the module, the learners will be able to

- Learn different ways of greeting and introducing oneself/others
- summarize the content with clarity and precision and take notes while listening to a talk/lecture and make use of them to answer questions
- replenish vocabulary with one word substitutes, homonyms, homophones, homographs to reduce errors in speech and writing

Unit4

1. Asking for Information and Giving Directions
2. Information Transfer
3. Non-verbal Communication – Dumb Charade

Learning Outcomes

At the end of the module, the learners will be able to

- Learn different ways of asking information and giving directions
- Able to transfer information effectively
- understand non-verbal features of communication

Unit 5

1. Oral Presentations
2. Précis Writing and Paraphrasing
3. Reading Comprehension and spotting errors

Learning Outcomes

At the end of the module, the learners will be able to

- make formal oral presentations using effective strategies
- learn different techniques of précis writing and paraphrasing strategies
- comprehend while reading different texts and edit short texts by correcting common errors

Suggested Software

- Young India Films
- Walden Infotech
- Orell

Reference Books

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.
- A Textbook of English Phonetics for Indian Students by T.Balasubramanyam

JNTUACEA **R20**

2020-21

JNTUA COLLEGE OF ENGINEERING (Autonomous):: ANANTAPURAMU

DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem	**L**	**P**	**T**	**C**
	3	**0**	**0**	**3**

20A15102 Differential Equations and Vector Calculus
Common to All branches of Engineering except CSE

Course Objectives:

1) To enlighten the learners in the concept of differential equations and multivariable calculus.
2) To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

UNIT 1: Linear differential equations of higher order

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

Learning Outcomes:

At the end of this unit, the student will be able to

- Identify the essential characteristics of linear differential equations with constant Coefficients
- Solve the linear differential equations with constant coefficients by appropriate method

UNIT 2: Equations reducible to Linear Differential Equations

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients, Applications to L-C-R Circuit problems and Mass spring system.

Learning Outcomes:

At the end of this unit, the student will be able to

- Classify and interpret the solutions of linear differential equations
- Formulate and solve the higher order differential equation by analyzing physical situations

UNIT 3: Partial Differential Equations First order partial differential equations, solutions of first order linear and non-linear PDEs.

Solutions to homogenous and non-homogenous higher order linear partial differential equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply a range of techniques to find solutions of standard PDEs
- outline the basic properties of standard PDEs

UNIT4: Vector differentiation

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply del to Scalar and vector point functions
- illustrate the physical interpretation of Gradient, Divergence and Curl

UNIT 5: Vector integration

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof)

and applications of these theorems.

Learning Outcomes:
At the end of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field
- evaluate the rates of fluid flow along and across curves
- apply Green's, Stokes and Divergence theorem in evaluation of double and triple
- integrals

Text Books:
1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

Reference Books:
1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B.Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
6. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
7. Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press
8. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
9. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
10. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.
11. H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.
12. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

Course Outcomes:
At the end of the course, the student will be able to

- solve the differential equations related to various engineering fields
- Identify solution methods for partial differential equations that model physical processes
- interpret the physical meaning of different operators such as gradient, curl and divergence
- estimate the work done against a field, circulation and flux using vector calculus

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JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU

DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Engineering Physics

Common to CIVIL, MECH & CHEM

COURSE OBJECTIVES	
1	To make a bridge between the physics in school and engineering courses.
2	To understand the concepts of mechanics and employ the applications of oscillations to engineering fields.

3	To familiarize the basic ideas of acoustics and ultrasonics with their Engineering applications.
4	The mechanisms of emission of light, achieving amplification of electromagnetic radiation through stimulated emission, study of propagation of light through transparent dielectric waveguides along with engineering applications.
5	To evoke interest on applications of superposition effects like interference, diffraction and polarization in engineering.
6.	To open new avenues of knowledge in dielectric and magnetic materials which find potential in the emerging micro device applications. Considering the significance of micro miniaturization of electronic devices and significance of low dimensional materials, the basic concepts of nano materials, their properties and applications in modern emerging technologies are elicited.

COURSE OUTCOMES	
After studying this course, the student will be able to:	
CO1	Understand the basics of mechanics and types of oscillations.
CO2	Explain sound propagation in buildings, acoustic properties of typically used materials in buildings and the use of ultrasonics.
CO3	Apply the different realms of physics in both scientific and technological systems through the study of lasers and fiber optics.
CO4	Analyze different physical phenomena of optics like interference, diffraction and polarization.
CO5	Compare the properties of dielectric, magnetic and nano materials along with their engineering applications.

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

CO2												
CO3												
CO4												
CO5												

Unit-1: Introduction to Mechanics and Oscillations

Introduction to Mechanics and Oscillations-Basic laws of vectors and scalars-Rotational frames-Conservative forces – F = - grad V, torque and angular momentum – Simple harmonic oscillators-Damped harmonic oscillator-Heavy, critical and under damping- Energy decay in damped harmonic oscillator- Forced oscillations – Resonance.

Unit-II: Acoustics and Ultrasonic's

Acoustics: Introduction to acoustics – Reverberation – Reverberation time– Sabine's formula-Derivation using growth and decay method – Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedies.

Ultrasonics: Introduction, Properties and Production by magnetostriction & piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications

Unit-III: Lasers and Fiber optics

Lasers: Introduction – Characteristics of laser – Spontaneous and stimulated emission of radiation – Einstein's coefficients – Population inversion – Pumping mechanisms – Nd:YAG laser – He-Ne laser – Applications of lasers.

Fiber optics- Introduction to Optical Fibers-Total Internal Reflection-Critical angle of propagation-Acceptance Angle-Numerical Aperture-Classification of fibers based on refractive index profile –Propagation of electromagnetic wave through optical fibers – Modes -Importance of V-number-Fiber optic sensors (Pressure/temperature/chemical change)

Unit-IV: Wave Optics

Interference-Principle of superposition –Interference of light – Conditions for sustained interference-interference in thin films- Colors in thin films-Newton's Rings-Determination of wavelength and refractive index.

Diffraction-Introduction-Fresnel and Fraunhofer diffraction-Fraunhofer diffraction due to single slit and double slit – Diffraction grating- Grating spectra.

Polarization-Polarization by double refraction-Nicol's Prism--Half wave and Quarter wave plates- Engineering applications of Polarization.

UNIT V:Engineering Materials

Dielectric Materials: Introduction-Dielectric polarization- Dielectric constant- Types of polarizations: Electronic and Ionic, Orientation Polarizations (Qualitative) - Lorentz (Internal) field – Clausius - Mossotti equation - Applications of Dielectrics: Ferro electricity and Piezoelectricity.

Magnetic Materials: Introduction-Magnetic dipole moment-Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment -Classification of Magnetic materials- Hysteresis - Soft and hard magnetic materials-Applications.

Nanomaterials: Introduction – Surface area and quantum confinement –Physical properties: electrical and magnetic properties- Synthesis of nanomaterials: Top-down: Ball Milling, Bottom-up: Chemical Vapour Deposition – Applications of nanomaterials.

Prescribed Text books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company

2. Engineering physics – D.K. Battacharya and Poonam Tandon, Oxford University press.

Reference Books:

1. Introduction to modern optics – Grant R Fowles
2. A text book on Optics – Brijlal & Subramanyam
3. Laser Fundamentals – William T. Silfvast, Cambridge University Press
4. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons
5. Introduction to Nanotechnology – C P Poole and F J Owens, Wiley
6. Hand Book of Non-destructive evaluation, C.J.Hellier, McGraw-Hill
7. Engineering Physics – K.Thyagarajan, MacGraw Hill Publishers
8. Engineering Physics – M.R.Srinivasan, New Age Publications
9. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
10. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press
11. Engineering Physics – M. Arumugam, Anuradha Publications

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JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

20A10801 Basic Thermodynamics

Objective:

To provide the students with the terminology of thermodynamics like system, properties, processes, reversibility, equilibrium, phases, components; the relationship between heat and work by understanding the significance of the thermodynamic laws.

UNIT -I

Introduction: The scope of thermodynamics, temperature, defined quantities; volume, pressure, work, energy, heat, Joules Experiments. The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady-flow process, equilibrium, the

phase rule, the reversible process, constant-V and constant- P processes, heat capacity, isobaric, isochoric, isothermal, adiabatic and polytrophic processes.

UNIT -II

Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, second virial coefficients from potential functions. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids, molecular theory of fluids.

UNIT- III

The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, entropy from the microscopic view point, calculation of ideal work and lost work.

UNIT -IV

Power cycles: Carnot cycle, Rankine cycle, Otto cycle, Diesel cycle. Refrigeration and liquefaction: The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.

UNIT –V

Thermodynamic properties of fluids: Property relations for homogeneous phases, residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlation for gases.

TEXT BOOKS

1. J. M. Smith and HC Van Ness, Introduction to Chemical Engineering Thermodynamics, 6thed, McGraw Hill,2003.

REFERENCE

1. Y.V. C. Rao, Chemical Engineering Thermodynamics, University publications.

2. K. V. Narayanan, Chemical Engineering Thermodynamics, PHI,2001

Outcome: This course will enable the student to understand the spontaneity and energy efficiency of a process.

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JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU

DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

20A10401 Basic Electrical & Electronics Engineering

Common to MECH, CSE & CHEM

PART- A

Course Objectives:

To make the students learn about:

1	The basics of AC & DC Circuits, DC generators & motors.
2	The construction and operation of Transformers, Induction motors and their performance aspects will be studied.

Course Outcomes:

After completing the course, the student should be able to :

CO1	understand the basics of AC & DC circuits and AC & DC machines
CO2	analyse the circuit elements, various AC and DC machines

Mapping of Course outcomes with Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												

Syllabus:

UNIT – I

Introduction to DC & AC Circuits

Ohm's Law, Basic Circuit Components, Kirchhoff's Laws, Resistive Networks, Series Parallel Circuits, Star-Delta and Delta-Star Transformation. Principle of AC Voltages, Waveforms and Basic Definitions, Root Mean Square and Average Values of Alternating Currents and Voltage, Form Factor and Peak Factor, Phasor Representation of Alternating Quantities, The 'j' Operator and Phasor Algebra, Basic concepts of AC series circuits.

Outcomes : After the completion of the unit the students will be able to

1. Perceive and analyse the basic laws of electrical circuits
2. Apply to basic laws to solve real life problems

UNIT-II

DC Machines

Constructional details of DC Machines

DC Generators: Principle of Operation, EMF equation, Types, O.C.C. of a DC Shunt Generator

DC Motors:Principle of Operation, Types, Torque Equation, Losses and Efficiency Calculation, Swinburne's Test, concepts of speed control.

Outcomes: After the completion of the unit the students will be able to

1. Apprehend and interpret basic principles of DC machines
2. Evaluate the performance of DC machines

UNIT-III

AC Machines

Transformers: Principles of Operation, Constructional Details, Losses and Efficiency, Regulation of Transformer, Testing: OC & SC Tests.

Three Phase Induction Motors: Principle of Operation, Slip and Rotor Frequency, Torque (Simple Problems).

Alternators: Principle of Operation, Constructional Details, EMF Equation, Voltage Regulation by Synchronous Impedance Method.

Outcomes : After the completion of the unit the students will be able to

1. Identify different types of AC machines
2. Analyse the performance of various AC machines

TEXT BOOKS:

1. Basic Electrical Engineering - By M.S.Naidu and S. Kamakshiah – TMH.
2. Basic Electrical Engineering –By T.K.Nagasarkar and M.S. Sukhija Oxford University Press.
3. Electrical and Electronic Technology-By Hughes – Pearson Education.

REFERENCES:

1. Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath PHI.
2. Principles of Electrical Engineering by V.K Mehta, S.Chand Publications.
3. Fundamentals of Electrical Electronics Engineering by T.Thyagarajan, SCITECH Publications 5th Edition-2007

JNTUA COLLEGE OF ENGINEERING (Autonomous):: ANANTHAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I –Year B.Tech.I -Semester

L	T	P	C
3	0	0	3

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

20A10401 ELECTRONICS ENGINEERING
PART- B
Common to MECH, CSE & CHEM

COURSE OBJECTIVES	
The students will be able to	
1	Understand principle and terminology of electronics.
2	Analyse the characteristics of electronic devices and understand the working of basic circuits such as rectifiers, amplifiers, filters, oscillators.
3	Understand the concept of Digital Logic
4	Understand the Concept & Principles of Digital Logic

COURSE OUTCOMES	
At the end of this course the student will be able to	
CO1	Able to apply the knowledge of diodes, Zener diodes, BJT's and FET's for applications of different circuits.
CO2	Analyse the applications of operational amplifiers.
CO3	Solve problems of various digital logic gates and circuits.
CO4	Correlate the fundamental concepts to various Real life applications of today.

UNIT I

Diodes and Transistors: Semiconductor Diode, Zener Diode, Rectifier Circuits, Wave Shaping Circuits,Bipolar Junction Transistors(operating modes modes,Configurations and Charecteristics), Introduction to Transistor Biasing and Transistor as an amplifier, Introduction to Field-Effect Transistors (Configurations and characteristics).

UNIT II

Operational Amplifiers: Op-amp Equivalent Circuit, Ideal and practical Op-amp characteristics, Op-Amp Applications (Inverting amplifier, Non -inverting amplifier, Summing, scaling & averaging amplifiers, integrator, differentiator, Active filters, oscillators and comparators).

UNIT III

Digital Electronics: Number Systems and Codes, Logic Gates, Boolean Theorems, DeMogan's Theorems, Algebraic Simplification, Karnaugh Map Method. Binary Addition, 2's Complement System, Full Adder, BCD Adder. NAND and NOR gate Latches, S-R Flip-Flop, JK Flip-Flop, D Flip-Flop, Introduction to Shift registers and Counters

Text Books:

1. Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
2. Ramakant A.Gayakwad, Op-Amps and Linear Integrated Circuits, Eastern Economy Edition
3.M.Morris Mano and Michael D.Ciletti, Digital Design, Pearson Education,4th Edition

References:

1. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education.
2. Bell, D. A., Electronic Devices and Circuits, Oxford University Press
3. 3.R.J. Tocci: Digital Systems; PHI, 6e, 2001.

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JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem

L	T	P	C
1	0	2	2

20A10301 Engineering Drawing
Common to CIVIL, MECH & CHEM

Course Objectives:

- Bring awareness that Engineering Drawing is the Language ofEngineers.
- Familiarize how industry communicates technicalinformation.
- Teach the practices for accuracy and clarity in presenting the technicalinformation.
- Develop the engineering imagination essential for successfuldesign.

Unit:I

Introduction to Engineering Drawing: Principles of Engineering Drawing and its significance-Conventions in drawing-lettering - BIS conventions.
a)Conic sections including the rectangular hyperbola- general methodonly,
b) Cycloid, epicycloids andhypocycloid c) Involutes

Learning Outcomes:

At the end of this unit the student will be able to

1. Lettering and dimensioning by freehand (L1)
2. Create geometric constructions; drawing parallel and perpendicular lines, and to construct circles, arcs, tangencies, and irregular curves (L6)
3. Create Conic sections and cycloidal curves.(L6)

Unit: II

Projection of points, lines and planes: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.

Learning Outcomes:

At the end of this unit the student will be able to

1. Understand the Projection of the objectives in four quadrants (L2)
2. Project the points, lines and planes (L6)

Unit: III

Projections of solids: Projections of regular solids inclined to one or both planes by rotational or auxiliaryviewsmethod.

Learning Outcomes:

At the end of this unit the student will be able to

1.Project the solids in both planes. (L6)
2. To draw the solids by auxiliary method. (L6)

Unit: IV

Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.

Learning Outcomes:

At the end of this unit the student will be able to

1.Project the sectional view of regular solids.(L6)
2. Understand how to draw the true shapes of the sections.(L2)

Unit:V

Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

Learning Outcomes:

At the end of this unit the student will be able to

1. Draw the development of surfaces of the solids.(L6)
2. Understand to develop the sectional parts of the solids.(L2)

Text Books:

1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers,2016.

Reference Books:

1. Dr K.Prahlada Rao, Dr. S. Krishnaiah, Prof.A.V.S. Prasad, Engineering Graphics, Amaravati publications.
2. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right,2009
3. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers,2000
4. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009
5. K.C.John, Engineering Graphics, 2/e, PHI,2013
6. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

Course Outcomes:

After completing the course, the student will be able to

- draw various curves applied in engineering.(L2)
- show projections of solids and sections graphically. (L2)
- draw the development of surfaces of solids.(L3)

Additional Sources

1. Youtube: http-sewor,Carleton.cag,kardos/88403/drawings.html conic sections-online, red woods.edu

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JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem

L	T	P	C
0	0	2	1

20A10302 Engineering Graphics Lab
Common to CIVIL, MECH & CHEM

Course Objectives:

- Instruct the utility of drafting & modelling packages in orthographic and isometric drawings.
- Instruct graphical representation of machinecomponents.

Computer Aided Drafting:

Introduction to Geometric Modeling: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets,arrays,dimensions.

Dimensioning principles and conventional representations.

Orthographic Projections: Systems of projections, conventions and application to orthographic projections - simple objects.

Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids.

Text Books:

1. K. Venugopal, V.Prabhu Raja, Engineering Drawing + Auto Cad, New Age International Publishers.
2. Kulkarni D.M, AP Rastogi and AK Sarkar, Engineering Graphics with Auto Cad, PHI Learning, Eastern Economy editions.

Reference Books:

1. T. Jayapoovan, Engineering Graphics using Auto Cad, Vikas Publishing House
2. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
3. Linkan Sagar, BPB Publications, Auto Cad 2018 Training Guide.
4. K.C.John, Engineering Graphics, 2/e, PHI,2013
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

Course Outcomes:

After completing the course, the student will be able to

- Use computers as a drafting tool.(L2)
- Draw isometric and orthographic drawings using CAD packages.(L3)

Additional Sources: 1. Youtube: http-sewor,Carleton.cag, kardos/88403/drawings.html conic sections-online, red woods.edu.

JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

20A10802 Basic Thermodynamics Lab

Objectives:

To gain insight into basic concepts taught in Chemical Engineering Thermodynamics theory course by performing hands on experiments.

Course Contents:

1. Mechanical equivalent of heat – heat, work and the first law of thermodynamics

2. Calorimetry – heat capacities, heat of formation, Hess's law

3. Thermodynamic cycles – adiabatic, isothermal, isochoric processes

4. Equation of state – ideal gas law, virial equation of pressure

5. Property change of mixing – volume, enthalpy and entropy changes

6. Raoult's law and Henry's law – applications in volatile organic compounds

7. Phase equilibria: VLE, LLE, humidity, solid-fluid equilibria, polymer-vapor equilibria8. Equilibrium solubility of solids – effect of temperature, measurement of pKa9. Reaction equilibria – liquid phase, gas phase (Le Chatelier principle), equilibrium constant10. Enthalpy/entropy driven physical processes

Text Books:

1. M. D. Koretsky, Engineering and Chemical Thermodynamics, , John Wiley & Sons, 20132. Laboratory manual

Reference Books:

1. N. de Nevers, Physical and Chemical Equilibrium for Chemical Engineers, 2nd Ed., Wiley, 2012.2. J. W. Tester and M. Modell, Thermodynamics and Its Applications, 3rd Ed., Prentice Hall, 1997.

JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem

L	T	P	C
0	0	3	1.5

20A15204 ENGINEERING PHYSICS LAB

Common to CIVIL, MECH & CHEM

COURSE OBJECTIVES	
1	The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies.
2	To develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.
3	To train engineering students on basis of measurements and the instruments
4	To equip the students with practical knowledge in electronic and optics experiments

COURSE OUTCOMES	
CO1	On Completion of this course, students are able to – Develop skills to impart practical knowledge in real time solution.
CO2	Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
CO3	Understand measurement technology, usage of new instruments and real time applications in engineering studies.
CO4	The student will be able to analyze the physical principle involved in the various instruments, also relate the principle to new application.
CO5	The various experiments in the areas of optics, mechanics and thermal physics will nurture the students in all branches of Engineering.

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

CO5												

LIST OF EXPERIMENTS

Any TEN of the following experiments has to be performed during the SEMESTER

1. Laser: Determination of wavelength using diffraction grating.
2. Laser: Determination of Particle size.
3. Determination of spring constant of springs using Coupled Oscillator
4. Determination of ultrasonic velocity in liquid (Acoustic grating)
5. Determination of dielectric constant and Curie temperature of a ferroelectric material.
6. B-H curve
7. Stewart-Gee's Method
8. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum)
9. Determination of numerical aperture of an optical fiber.
10. Determination of thickness of thin object by wedge method.
11. Determination of radius of curvature of lens by Newton's rings.
12. Determination of wavelengths of various colours of mercury spectrum using diffraction grating in normal incidence method.
13. Determination of dispersive power of the prism
14. Sonometer: Verification of the three laws of stretched strings
15. Meldes experiment: Determination of the frequency of tuning fork

Note: Out of 10 experiments, two experiments will be performed using virtual laboratory.

Data Books Required: Nil

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JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU

DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem	**L**	**T**	**P**	**C**
	0	**0**	**1.5**	**0.75**

20A10402 BASIC ELECTRICAL ENGINEERING LAB

(PART-A - ½ LAB)

Common to MECH ,CSE& CHEM

Course Objectives: To make the student learn about:

1	The DC motors, DC Generators and know various characteristics, performance analysis of DC machines and speed control techniques of DC machines.
2	Various test conditions of single phase transformers.

Course Outcomes:

After completing the course, the student should be able to do the following:

CO1	Learn about DC motors, DC Generators and know various characteristics, performance analysis of DC machines and speed control techniques of DC machines.
CO2	Various test conditions of single phase transformers.

Mapping of Course outcomes with Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												

Syllabus:

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's Test on DC Shunt Machine (Predetermination of Efficiency of a Given DC Shunt Machine Working as Motor and Generator).
2. OC & SC Tests on Single-Phase Transformer (Predetermination of Efficiency and Regulation at Given Power Factors and Determination of Equivalent Circuit).
3. Brake Test on 3-Phase Induction Motor (Determination of Performance Characteristics)
4. Regulation of Alternator by Synchronous Impedance Methods.
5. Speed Control of D.C.Shunt Motor by

a) Armature Voltage Control B) Field Flux Control Method

6. Brake Test on D.C Shunt Motor

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JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
DEPARTMENT OF CHEMICAL ENGINEERING

I- Year B.Tech. II-Sem

L	T	P	C
0	0	1.5	0.75

20A10402 BASIC ELECTRONICS ENGINEERING LAB

Common to MECH, CSE & CHEM

(PART-B - ½ LAB)

(Common to ME & CHEM)

COURSE OBJECTIVES	
The students will be able to	
1	Understand the characteristics of PN junction diode and zener diode.
2	Understand the characteristics of BJT in CE and CB configurations
3	Learn the frequency response of CE Amplifier
4	Exposed to linear and digital integrated circuits

COURSE OUTCOMES	
At the end of this course the student will be able to,	
CO1	Learn the characteristics of basic electronic devices like PN junction diode, Zener diode & BJT.
CO2	Analyze the application of diode as rectifiers, clippers and clampers.
CO3	Learn the fundamental principles of amplifier circuits and need of Bias in Amplifier circuits.
CO4	Learn the basics of linear integrated circuits and understand characteristics of operational amplifier.
CO5	Learn about available digital ICs and verify truth tables of logic gates and flip flops.

LIST OF EXPERIMENTS:

1. PN Junction diode characteristics A) Forward bias B) Reverse bias.
2. Zener diode characteristics and Zener as voltage Regulator
3. Full Wave Rectifier with & without filter
4. Wave Shaping Circuits (Clippers & Clampers)
5. Input & Output characteristics of Transistor in CB / CE configuration
6. Frequency response of CE amplifier.

7. Inverting and Non-inverting Amplifiers using Op Amps
8. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs
9. Verification of Truth Tables of RS, JK, T & D flip flops using respective ICs

LAB REQUIREMENTS:

Cathode Ray Oscilloscopes (30MHz)

Signal Generator /Function Generators (3 MHz)

Dual Regulated Power Supplies (0 – 30V)

IC Trainer Kit

Bread Boards

Electronic Components

JNTUA COLLEGE OF ENGINEERING (Autonomous) :: ANANTAPURAMU
(Common to All Branches of Engineering)

20AS19101 UNIVERSAL HUMAN VALUES

Common to CIVIL, MECH & CHEM

I - Year B.Tech. II-Sem **L T P C**

3 0 0 0

1. Introduction:

This course discusses the role of human values in one's family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course names as"H-102 Universal Human Values 2 : "Understanding Harmony" is designed which may be covered in their III or IV Semester.

In the Induction Program, students would get an initial exposure to human values through Universal HumanValues–I.This exposure is to be augmented by this compulsory full semester foundation course.

2.Learning Objectives:

1. Exposure to the value of life, society and harmony
2. Leading towards holistic perspective based on self-exploration about themselves (human being), family, and society and nature/existence.
3. Bringing transition from the present state to Universal Human Order
4. Instill commitment and courage to act.
5. Know about appropriate technologies and management patterns

3. COURSE TOPICS:

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Universal Human Values-I - Self-Exploration - content and process; 'Natural Acceptance' and Experiential Validation - self-exploration - Continuous Happiness and Prosperity - Human Aspirations - current scenario - Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself!

human being as a co-existence of the sentient 'I' and the material'Body' - the needs - happiness and physical facility -the Body as an instrument of 'I' - the characteristics and activities of 'I' and harmony in 'I' - the harmony of I with the Body

Unit 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Values in human relationship; meaning of Justice; Trust and Respect; Difference between intention and competence; the other salient values in relationship - the harmony in the society: Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

the harmony in the Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence as Co-existence of mutually interacting units in all- pervasive space - Holistic perception of harmony at all levels of existence.

Unit 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Humanistic Education - Competence in professional ethics: professionalcompetence - people friendly and eco-friendly production systems - appropriate technologies and management patterns for above production systems. Individuals as socially and ecologically responsible engineers, technologists and managers

Text Book

1. *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Teachers' Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1.JeevanVidya: EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak, 1999

2. HumanValues,A.N.Tripathi,NewAgeIntl.Publishers,NewDelhi,2004.

3. The Story of Stuff (Book).

4. Economy of Permanence - J C Kumarappa 8.

Bharat Mein Angreji Raj - PanditSunderlal 9.

Rediscovering India - byDharampal

5. Hind Swaraj or Indian Home Rule - by Mohandas K.Gandhi
6. India Wins Freedom - Maulana Abdul Kalam Azad 12.

Vivekananda - Romain Rolland(English)

COURSE OUTCOMES:

By the end of the course,

CO1: Define terms like Natural Acceptance, Happiness and Prosperity

CO2: Understand awareness of oneself, and ones surroundings (family, society, nature)

CO3: Apply what they have learnt to their own self in different day-to-daysettings in real life

CO4: Relate human values with human relationship and human society.

CO5: Justify the need for universal human values and harmonious existence

CO6: Develop as socially and ecologically responsible engineers

II B.TECH I SEMESTER

1. 20A35101 NUMERICAL METHODS &PROBABILITY THEORY
Common to CIVIL & CHEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations. The theory of Probability and random variables.

UNIT - I

Solution of Algebraic & Transcendental Equations:

Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method

System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

Interpolation

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

UNIT – III

Numerical Integration & Solution of Initial value problems to Ordinary differential equations

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

UNIT – IV

Probability theory, Random variables & Distributions:

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties-Uniform distribution-exponential distribution.

UNIT – V

Descriptive statistics

Data science, Statistics Introduction, Population vs Sample, Collection of data, primary and secondary data, Type of variable: dependent and independent Categorical and Continuous variables, Data visualization, Measures of Central tendency, Measures of Variability (spread or variance) Skewness, Kurtosis, correlation, correlation coefficient, rank correlation, regression coefficients, method of least squares, regression lines.

TEXT BOOKS:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole,PNIE.
3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

REFERENCES:

1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview
2. nptel.ac.in/courses/117101056/17
3. http://nptel.ac.in/courses/111105090

Course Outcomes : Student will be able to

- apply numerical methods to solve algebraic and transcendental equations
- derive interpolating polynomials using interpolation formulae
- Solve differential and integral equations numerically
- apply Probability theory to find the chances of happening of events.
- understand various probability distributions and calculate their statistical constants.

II B.TECH I SEMESTER

2. **20A30801 CHEMICAL PROCESS CALCULATIONS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce chemical process calculations, different unit systems and conversion from one unit system to another.
- To introduce the use of Log-Log, Semi-Log and triangular graphs and graph plotting software such as MS-Excel, Polymath, Minitab, Origin etc.
- To impart concepts of vapour pressure and calculation of percent saturation of a given vapor-gas mixture.
- To emphasize the importance of basis of calculation and develop a systematic methodology to carry out material balances on chemical processes/equipment without and with reactions including recycle, purge and bypass.
- To convey different thermal effects associated with processes involving chemical reactions and phase changes
- To present how to calculate mass and energy balances involving combustion of fuels.

UNIT- I

Stoichiometric & Composition relations: Stoichiometric relation, basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

(For Assignments only: Use of Log-Log and Semi-Log graphs; Graph plotting using plotters like MS-Excel, Polymath, Minitab, Origin, etc..)

Behaviour of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT -II

Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of immiscible liquids and ideal solutions, Raoult's law, Non-volatile solutes.

Humidity and Saturation: Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization.

UNIT- III

Material balances: Tie substance, Yield, conversion, limiting reactant, excess reactant, processes involving reactions, Material balances with the help of Stoichiometric equations, Material balances involving drying, dissolution, & crystallization. Material balance calculations for processes involving recycle, bypass and purge.

UNIT -IV

Thermo physics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non-polar liquids enthalpy and its evaluation.

Thermo chemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change,

UNIT- V

Flame Temperature Calculations: Calculation of theoretical and actual flame temperatures.

Combustion Calculations: Introduction, fuels, calorific value of fuels, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations, incomplete combustion, material and energy balances, thermal efficiency calculations.

TEXT BOOKS:

1.Chemical process principles, Part -I, Material and Energy Balance, Hougen O A, Watson K.M. and Ragatz R.A. 2nd Edition,John Wiley and Sons, New York, 1963.

REFERENCES:

1. Basic principles and calculations in chemical engineering by D.H. Himmelblau, 7th Ed. PHI, 2013
2. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996)

Data Tables: Use of steam tables, humidity chart under data tables permitted in the Examination hall

Course outcomes:

At the end of the course, student will be able to:

- Identify process calculations relevant to chemical engineering processes including conversion of physical quantities into different unit systems.
- Predict the behaviour of gases and vapours using ideal gas law.
- Estimate the composition of the given vapour-gas mixture using the principles of vapour pressure.
- Solve material balances on chemical processes/equipment without and with reactions including recycle, purge and bypass.
- Evaluate thermal effects associated with chemical reactions.
  Calculate mass and energy balances involving combustion of fuels.

II B.TECH I SEMESTER

3. **20A30802 MOMENTUM TRANSFER**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic concepts of static and dynamic behaviour of fluids
- To disseminate different flow regimes and identification of types of fluids along with necessary equations to represent their behaviour
- To derive Bernouli's theorem and explain its application to fluid flow problems
- To introduce the concept of friction factor and its estimation for different types of flow through pipes and fittings.
- To explain dimensional analysis using Rayleighs and Buchinghm π Methods.
- To expose flow measuring devices such as head and area meters.
- To explain fluid moving machinery and its selection for a given flow problem.

UNIT- I

Unit operations and unit processes, unit systems, basic concepts, nature of fluids, hydrostatic equilibrium, applications of fluid statics.

Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

UNIT- II

Basic equation of fluid flow –Mass balance in a flowing fluid; continuity equation, differential momentum balance; equations of motion, Macroscopic momentum balances, Bernoulli equation.

Incompressible Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT- III

Dimensional analysis: Buckingham π Theorem and Rayleigh's method.

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

UNIT -IV

Flow past immersed bodies, Drag and Drag coefficient, friction in flow through beds of solids, Kozeny-Carman, Blake-Plummer and Ergun equations, and motion of particles through fluids.

Fluidization: Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized beds, Applications of fluidization, Continuous fluidization: Slurry and pneumatic transport.

UNIT- V

Transportation and Metering of fluids: Pipes, fittings and valves, Fluid- moving machinery, Fans, blowers, and compressors.

Measurement of flowing fluids: Variable head meters- Orifice meter, Venturi meter, Pitot tube; Area meter- Rota meter.

TEXT BOOKS:

1. Unit Operations of Chemical Engineering by W.L. McCabe, J.C.Smith& Peter Harriot, McGraw-Hill, 7th ed, 2007

REFERENCES:

1. Transport processes and unit operations by Christie J. Geankoplis, PHI
2. Unit operations, Vol-1 –Chattopadhya, Khanna publishers
3. Principles of Unit Operations, Foust *et al*, 2nd ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.
5. Unit operations- Brown et al., Asian Publishing House.

II B.TECH I SEMESTER

4. 20A30803 CHEMICAL TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Unit operations unit processes involved in manufacture of important and widely employed organic and inorganic chemicals.
- Develop skills in preparing /presenting a neat Engineering drawing for Chemical Process Industries.
- Impart clear description of one latest process along with its Chemistry, Process parameters, Engineering Problems and Optimum Conditions.
- Demonstrate the importance of updating the latest technological developments in producing products economically and environment friendly.
- Appreciate the usage of other engineering principles such as Thermodynamics, Heat, mass and momentum transfer in operation and maintain the productivity

UNIT – I

Water and Air: Importance of water, sources, plant location factors related to water, water shortage problems, methods of treating fresh water, methods of obtaining fresh water from saline waters, waste water treatment and disposal, air as a chemical raw material.

Soda ash, caustic soda and chlorine, Glass: manufacture of special glasses

UNIT – II

Industrial gases: carbon dioxide, hydrogen and oxygen – products of water gas, producer gas. Nitrogen industries: synthetic ammonia, urea, nitric acid (ammonium nitrate), ammonium chloride, ammonium phosphate and complex fertilizers

Sulphur and sulphuric acid, manufacture of sulphuric acid, hydrochloric acid and some other chemicals –Aluminum sulphate and alum.

UNIT – III

Cement manufacture, special cements, miscellaneous calcium compounds, magnesium compounds.

Manufacture of phenols, formaldehyde, vinyl chloride and vinyl acetate, manufacture of phenol-formaldehyde resin and polyvinyl chloride polymer, SBR

UNIT – IV

Oils: Definition, constitution, extraction and expression of vegetable oils, refining and hydrogenation of oils.

Synthetic fibers: Classification, manufacture of Nylon 66, polyester fiber and viscose rayon fiber.

Soaps and detergents: Definitions, continuous process for the production of fatty acids, glycerin and soap, production of detergents.

UNIT – V

Pulp and paper industry: methods of pulping, production of sulphate and sulphite pulp, production of paper –wet process

Pharmaceutical Industries: Classification, Alkylation, Carboxylation and Acetylation, Condensation and Cyclization, Dehydration,Halogenation, Oxidation, Sulfonation, Amination, Radio isotopes in Medicine, Fermentation and Life processing for Antibiotics, Hormones, and Vitamins, Biologicals, Steroid hormones, isolates and Animals.

TEXT BOOKS:

1. Shreve's Chemical Process Industries edited by Austin, Mc.graw-Hill.5th ed.1985.

2. Dryden's Outlines of Chemical Technology edited by M. Gopal Rao and M. Sittig, 2nd ed. 1973.

References:

1. Industrial Chemistry by B.K. Sharma,
2. Hand book of industrial chemistry Vol 1& II K.H.Davis& F.S. Berner Edited by S.C. Bhatia, CBS publishers
3. Chemical Technology: G.N. Panday, Vol 1& Vol II.

II B.TECH I SEMESTER

5. 20A30804 MECHANICAL OPERATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce to the concepts of characterization of solids

- To discuss different types of mixers for mixing of solids
- To impart knowledge on screening, size reduction and equipment for size reduction
- To give exposure to Laws of crushing
- To explain the phenomenon of particle settling in fluids and transportation of solids
- To disseminate knowledge on different techniques of particle separation from fluid
- To estimate the power consumption in agitation and mixing of liquids

UNIT- I

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free flowing solids.

UNIT- II

Size reduction: Principles of computer simulation of milling operations, size reduction equipment-crushers, grinders, ultra-fine grinders, cutting machines, Equipment operation. Laws of crushing: Kick's law, Bond's law, Rittinger's law

Screening, Industrial screening equipment, Effectiveness of the screen, differential & cumulative analysis.

UNIT -III

Filtration, cake filters, centrifugal filters, cyclone separators, electro-static precipitators.

Principles of cake filtration, Clarifying filters, vacuum filtration, liquid clarification, gas cleaning, principles of clarification. Introduction to cross flow filtration.

UNIT- IV

Separations based on motion of particles through fluids: gravity settling processes and centrifugal settling processes, float and sink method, differential settling, coagulation, Flotation-separation of ores, flotation agents

Crystallization: crystal geometry, principles of crystallization, equilibria and yields, nucleation, crystal growth

UNIT- V

Agitation and mixing of liquids: Agitation of liquids, circulation velocities, power consumption in agitated vessels. Blending and mixing of liquids, suspension of solid particles, dispersion operations.

Introduction to transportation of solid particulate mass: Belt, screw, apron conveyers, bucket elevators, pneumatic conveying.

TEXT BOOK:

1. Unit Operations in Chemical Engineering by W.L. McCabe and J.C. Smith and Peter Harriott, McGraw Hill 7^{th} ed. 2001.

REFERENCES:

1. Chemical engineers hand book, J.H. Perry, 7th ed. McGraw Hill
2. Introduction to Chemical Engineering by J.T.Banchero & W.L. Badger., TMH, 1997.

II B.TECH I SEMESTER

6. 20A30805 MOMENTUM TRANSFER LAB

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES: The lab provides knowledge on various flow patterns, flow measuring devices and pumps.

1. Identification of laminar and turbulent flows - Major equipment - Reynolds apparatus
2. Measurement of point velocities - Major equipment - Pitot tube setup
3. Verification of Bernoulli's equation - Major equipment – Bernoulli's Apparatus
4. Calibration of Rotameter - Major equipment – Rotameter Assembly
5. Variation of Orifice coefficient with Reynolds Number - Major equipment - Orifice meter Assembly
6. Determination of Venturi coefficient - Major equipment – Venturi meter Assembly
7. Friction losses in Fluid flow in pipes - Major equipment - Pipe Assembly with provision for Pressure measurement
8. Pressure drop in a packed bed for different fluid velocities - Major equipment - Packed bed with Pressure drop measurement
9. Pressure drop and void fraction in a fluidized bed - Major equipment - Fluidized bed with Pressure drop measurement
10. Studying the coefficient of contraction for a given open orifice - Major equipment - Open Orifice Assembly
11. Studying the coefficient of discharge in a V-notch - Major equipment - V-notch Assembly
12. Studying the Characteristics of a centrifugal pump - Major equipment - Centrifugal Pump
13. Drag studies using two different fluids

II B.TECH I SEMESTER

7. 20A30807 CHEMICAL TECHNOLOGY LAB

L	T	P	C

0	0	3	1.5

COURSE OBJECTIVES:

1. To determine the acid, iodine and saponification value of a given sample.
2. To determination of Saponification value

List of Experiments:

1. Determination of Acid value of Coconut oil
2. Determination of Iodine value
3. Determination of Saponification value
4. Estimation of acid insolubles, available lime and calcium carbonate
5. Estimation of available chlorine in bleaching powder
6. Estimation of glucose
7. Estimation of total cellulose in saw dust
8. Preparation of soap
9. Application of pH meter to find acidity and alkalinity of a solution
10. Preparation of phenol formaldehyde resin
11. Determination of viscosity by red wood viscometer
12. Estimation of silica and moisture content in cement analysis
13. Analysis of the percentage of ash and lactose content in the given milk sample

II B.TECH I SEMESTER

8. 20A30806 MECHANICAL OPERATIONS LAB

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES: The course will equip students with the practical knowledge of different mechanical unit operations & operational conditions of different equipment.

List of Experiments:

1. To determine the time of grinding in a ball mill for producing a product with 80 % passing a given screen.
Major equipment - Ball mill Apparatus, Sieve shaker, Different sizes of sieves, weighing balance.
2. To verify the laws of crushing using any size reduction equipment like crushing rolls or vibrating mills and to find out the working index of the material.
Major equipment – Jaw Crusher, Sieve shaker, Different sizes of sieves, Weighing Balance, Energy meter.
3. To find the effectiveness of hand screening and vibrating screen of a given sample.
Major equipment - Vibrating Sieve shaker, Different sizes of sieves, Weighing Balance.
4. To achieve beneficiation of a ore using froth flotation technique.
Major equipment - Froth flotation cell
5. To obtain batch sedimentation data and to calculate the minimum thickener area under given conditions.
Major equipment- Sedimentation apparatus
6. To determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.
Major equipment - Plate and frame filter press.
7. To separate a mixture of particles by Jigging.
Major equipment - Jigging apparatus
8. To calculate separation efficiency of particles in a mixture using cyclone separator.
Major equipment - Cyclone separator
9. To determine reduction ratio of a given sample in a pulverizer.
Major equipment - Pulverizer
10. Filtration Studies using
    a. Plate and Frame Filter Press
    b. Rotary Drum Filter
    c. Batch Centrifuge
11. To Perform mixing studies using Ribbon Mixer.

12. To determine reduction ratio of a given sample in .a grinder Major equipment - Grinder

II B.TECH I SEMESTER

9. 20A30808 SKILL ORIENTED COURSE – 1
(ANALYTICAL TECHNIQUES FOR CHEMICAL ENGINEERS)

L	T	P	C
1	0	2	2

COURSE OBJECTIVES:

This course aims to provide the student to

- Acquire basic principles of simple instrumental methods for estimation of organic/inorganic species.
- Gain basic knowledge of limitations of analytical methods.
- Characterize the Materials synthesized by chemical industry.
- Understand the chromatographic techniques for the separation of impurities in the industrially synthesized compounds.
    - Learn the basic principles of spectrophotometry like UV-Vis and IR

UNIT I: Basic Principles of Quantitative Analysis

Limitations of analytical methods, Classification of errors, Accuracy, Precision, How to reduce systematic errors, Significant figures, Calculators and Computers, Mean and Standard deviation, Distribution of Random errors, Reliability of Results, Confidence interval , Comparison of results, Comparing the means of two samples, Paired T-test, Correlation and regression, Standard deviations.

UNIT II: Chromatographic Methods:

Column chromatography-general principles, terminology: retention time, rotation volume, separation factor, resolution of peaks. Principles of gas chromatography, block diagram of gas chromatograph - detectors (FID, ECD), stationary phases for column, mobile phases, chromatogram, qualitative analysis, special plots, quantitative analysis, HPLC: Principles of High Performance Liquid Chromatography. Block diagram of HPLC Systems, function of each component, stationary phases, eluting solvents, pumps, detectors, quantitative applications of HPLC. Ion Exchange chromatography-seperation of anions and cations. Suppressed & non-suppressed ion chromatography. Numerical calculations.

UNIT III: Thermal methods of Analysis:

Introduction to Thermal methods, Thermogravimetric Analysis (TGA)-principles, and applications (determination of drying temperatures, kinetic methods, automatic thermo gravimetric Analysis) DTA: Differential thermal analysis-Principles and applications (exothermic and endothermic peaks, heat of reaction, catalysis, decompositions etc.,)DSC: Differential scanning calorimetry, principles & applications (exothermic & endothermic peaks, compound purity determination, percentage crystallinity, glass transition temperature).

UNIT IV: Electro-Analytical Techniques

i). Brief introduction about polarography, Basic principle, instrumentation and applications of cyclic voltametry.

ii), Amperometric Titrations: Basic principle involved in the Amperometry, Amperometric Titrations and applications, Advantages and disadvantages of Amperometric Titrations.

UNIT-V: Spectrophotometric Methods:

Introduction to Analysis: Qualitative & Quantitative Analysis; Conventional & Instrumental methods of analysis. Molecular spectrophotometry-Beer's law Block diagram of UV-Visible Spectrophotometer – quantitative analysis direct method for the determination metal ions: Chromium, Manganese, Iron, etc in alloys. Infrared spectrophotormetry-principle, instrumentation and Functional group analysis of organic compounds using infrared spectra. Quantitative analysis of organic molecules. Atomic absorption spectrophotometry(AAS) and flame photometry: principle, instrumentation and applications (Determination of Sodium, Potassium and Calcium.)

TEXT BOOKS:

1. Quantitative analysis, R.A.Day& A.L. Underwood , 5th edition, Printice- Hall of India Pvt. Ltd., 2000.
2. Vogel's Text Book of Qualitative chemical analysis, J. Mendham, R.C.Denney, J. Darnes, M.J.K. Thomas, Persar education 6th edition, 2002.
3. Elements of Physical Chemistry-Peter Atkins, Oxford Uni.Press, 3rd Edition, 2010.

REFERENCES:

1. Atkin's Physical Chemistry – P. Atkins and J. De Paula, Oxford Univ.Press, 9th Edition, 2012
2. Instrumental lMethods of Chemical Analysis, GurdeepR.Chatwal, Sham K.Ananad,
3. Himalayha publishing House,5th Edition, 2012.
4. Advanced physical chemistry – Gurudeepraj, Goel Publishing House, 2000
5. Essentials of Physical Chemistry- ArunBahl, B.S.Bahl and G.D.Rulasi, S.Chand Publishers, New Delhi.

COURSE OUTCOMES:

After completion of the course student shall be able to

- Analyse the statistical data for the analysis in analytical chemistry.
- Acquire enough knowledge on industrial processes and Identification of Products using different analytical and instrumental techniques.
- Analyse the compounds by using the TGA, DTA and DSC techniques for the analysis of metals and alloys
- Gain the knowledge of cyclic voltameter and amperometric titration techniques

II B.TECH I SEMESTER

10. 20A10803 ENVIRONMENTAL SCIENCE
Common to CIVIL, MECH & CHEM

L	T	P	C
3	0	0	0

COURSE OBJECTIVES: To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.

UNIT – I:

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES: – Definition, Scope and Importance – Need for Public Awareness.

NATURAL RESOURCES : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT – II:

ECOSYSTEMS: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

BIODIVERSITY AND ITS CONSERVATION : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III:

ENVIRONMENTAL POLLUTION: Definition, Cause, effects and control measures of :

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

SOLID WASTE MANAGEMENT : Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV:

SOCIAL ISSUES AND THE ENVIRONMENT: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT – V:

HUMAN POPULATION AND THE ENVIRONMENT: Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

FIELD WORK : Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

TEXT BOOKS :

(1) Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
(2) Environmental Studies by Palani Swamy – Pearson education
(3) Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company

REFERENCES :

(1) Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Pubilications.
(2) Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.
(3) Comprehensive Environmental studies byJ.P.Sharma, Laxmi publications.
(4) Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Printice hall of India Private limited.
(5) A Text Book of Environmental Studies by G.R.Chatwal, Himalaya Pubilishing House
(6) Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.

II B.TECH II SEMESTER

1. 20A45301 ORGANIC CHEMISTRY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

This course aims to provide the student to

- Understand the Mechanism of organic chemical reaction is essential to synthesis new organic compounds in drug and pharmaceutical industries. In order to study their kinetics of reactions to regulate the process for optimization of production of drugs and pharmaceutical, the principles of organic chemistry are essential.
- Carry out a processes industrially for the manufacture of drgus and pharmaceuticals, Comprehension on basic reactions, reagents and their applications is needed.
- Explain the electronic behaviour of organic molecules, their special and geometrical arrangement of functional groups.
- Conduct the most common reactions like addition, substitution, oxidation, reduction etc., on large scale.

UNIT I:
Polar effects – Inductive effect, electrometric effect, resonance, hyper conjugation, steric hindrance, and aromaticity – examples. (9h)

UNIT II:
Electrophilic reactions: a) Friedel-Craft reaction b) Riemer- Teimenn Reaction c) Backmann rearrangement.
Nucleophilic reactions : a) Aldol condensation b) Perkin Reaction c) Benzoin condensation.(10h)

UNIT – III:
Stereo isomerism; Optical isomerism; Symmetry and chirality; Optical isomerism in lactic acid and tartaric acid; Sequence rules; Enantiomers, diastereomers; Geometrical Isomerism; E-Z system of nomenclature, conformational analysis of ethane and Cyclohexane. (12h)

UNIT.IV
Some Reagents of Synthetic importance:
Preparation and applications of Aluminium Chloride, N-Bromosuccinamide (NBS), Diazomethane, Dicyclo hexyl carbodiimide(DCC), Potassium tertiary butoxide and Grignard reagent. (12h)

UNIT.V:
Some Useful Reactions in Organic Synthesis:
i). Protection of functional groups: Hydroxyl, Carbonyl and amino groups
ii). Oxidation: Oxidation of alcohols and carbonyl compounds with suitable examples
iii). Reduction: Reduction of double and triple bonds and carbonyl compounds with suitable examples. (12h)

TEXT BOOKS:
1. Text book of Organic Chemistry – Morrsion and Boyd.
2. Organic Reaction Mechanisms by VK Ahulwalia and RK Parashar
3. Vogels Text Book of Qualitative Organic Analysis.

References:
1. Reaction mechanism – Peter Skyes.
2. Text book of Organic Chemistry – P.L. Soni.
3. Organic Chemistry Vol- I-IL. Finar.
4. Reactions and Reagents – O.P. Agrawal.
5. A TEXT BOOKS of Organic Chemistry- Bahl and ArunBahl, S. Chand company, New Delhi
6. Polymer Science and Technology- Hema Singh, Acme Learning, New Delhi

COURSE OUTCOMES:
After completion of the course student shall be able to

- Analyze the mechanism of organic chemical reaction which are essential to synthesis new organic compounds in drug and pharmaceutical industries
- carry out a chemical processes industrially for the manufacture of drugs and pharmaceuticals, Comprehension on basic reactions, reagents and their applications.
- Illustrate the electronic behaviour of organic molecules, their special and geometrical arrangement of functional groups.

- Explain the reaction mechanisms for different types of reactions.
- Conduct the most common reactions like addition, substitution, oxidation, reduction etc., on large scale.

II B.TECH II SEMESTER

2. 20A40801 PROCESS HEAT TRANSFER

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To demonstrate different modes of heat transfer
- To describe formulae for steady/ unsteady rate of heat transfer by conduction for rectangular, cylindrical and spherical geometries
- To teach how to estimate the heat transfer coefficients for different flow geometries
- To explain the working and design of double pipe, shell and tube heat exchangers and evaporators
- To impart knowledge on the phenomenon of radiation, radiation shields and estimation of emissivity.

UNIT -I

Introduction: Nature of heat flow, conduction, convection, natural and forced convection, radiation.

Heat transfer by conduction in Solids: Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres.

Unsteady state heat conduction: Equation for one-dimensional conduction, Semi-infinite solid.

UNIT- II

Principles of heat flow in fluids: Typical heat exchange equipment, counter current and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

UNIT- III

Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

UNIT -IV

Natural convection: Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar-flow heat transfer.

Heat transfer to fluids with phase change: Heat transfer from condensing vapors, heat transfer to boiling liquids.

Radiation: Introduction, properties and definitions, black body radiation, real surfaces and the Gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation Shielding, radiation to semi-transparent materials, combined heat transfer by conduction, convection and radiation.

UNIT- V

Heat exchange equipment: General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method)

Evaporators: Evaporators, performance of tubular evaporators, capacity and economy, multipleeffect evaporators, methods of feeding, vapor recompression

TEXT BOOK:

1. Unit Operations of Chemical Engineering, 6th ed., W.L. McCabe, J.C. Smith and P. Harriot, McGraw-Hill, New York, 2001

REFERENCES:

1. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi, 1997.
2. Heat Transfer, 4th ed., J.P. Holman, McGraw-Hill, New York, 1976.
3. Chemical Engineering, Volume-I, J. Coulson and R.F. Richardson, Pergamon Press

COURSE OUCOMES:

At the end of the course the student will be able to

- Determine individual and overall heat transfer coefficients in laminar and turbulent flow conditions.
- Design of heat exchange equipment such as double pipe heat exchanger, shell and tube heat exchanger used in chemical industry.
- Estimate the performance (capacity, economy) of a given single/multiple effect evaporator.
- Calculate heat transfer coefficient in forced convection and natural convection.

Analyze radiation heat transfer between different surfaces

II B.TECH II SEMESTER

3. 20A40802 CHEMICAL ENGINEERING THERMODYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To introduce the concepts of chemical potential, partial properties, property relations for ideal gases, fugacity excess properties and to develop the theoretical foundation for applications of thermodynamics to gas mixtures and liquid solutions and to perform the phase equilibrium calculations using simple models for VLE, Gamma/Phi approach and equation of state approach.

UNIT I

Solution Thermodynamics: Theory, Fundamental property relation, chemical potential as a criterion for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, fugacity and fugacity coefficient for species in solutions, generalized correlations for Fugacity coefficient, The ideal solutions, excess properties.

UNIT II

Solution Thermodynamics: Applications: The liquid phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing

VLE at low to moderate pressures: The nature of equilibrium, the phase rule, Duhems theorem, VLE: Qualitative behaviour, the gamma /Phi formulation of VLE, Dew point and bubble point calculations, flash calculations, solute (1)/solvent (2) systems

UNIT III

Thermodynamic Properties and VLE from Equations of State: properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, fluid properties from correlations of the Pitzer type, VLE from cubic equations of state

Topics in Phase Equilibria: Equilibrium and stability, Liquid-Liquid Equilibrium (LLE), Vapor-Liquid–Liquid Equilibrium (VLLE), Solid-Liquid Equilibrium (SLE), Solid Vapor Equilibrium (SVE).

UNIT IV

Chemical Reaction Equilibria: The reaction coordinate, application equilibrium criterion to chemical reactions, The standard Gibb's energy change and the equilibrium constant, effect of temperature on equilibrium constants, relation of equilibrium constants to composition, equilibrium conversion for single reactions, Phase rule and Duhem's theorem for reacting systems.

UNIT V

Introduction to Molecular Thermodynamics : Molecular Theory of Fluids, Second Virial Coefficients from Potential Functions, Internal Energy of Ideal Gases: Microscopic view, Thermodynamic Properties and Statistical Mechanics ,Hydrogen Bonding and Charge-Transfer Complexing ,Behavior of Excess Properties ,Molecular Basis for Mixture Behavior, VLE by Molecular Simulation.

TEXT BOOK:

1. Introduction to Chemical Engineering Thermodynamics, 6^{th} ed., J.M. Smith, H.C. Van Ness and M.M. Abbott, Tata McGraw-Hill, New Delhi, 2003.

REFERENCE:

1. Chemical Engineering Thermodynamics, Pradeep Ahuja, PHI Learning Pvt. Ltd., New Delhi, 2009
2. A Text Book of Chemical Engineering Thermodynamics, K.V. Narayanan, PHI Learning Pvt. Ltd., New Delhi, 2001.

II B.TECH II SEMESTER

4. 20A40803 INSTRUMENTATION AND PROCESS CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Describe the various elements of instruments, measurement of temperature, pressure and level in process industries.
- Define the basics of process control and develop transfer function models for dynamic processes.
- Drawthe block diagrams and analyse process stability

UNIT- I

Elements of instruments, static and dynamic characteristics, basic concepts of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer. Industrial thermocouples, thermocouple wires, thermo couple wells. Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels. Pressure vacuum and head: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids.

UNIT- II

Introduction to process dynamics and control: Laplace transforms, Inverse Laplace transform, Response of First Order Systems. Physical examples of first order systems- Liquid level, mixing process, R- C circuit. Linearization. Response of first order systems in series-interacting and non- interacting systems, second order systems, transportation lag.

UNIT- III

Control system: Components of a control system, Servo Vs regulator problem, development of block diagram. Controllers and final control elements: Control valve and its construction, PD, PI, PID controllers. Stability: Concept of Stability, Stability criterion, Routh test for stability.

UNIT- IV

Root locus: concept of root locus, rules for plotting the root locus diagram. Introduction to frequency response: Substitution rule, Bode diagrams Control systems design by frequency response: Bode stability criterion, Gain and Phase margins.

UNIT- V

Controller tuning: Tuning of P, PD, PI, PID controllers, Ziegler- Nichols technique, Cohen and Coon rules. Advanced control strategies: Cascade control, feed forward control, ratio control, Smith predictor.

TEXT BOOKS:

1. Industrial instrumentation by Donald P.Eckman, Wiley eastern, 1950.

2. Process Systems Analysis and Control, 2nd ed., D.R. Coughanowr, McGraw-Hill, 1991

REFERENCES:

1. Chemical Process Control, G. Stephanopoulos, PHI Learning Pvt. Ltd., New Delhi, 2010 2. Process Control, B.W. Bequette, PHI Learning Pvt. Ltd., New Delhi, 2010

Common to Civil, Mech, CHEM

Course Code		L	T	P	C
20A49101a	**MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS**	3	0	0	3

Pre-requisite **Semester -IV**

Course Objectives:

The objectives of this course are:

1.	To inculcate the basic knowledge of micro economics and financial accounting
2.	To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
3.	To know the various types of Market Structures & pricing methods and its strategies
4.	To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
5.	To provide fundamental skills on Accounting and to explain the process of preparing Financial statements

UNIT – I

Managerial Economics

Introduction – Nature, meaning, significance, functions and advantages. Demand-Concept, Function, Law of Demand – DemandElasticity- Types – Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

LEARNING OUTCOMES: At the end of the Unit, the learners will be able to

State the Nature of Managerial Economics and its importance

- Understand the concept of demand andits determinants
- Analyze the Elasticity and degree of elasticity
- EvaluateDemand forecasting methods
- Design the process of demand estimation for different types of demand

UNIT - II

Production and Cost Analysis

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination–Shortrun and longrun Production Function- Isoquants andIsocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost&Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.

UNIT - III

Business Organizations and Markets

Introduction – Nature, meaning, significance, functions and advantages.Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises.Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition – Monopoly-Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies.

UNIT - IV

Capital Budgeting

Introduction – Nature, meaning, significance, functions and advantages. Typesof Working Capital,Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals,Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

UNIT - V

Financial Accounting and Analysis

Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions-Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). ***Financial Analysis -*** Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:

1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

Reference Books:

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU
B.Tech (R-20 Chemical Engineering)
Common to Civil, Mech, CHEM

Course Code		L	T	P	C
20A49101b	**ENTREPRENEURSHIP& INCUBATION**	3	0	0	3

COURSE OBJECTIVES: The objective of this course is	
1	To make the student understand about Entrepreneurship
2	To enable the student in knowing various sources of generating new ideas in setting up ofnew enterprise
3	To facilitate the student in knowing various sources of finance in starting up of a business
4	To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
5	To encourage the student in creating and designing business plans

COURSE OUTCOMES: At the end of the course, students will be able to	
CO1	Define the Concepts related to the Entrepreneurship and Incubators
CO2	Understand the concept of Entrepreneurship and challenges in the world of competition.
CO3	Apply the Knowledge in generating ideas for New Ventures.
CO4	Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.
CO5	Evaluate the role of central government and state government in promoting Entrepreneurship.
CO6	Create and design business plan structure through incubations.

UNIT-I: Entrepreneurship

Introduction-Nature, meaning, significance, functions and advantages. concept, characteristics-

knowledge and skills requirement - process - Factors supporting entrepreneurship - Differences between Entrepreneur and Intrapreneur - entrepreneurial mindset and personality - Recent trends.

LEARNING OUTCOMES

At the end if the Unit, the learners will be able to

- Understand theconcept of Entrepreneur and Entrepreneurship in India
- Analyzerecent trends in Entrepreneurship across the globe
- Develop a creative mind set and personality in starting a business.

UNIT-II: Women Entrepreneurship

Introduction – Nature, meaning, significance, functions and advantages. Growth of women entrepreneurship in India. - Issues & Challenges - Entrepreneurial motivations.Entrepreneurship Development and Government. Role, of Central and State Government - incentives, subsidies and grants – Export-oriented Units - Fiscal and Tax concessions.

LEARNING OUTCOMES

At the end of the Unit, the learners will be able to

- Understand the role of government in promoting women entrepreneurship
- Analyze the role of export-oriented units
- Evaluate the tax concessions available for Women entrepreneurs

UNIT-III:Product Development

Introduction – Nature, meaning, significance, functions and advantages. Startup Initiatives - Generating business/ Service idea – Sources and methods –Identifying opportunities - Feasibility study - Market feasibility, technical/operational feasibility, Financial feasibility. Developing business plan, Preparing project report, Presenting business plan to investors.

LEARNING OUTCOMES

At the end if the Unit, the learners will be able to

- Analyze the sources of new methods in generating business idea
- Evaluate market feasibility, financial feasibility and technical feasibility
- Design and draw business plansinproject preparation and prepare project reports

UNIT-IV:Startups

Introduction – Nature, meaning, significance, functions and advantages. Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation and the business incubator and how they operate and influence theType/benefits of incubators - Corporate/educational / institutional incubators - Broader business incubation environment - Pre-Incubation and Post - Incubation process - Idea lab, Business plan structure -Value proposition

LEARNING OUTCOMES

At the end of the Unit, the learners will be able to:

- Understand the importance of business incubation

- Apply brilliant ideas in the process of business incubation
- Analyze the process of business incubation/incubators.
- Design their own business incubation/incubators as viable-business unit.

UNIT-V: Finance

Introduction – Nature, meaning, significance, functions and advantages. Sources - Long term and Short term - Institutional Finance – Commercial Banks, SFC's and NBFC's in India, Role in small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions supporting entrepreneurship development.

LEARNING OUTCOMES

At the end of the Unit, the learners will be able to

- Understand the various sources of finance in Starting the new venture
- Analyze the role of banks and other financial institutions in promoting entrepreneurship in India
- Evaluatethe need and importance of MSMEs in the growth of country

TEXT BOOKS

1. D F Kuratko and T V Rao, **Entrepreneurship** - A South-Asian Perspective – Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit :login.cengage.com)
2 .Nandan H, Fundamentals of Entrepreneurship, PHI, 2013

REFERENCES

1.Vasant Desai,Small Scale Industries and Entrepreneurship, Himalaya Publishing 2012.
2. Rajeev Roy Entrepreneurship, 2nd Edition, Oxford, 2012.
3.B.JanakiramandM.Rizwana‖ Entrepreneurship Development: Text & Cases, Excel Books, 2011.
4.Stuart Read, Effectual Entrepreneurship, Routledge, 2013.

E-RESOURCES

1. Entrepreneurship-Through-the-Lens-of-enture Capital

2.http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship

3.http://nptel.ac.in/courses/122106032/Pdf/7_4.pd

4.http://freevideolectures.com/Course/3514/Economics-/-Management-/-Entrepreneurhip/50

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU
B.Tech (R-20 Chemical Engineering)
Common to Civil, Mech, CHEM

Course Code		L	T	P	C
20A49101c	BUSINESS ETHICS AND CORPORATE GOVERNANCE	3	0	0	3

Pre-requisite **Semester -IV**

Course Objectives:

The objectives of this course are:

1.	To make the student understand the principles of business ethics
2.	To enable them in knowing the ethics in management
3.	To facilitate the student's role in corporate culture
4.	To impart knowledge about the fair-trade practices
5.	To encourage the student in creating knowing about the corporate governance

UNIT – I

ETHICS

Introduction – Meaning – Nature, Scope, significance, Loyalty, and ethical behavior - Value systems - Business Ethics,Types, Characteristics, Factors, Contradictions and Ethical Practices inManagement- Corporate Social Responsibility – Issues of Management – Crisis Management.

UNIT - II

ETHICS IN MANAGEMENT

Introduction Ethics in production, finance, Human Resource Management and, Marketing Management - Technology Ethics and Professional ethics - The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures, Culture and Individual Ethics.

UNIT - III

CORPORATE CULTURE

Introduction, Meaning,definition,Nature, Scope, Functions,andsignificance–
Cross cultural issues in Ethics - - Emotional Honesty – Virtue of humility – Promote happiness – karma yoga – proactive – flexibility and purity of mind. The Ethical Value System – Universalism, Utilitarianism, Distributive

Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics –

Ethical Values in different Cultures, Culture and Individual Ethics.

UNIT - IV

LEGAL FRAME WORK

Law and Ethics, Agencies enforcing Ethical Business Behavior, Legal Impact– Environmental Protection, Fair Trade Practices,legal Compliances, Safeguarding Health and wellbeing of Customers.

UNIT - V

CORPORATE GOVERNANCE

Introduction, meaning – scope Nature - Issues, need, corporate governance code, transparency & disclosure, role of auditors, board of directors and shareholders. Global issues, accounting and regulatory frame work, corporate scams, committees in India and abroad, corporate social responsibility. of BoDs composition, Cadbury Committee - various committees - reports - Benefits and Limitations

Textbooks:

1. Murthy CSV: Business Ethics and Corporate Governance, HPH
2. Bholananth Dutta, S.K. Podder – Corporation Governance, VBH.

Reference Books:

1.Dr. K. Nirmala, KarunakaraReddy: Business Ethics and Corporate Governance, HPH

2. H.R.Machiraju: Corporate Governance

3. K. Venkataramana, Corporate Governance, SHBP.

4. N.M.Khandelwal : Indian Ethos and Values for Managers

II B.TECH II SEMESTER

5. 20A40804 PROCESS HEAT TRANSFER LAB

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVE: This lab will provide practical knowledge on various heat transfer process and equipment like heat exchangers and evaporators.

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall.
   Major equipment - Composite wall Assembly
2. Determination of thermal conductivity of a metal rod.
   Major equipment - Thermal Conductivity apparatus
3. Determination of natural convective heat transfer coefficient for a vertical tube.
   Major equipment - Natural convection heat transfer apparatus
4. Determination of critical heat flux point for pool boiling of water.
   Major equipment- Pool boiling apparatus
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
   Major equipment – Forced convection heat transfer apparatus
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
   Major equipment - Double pipe heat exchanger apparatus
7. Determination of heat transfer coefficient for a helical coil in an agitated vessel.
   Major equipment – Helical coil in a agitated vessel.
8. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
   Major equipment - Pin fin apparatus
9. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
   Major equipment - Heat transfer coefficient determination apparatus
10. Determination of Stefan – Boltzmann constant.
    Major equipment - Stefan Boltzmann apparatus
11. Determination of emissivity of a given plate at various temperatures.
    Major equipment - Emissivity determination apparatus

II B.TECH II SEMESTER

6. 20A40805 ORGANIC CHEMISTRY LAB

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

This course aims to provide the student to

- Detailed organic structure analysis
- The planning and implementation of advanced organic reactions
- Understand the major concepts, theoretical and experimental principles.

ORGANIC CHEMISTRY LAB:

1. Criteria of Purity of Solid and Liquid, Determination of Melting Point & Boiling Point. Detecting Nitrogen, Sulphur, and Halogens in Organic Compounds.
2. Identification of an Unknown Substance from the following classes of Organic Compounds, Alcohols, Phenols, Aldehydes, Ketenes, Carbohydrates and Carboxylic acids.
3. Preparation of Aspririn
4. Preparation of Paracetamol
5. Preparation of Acetanilide
6. Preparation of Sulphonic acid
7. Preparation of derivatives for Aldehydes and Amines.
8. Beckman Rearrangement (Preparation of Benzanilide from Benzophenoneoxime).
9. Determination of strength of a Glycine Solution.
10. Estimation of an Aldehyde.

TEXT BOOKS:

1. Text book of Organic Chemistry – Morrsion and Boyd.
2. Organic Reaction Mechanisms by VK Ahulwalia and RK Parashar
3. Vogels Text Book of Qualitative Organic Analysis.

REFERENCES:

1. Reaction mechanism – Peter Skyes.
2. Text book of Organic Chemistry – P.L. Soni.
3. Organic Chemistry Vol- I-IL. Finar.
4. Reactions and Reagents – O.P. Agrawal.
5. A TEXT BOOKS of Organic Chemistry- Bahl and ArunBahl, S. Chand company, New Delhi
6. Polymer Science and Technology- Hema Singh, Acme Learning, New Delhi

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II B.TECH II SEMESTER

7. INSTRUMENTATION AND PROCESS CONTROL LAB

20A40806

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

1. Study about process dynamics and various forms of mathematical models to express them
2. Determine the time lag for first and second order systems.
3. Emphasize theoretical concepts of open and close loop runs on liquid level and liquid temperature.

List of Experiments:

1. Calibration and determination of time lag of various first and second order instruments Major equipment - First order instrument like Mercury-in-Glass thermometer and Overall second order instrument like Mercury-in-Glass thermometer in a thermal well
2. Experiments with single tank system. Single tank - Step Response Single tank - Impulse Response
3. Experiments with two tank system with interaction. Interacting Tanks – Step Response Interacting Tanks – Impulse Response
4. Experiments with two tank system without interaction. Non Interacting Tanks – Step Response Non Interacting Tanks – Impulse Response
5. Level control trainer Major equipment - Level control trainer set up with computer
6. Temperature control trainer Major equipment - Temperature control trainer with computer
7. Experiments on proportional, reset, rate mode of control etc. Major equipment – PID control apparatus
8. Control valve characteristics Major equipment – Control valve set up
9. Estimation of damping coefficient for U-tube manometer Major equipment - U-tube manometer.

II B.TECH II SEMESTER

8. SKILL ORIENTED COURSE-II
(INDUSTRIAL SAFETY AND HAZARD MANAGEMENT)

20A40807

L	T	P	C
1	0	2	2

COURSE OBJECTIVES:

- Have awareness of different hazards in process industries
- Classification of hazards and their identifications
- Precautions in chemical storage and handling
- Learn risk analysis techniques and quantify them
- Learn emergency management plans

Unit – I

Introduction, Factors Contributing to the Costs of Accidents, List of some Notable accidents in the process industry/selected case histories, some common features of high cost accidents, reasons for high priority towards safety.

Unit – II

Material hazards1: Introduction Hazardous substances-categories, Toxicity, Radiation, Flammability, Ignition, Fires and explosions.

Unit – III

Material hazards 2: Fire balls, Fire damage, run away chemical reaction, incompatible materials, material safety and data sheets

Process and plant Hazards: Hazards of pressure, causes of over pressures, flow deviations, effects of leakages/releases, hazards of temperatures.

Unit – IV

Hazard analysis: process safety management, process hazards analysis, hazards analysis methods, check list, preliminary hazard analysis, what-if / check list, hazard and operability analysis, FMEA, Fault tree analysis, cause and consequence analysis.

Unit – V

Preventive and protective measures: Safety options, process safety approaches, inherent safety and design, plant layout, inherent security, explosion prevention and protection, personal protective systems, plant modifications and management change, relief valves and rupture discs, breather vents for storage tanks, explosions vents, flame arresters, flare systems

TEXT BOOKS:

1. Chemical process industry safety by K S N Raju, Mc-Graw Hill education (India) Pvt.Ltd,2014
2. Chemical process Safety by Crowl, 2014

REFERENCES:

1. Chemical process safety by Sanders, 5th ed, 2013

II B.TECH II SEMESTER

9. 20A49102 MANDATORY NON-CREDIT COURSE-III (DESIGN THINKING FOR INNOVATION)

L	T	P	C
2	1	0	0

COURSE OBJECTIVES:

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

UNIT - I

Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT - II

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT - III

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT - IV

Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT - V

Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Relibility and plan for startup.

TEXT BOOKS:

1. Change by design, Tim Brown, Harper Bollins (2009)
2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

REFERENCES:

1. Design Thinking in the Classroom by David Lee, Ulysses press
2. Design the Future, by Shrrutin N Shetty, Norton Press
3. Universal principles of design- William Lidwell, Kritinaholden, Jill Butter.
4. The era of open innovation – Chesbrough.H

Online Learning Resources:

https://nptel.ac.in/courses/110/106/110106124/
https://nptel.ac.in/courses/109/104/109104109/
https://swayam.gov.in/nd1_noc19_mg60/preview

Course Outcomes :

- Define the concepts related to design thinking.
- Explain the fundamentals of Design Thinking and innovation
- Apply the design thinking techniques for solving problems in various sectors.
- Analyse to work in a multidisciplinary environment
- Evaluate the value of creativity
- Formulate specific problem statements of real time issues

10. 20A49901 NSS/NCC/NSO Activities

L	T	P	C
0	0	2	0

III-I

Course Code	1. CHEMICAL REACTION	L	T	P	C
20A50801	ENGINEERING	3	0	0	3
Pre-requisite	Semester - V				

Course Objectives:

- To explain the temperature dependency of rate of reaction as per Arrhenius law, Collision theory and Transition State theory.
- To teach how to determine kinetics of a chemical reaction both at constant and variable volume from the experimental data using integral, differential and method of fractional lives.
- To inform how to obtain the rate law for a non-elementary chemical reaction from a given mechanism
- To describe the designing of reactors for conducting homogenous reactions under isothermal conditions.
- Learn the importance of RTD and the compartmental models for modelling of non-ideal flow reacting vessels.
- Calculate the conversions based on segregated flow model, dispersion model and tanks-in-series models.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Understand the various factors for selection of the chemical reactors for a particular process and rate law for both elementary and non – elementary reactions.
CO2	Analyse and interpret experimental data from batch reactors and determine the order of simple chemical reactions using integral and differential method of analysis
CO3	Able to Distinguish ideal reactor types (batch, CSTR and PFR) and apply quantitative methods to design the size of reactors for simple chemical reaction schemes.
CO4	Design of an optimal ideal reactor through multiple reactions for yield or selectivity, and evaluate the reactor performance for reactors when the temperature is not uniform within the reactor
CO5	Ability to Understand the importance of RTD and the compartmental models for modelling of Non – Ideal flow reacting vessels and evaluate the conversions based on segregated flow model, dispersion model and tanks – in – series models.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2		1	2	1	2	1		2

CO2	3	3	3	2		1	1	1	1	1		2
CO3	2	3	3	2		1	2	1	1	1		1
CO4	3	2	3	1		1	1	1	2	1		3
CO5	2	3	1	1		1	2	1	2	1		2

UNIT - I

Overview of chemical reaction engineering-classification of reactions, variables affecting the rate of reaction definition of reaction rate, kinetics of homogenous reactions- concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory.

Interpretation of batch reactor data- constant volume batch reactor:- Analysis of total pressure data obtained in a constant-volume system, the conversion, Integral method of analysis of data– general procedure, irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions, irreversible trimolecular type third order reactions, empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions from the half-life, fractional life method, irreversible reactions in parallel, homogenous catalysed reactions, autocatalytic reactions, irreversible reactions in series.

UNIT - II

Constant volume batch reactor– first order reversible reactions, second order reversible reactions, reversible reactions in general, reactions of shifting order, Differential method of analysis of data. Varying volume batch reactor–differential method of analysis, integral method of analysis, zero order, first order, second order, nth order reactions, temperature and reaction rate, the search for a rate equation

UNIT - III

Introduction to reactor design- general discussion, symbols and relationship between C_A and X_A. Ideal reactors for a single reaction- Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors.

Design for single reactions- Size comparison of single reactors, Multiple- reactor systems, Recycle reactor, Autocatalytic reactions.

UNIT - IV

Design for parallel reactions- introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size.

Multiple reactions-Irreversible first order reactions in series, quantitative discussion about product distribution, quantitative treatment, plug flow or batch reactor, quantitative treatment, mixed flow reactor, first-order followed by zero-order reaction, zero order followed by first order reaction.

UNIT - V

Basics of non-ideal flow: E, the exit age distribution function of fluid, the RTD, conversion in non-ideal flow reactors, diagnosing reactors (qualitative discussion only).

The dispersion model: axial dispersion, correlations for axial dispersion, chemical reaction and dispersion.

The tanks in series model: Pulse response experiments and the RTD, chemical conversion. The convection model for laminar flow- the convective model and its RTD, chemical conversion in laminar flow reactors

Earliness of mixing, segregation and RTD: Self-mixing of a single fluid, mixing of two miscible fluids.

Textbooks:

1. Chemical Reaction Engineering, 3rd ed., O. Levenspiel, John Wiely& Sons, 1999.

Reference Books:
1. Elements of Chemical Reaction Engineering, 2nd ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010. 2. Chemical Engineering Kinetics, 3rd ed., J.M. Smith, McGraw-Hill, New York, 1981.
Online Learning Resources:

Course Code	MASS TRANSFER	L	T	P	C
20A50802	OPERATIONS - I	3	0	0	3
Pre-requisite	Semester - V				

Course Objectives:

- To impart the basic concepts of molecular diffusion, mass transfer coefficients and analysis of different mass transfer processes.
- To discuss the fundamental concepts of mass transfer principles and their applications to real engineering problems.
- To introduce the mass transfer rates and Fick's Law of diffusion.
- To describe convective mass transfer rates and mass transfer coefficients.
- To appraise different types of equipment and their operation for gas-liquid separations.
- To explain the design of mass transfer equipment for absorption, stripping, drying and humidification.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Identify diffusion phenomena in various chemical processes.
CO2	Determine diffusivity coefficient in gases, liquids and solids.
CO3	Calculate mass transfer coefficients at interfaces of multiphase mass transfer systems
CO4	Design equipment for gas-liquid mass transfer operations.
CO5	Interpret and design driers, humidifiers

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

The Mass Transfer Operations: Classification of the Mass-Transfer Operations, Choice of Separation Method, Methods of Conducting the Mass-Transfer Operations, Design Principles, Unit Systems

Molecular Diffusion in Fluids: Molecular Diffusion, Equation of Continuity, binary solutions, Steady State Molecular Diffusion in Fluids at Rest and in Laminar Flow, estimation of diffusivity of gases and liquids, Momentum and Heat Transfer in Laminar flow
Diffusion:Diffusion in Solids, Fick's Diffusion, Unsteady State Diffusion, Types of Solid Diffusion, diffusion through polymers, diffusion through crystalline solids, Diffusion through

porous solids & hydrodynamic flow of gases.

UNIT - II

Mass Transfer Coefficients: Mass Transfer Coefficients, Mass Transfer Coefficients in Laminar Flow (Explanation of equations only and no derivation), Mass Transfer Coefficients in Turbulent Flow, eddy diffusion, Film Theory, Penetration theory, Surface-renewal Theory, Combination Film-Surface-renewal theory, Surface-Stretch Theory, Mass, Heat and Momentum Transfer Analogies, Turbulent Flow in Circular Pipes. Mass transfer data for simple situations.

Inter Phase Mass Transfer: Concept of Equilibrium, Diffusion between Phases, Material Balances in steady state co-current and counter current stage processes, Stages, Cascades, Kremser – Brown equation.

UNIT - III

Equipment For Gas-Liquid Operations: Gas Dispersed, Sparged vessels (Bubble Columns), Mechanical agitated equipments(Brief description),Tray towers, General characteristics, Sieve design for absorption and distillation (Qualitative Treatment), Different types of Tray Efficiencies, Liquid Dispersed venturi Scrubbers, Wetted-Wall Towers, Packed Towers, Counter current flow of Liquid & Gas through packing, Mass transfer coefficients for packed towers, End effects and Axial Mixing Tray tower vs Packed towers.

UNIT - IV

Absorption And Stripping: Absorption equilibrium, ideal and non-ideal solutions, selection of a solvent for absorption, one component transferred: material balances. Determination of number of Plates (Graphical), Absorption Factor, estimation of number of plates by Kremser Brown equation, Continuous contact equipment; HETP, Absorption of one component,
Determination of number of Transfer Units (NTU) and Height of the Continuous Absorber, overall coefficients and transfer units, dilute solutions, overall height of transfer units.

UNIT - V

Humidification Operations: Vapor-Pressure Curve, Definitions, Psychometric Charts, Enthalpy of gas-vapor Mixtures, Humidification and Dehumidification, Operating lines and Design of Packed Humidifiers.

Drying: Equilibrium, Definitions, Drying Conditions- Rate of Batch Drying under constant drying conditions, Mechanisms of batch drying, drying time through circulation drying.
Classification of Drying Operations: Batch and Continuous Drying Equipment.

Textbooks:

1. Mass transfer operations by R.E. Treybal, 3rd ed. Mc Graw Hill, 1980.
2. Separation process C.J King, Tata Mc Graw Hill
3. Principles of Mass Transfer and Separation Processes by B K Dutta, Printice Hall of India Pvt Limited, New Delhi

Reference Books:

1. Diffusion mass transfer in fluid system by E. L. Cussler.
2. Transport processes and unit operations by Christie J. Geankoplis
3. Separation Process Principles, J D Seader and E. J. Henley, John Wiley & Sons, Inc,

New York

Online Learning Resources:

Course Code	CHEMICAL PROCESS EQUIPMENT DESIGN	L	T	P	C
20A50803		3	0	0	3
Pre-requisite	Semester - V				

Course Objectives

Chemical process plants include a number of important equipment such as reactors, distillation columns, absorbers, heat exchangers, evaporators, crystallizers, etc. Design of such equipment should be carried out a priori to set-up a process plant and thus, it is the basic step in a chemical process. The present course enables one to learn about the complete process design of Heat Exchanger, Condenser, Reboiler, Crystallizer, Evaporator, Packed column and Distillation column.

Prerequisites: Basic knowledge of chemical process calculations, momentum, heat and mass transfer.

Course Outcomes (Students will be able to……)

1. Understand the use of basic concepts of science and engineering.
2. Use design concepts for designing process equipment.

CO1	Mechanical design of pressure vessels
CO2	Process design of separation equipment's for distillation, absorption, stripping, liquid-liquid extraction, adsorption.
CO3	Selection of piping materials, pumps, compressors,fans and blowers, vacuum system equipment, turbines, and expanders.
CO4	Design of material handling equipment like piping system,pumps, compressors, turbines and expanders
CO5	Design ofkey heat exchanger types like heat exchangers, Double pipe and multiple double pipe, shell and tube heat exchanger etc.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Introduction to Process Equipment Design, basic definition of designing, its constraints, necessity of this course and different equipment to be designed, classification of heat exchangers based on different factors, Working of different heat exchangers such as double pipe exchanger, shell and tube exchanger, plate heat exchanger, extended surface heat exchanger, air cooled heat exchanger, storage type exchanger,

Basic design parameters for designing of heat exchangers such as overall heat transfer coefficient, dirt factor and mean temperature difference, Basic parameters for design of heat exchangers such as Ft correction factor, allocation of fluids and acceptable limits of pressure drop and velocity Design steps of double pipe heat exchanger

UNIT - II

Types of shell and tube heat exchangers, respective merits and demerits, front and rear heads of this exchanger, comparison of types, Different types of tubes, methods to decide suitable diameter

and length of tubes, tube arrangement and passes in shell and tube exchanger, different standards available for shells, bundle diameter, shell diameter, types of shell, baffles, tie rods and spacers.
Design of shell and tube exchanger using Kern's method and Bell's method.

UNIT - III

Uses of condensers, types of shell and tube condensers, Design of condenser.
Utility of reboiler and its classification, detailed construction and heat transfer mechanism in kettle type and thermosiphon reboilers, design of kettle type and thermosiphon reboilers, forced circulation reboilers, comparison of different types of reboilers

UNIT - IV

Definition of Evaporation, its application and necessity, Performance of evaporators, Basic parts of evaporator, types of evaporators, Material and energy balance in an evaporator, boiling point rise, detailed working of triple effect evaporator system, Governing equations for design of multiple effect evaporator system, Badger McCabe method, Design of evaporators using Newton Raphson method, vertical and horizontal vapour liquid separators.
Definition of Crystallization, different shapes of crystals, applications of crystallizers, supersaturation, solid-liquid phase equilibrium, solubility curve, nucleation and crystal growth, working of crystallizer, important facts of design considerations of crystallizer, steps involved in design of crystallizer

UNIT - V

Packed column and its utility, Selection of packed and plate columns considering different factors, different components of packed column, few factors for packing, Different types of random packing, structured packing, respective features, determination of height of transfer unit, estimation of column diameter, column internals such as packing support, liquid distributers, hold down plate.

Distillation column, its process, different reflux ratio, design of binary system using McCabe-Thiele method, design of multi-component distillation column using Lewis-Matheson method, Hengstebeck's method and Erbar-Maddox method. Plate efficiency, O'Connell and AIChE methods, Plate contactors, details of sieve plate, bubble cap plate and valve plate, respective merits and demerits, selection of plate, liquid flow pattern and downcomer, operating range of parameters for plate of distillation column, design of plate considering different factors.

Textbooks:

Books and references

1. Backhurst, J. R. and Harker J. H.,"Coulson and Richardson Chemical Engineering", Vol. II, 5th Ed., 2002, Butterworth-Heinemann.
2. Sinnott, R.K., "Coulson and Richardson's Chemical Engineering Series: Chemical Engineering Design", Vol. VI, 4th Ed., 2005, Elsevier Butterworth-Heinemann.
3. Serth, R.W., "Process Heat Transfer: Principles and Applications" 2007, Elsevier Ltd.

Online Resources

Process Equipment Design By Prof. Shabina Khanam, IIT Roorkee under NPTEL Program (https://youtu.be/d2-D8dTrEWM)

Professional Elective Course - I

Course Code	**PE1. ENVIRONMENTAL**	**L**	**T**	**P**	**C**
20A50804a	**ENGINEERING**	**3**	**0**	**0**	**3**
Pre-requisite	**Semester - V**				

Course Objectives:

1. To illustrate the importance of Environment and society to engineering professional students
2. To impart the causes and preventive measures against soil, water, air and noise pollution
3. Describe the preventive methods of different types of pollution

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understandimportanceofenvironmentanddifferenttypesofpollution.
CO2	Explaincausesandpreventivemeasuresagainstairpollution.
CO3	Describecausesandpreventivemeasuresagainstwaterpollution.
CO4	Describecausesandpreventivemeasuresagainstsoilpollution.
CO5	Explaincausesandpreventivemeasuresagainstnoisepollution.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

ManandEnvironment:Overview(socio-economicstructure&occupationalexposures)–ScopeofEnvironmentalEngineering–pollutionproblemsduetourbanization&industrialization

UNIT – II

Air pollution Sampling and Measurement: Ambient air sampling, Stack sampling and Analysis of Sulphur Dioxide, Nitrogen Oxides and Particulate matter.

UNIT – III

Air Pollution Control Methods and Equipment: Control methods, Source correction methods, Cleaning of gaseous effluents, Particulate emission control, Selection of a particulate collector and Control of Gaseous emissions

Control of Specific Gaseous Pollutants: Control of Sulphur dioxide, Control of Nitrogen Oxides, Carbon Monoxide and Hydrocarbons.

UNIT – IV

Water Pollution: Water resources, Origin of waste water, Types of Water Pollutants and their effects, Water Pollution Laws and Standards.

Waste Water Sampling, Analysis and Treatment: Sampling, Methods of Analysis, Determination of Organic Matter, Inorganic Matter and Physical Characteristics, Primary, Secondary, Advanced Waste Water Treatment and Recovery of Materials from Process Effluents.

UNIT - V

Solid waste Management: Sources and Classification, Public health aspects, Disposal methods and Potential methods of disposal.

Hazardous Waste Management: Definition, Sources, Classification, Hazardous Waste Management Strategy, treatment methods and Disposal methods.

Textbooks:

1. *Environmental Pollution Control Engineering by C.S.Rao, 2nd edition, New Age International Ltd (2006)*
2. Kormondy- concept of Ecology, Concept of Ecology Prentice-Hall of India, N.Delhi
3. Odum - FundamentalofEcology
4. J.Turk&A.Turk - EnvironmentalScience
5. D.Lal - WaterSupply&WasteWater
6. Dix - EnvironmentalPollution

References:

1. *Air pollution by M.N.Rao, H.V.N. Rao, Tata McGraw Hill (2007)*

Online Learning Resources:

	Professional Elective Course -I				
Course Code	**PE2. PROCESS MODELING &**	**L**	**T**	**P**	**C**
20A50804b	**SIMULATION**	**3**	**0**	**0**	**3**
Pre-requisite	**Semester - V**				

Course Objectives:

- Learn to develop mathematical model for problems.
- To impart knowledge on modelling of various equipment and their simulation using different numerical techniques.
- Formulate a chemical engineering problem as a mathematical model, and select an appropriate solution method.
- Understand the computational requirements of various solution options and use this understanding in the selection of the solution method
- Formulate and solve process design problems, based on fundamental analysis and using mathematical models of chemical processes

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Understand the stages involved in the development of a process model.
CO2	Formulate a chemical engineering problem as a mathematical model from basic engineering principles
CO3	Identify the appropriate numerical solutions for solving the models.
CO4	Understand various techniques for solving ODEs and PDEs and solve the developed models.
CO5	Simulating the chemical engineering models developed.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Introduction: Modelling and simulation, definition, concept and uses of mathematical models, Classification of mathematical models- steady state Vs dynamic models, lumped Vs distributed parameter models, deterministic Vs stochastic models.
Fundamental laws: Principles of formulation, Continuity Equation, Component Continuity Equation, Energy equation, and Equation of motion.

UNIT - II

Examples of mathematical models of reactor systems: Series of isothermal constant hold-up Continuous Stirred Tank Reactors (CSTRs), CSTRs with variable hold-ups, Two heated tanks, gas phase pressurized CSTR, Non-isothermal CSTR.

UNIT - III

Examples of mathematical models of systems: Single component vaporizer, batch reactor, Reactor with mass transfer, ideal binary distillation column, batch distillation with hold-up

UNIT - IV

Empirical model building- Method of least squares, linear, polynomial
Solution of non-linear algebraic equations- Bisection, False position, Newton- Raphson method
Numerical solution of ordinary differential equations- Euler's method, Modified Euler's method, Runge- Kutta 4^{th} order method

UNIT - V

Modular approaches to process simulation: Analysis Vs Design mode, sequential modular approach, Simultaneous modular approach, Equation solving approach.
Simulation of chemical processes: Introduction to various simulation software packages in chemical engineering, Simulation of models such as isothermal CSTR, non-isothermal CSTR, and batch reactor

Textbooks:

1. William L Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", McGraw Hill Publishing Company, 2^{nd} edition, 1990
2. Numerical Methods for Engineers, S.K. Gupta, Wiley Eastern, New Delhi, 1995
3. Process Plant Simulation, B.V.Babu, Oxford University Press, 2004

Reference Books:

1. Numerical Methods for Engineers and Scientists, S.S. Rao
2. Introduction to Numerical Methods in Chemical Engineering, P. Ahuja, PHI learning Pvt. Ltd., New Delhi, 2010
1. Process Modeling and Simulation, Amiya K. Jana, 2012.

Online Learning Resources:

Professional Elective Course - I

Course Code	**PE3. MATERIAL SCIENCE FOR**	**L**	**T**	**P**	**C**
20A50804c	**CHEMICAL ENGINEERS**	**3**	**0**	**0**	**3**
Pre-requisite	**Semester**				

Course Objectives:
This course will help students to learn about the relationship between structure and properties of materials, application of various classes of materials including metals, ceramics, polymers.

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand and identify various crystal systems. Calculation of parameters for simple crystal structures predict the behavior of crystal systems due to imperfections
CO2	Analyze the properties of simple alloys and steels based on their phase diagrams, phase transitions and heat treatment.
CO3	Evaluate the mechanical behavior, failure and strengthening mechanisms of various metals, alloys and plastics
CO4	Ability to apply types of corrosion and illustrate methods to mitigate corrosion and select suitable material for various chemical processes.
CO5	Proper selection of materials for designing various equipment's in a chemical industry

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Introduction: Engineering Materials – Classification – levels of structure.

Crystal Geometry and Structure Determination: Space lattice and Unit cell. Bravais lattices, crystal systems with examples. Lattice coordinates, Miller indices, Bravais indices for directions and places: crystalline and non crystalline solids; ionic, covalent and metallic solids; packing efficiency, coordination number; structure determination by Bragg's X-ray diffraction and powder methods.

UNIT - II

Crystal Imperfection: Point defects, line defects-edge and screw dislocation, Berger's circuit and Berger's vectors, dislocation reaction, dislocation motion, multiplication of dislocations during deformation, role of dislocation on crystal properties; surface defects, dislocation density and stress required to move dislocations

UNIT - III

Basic thermodynamic functions: phase diagrams and phase transformation: Primary and binary systems-general types with examples; tie line& lever rule, non-equilibrium cooling: phase diagrams of Fe-Fe_3-C, Pb-Sn, Cu-Ni systems.

Phase transformations in Fe-Fe_3-C steels, Time-Temperature-Transformation (TTT) curves for eutectoid steels and plain carbon steels; effect of alloying elements on properties of steels; types of steels, alloys and other metals used in chemical industry.

UNIT - IV

Elastic, an elastic and plastic deformations in solid materials; rubber like elasticity, visco-elastic behaviour (models); shear strength of real and perfect crystals, work hardening mechanisms, cold working, hot working; dynamic recovery, recrystallization, grain growth, grain size and yield stress, Brief description of heat treatment in steels.

UNIT - V

Fracture in ductile and brittle materials, creep: mechanism of creep and methods to reduce creeping in materials, creep rates and relations. Fatigue-mechanisms and methods to improve fatigue resistance in materials. Composite materials: types; stress-strain relations in composite materials, applications.

Oxidation and Corrosion: Mechanisms of oxidation, oxidation resistant materials, principles and types of corrosion, protection against corrosion.

Textbooks:

Materials Science and Engineering, 5thed. V. Raghavan, PHI Learning Pvt. Ltd., New Delhi, 2009.

Reference Books:

Elements of Materials Science, L.R. Van Vlack,

2. Science of Engineering Materials, vols. 1&2, ManasChanda, McMillan Company of India Ltd.

Online Learning Resources:

Course Code	Open Elective Course – I	L	T	P	C
20A50805	ENERGY CONVERSION AND STORAGE DEVICES	3	0	0	3
Pre-requisite	Common to All Branches				

Course Objectives:

1. Understand the fundamentals of fossil energy sources, solar, biomass and electrochemical energy etc
2. Understand the basics of photosynthetic, photocatalytic and photoelectrochemical systems and devices for the efficient energy and fuels production.
3. Learn the principles and operations of electrochemical energy storage devices,

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand the need of energyconversion and the various methods of energy storage
CO2	Identify Winds energy as alternateform of energy and to know how itcan be tapped
CO3	Understand the nuclear and bio energy, its mechanism of production and its applications
CO4	Analyse chemical, electrochemical energy storage devices and interpret the conversion efficiencies
CO5	Explain bio gas generation and itsimpact on environment

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Outline of the course. Introduction and scope of energy conversion. World Energy Production and Balance. Motivations for studying future energy systems (e.g. pollution, climate change, energy security).

UNIT - II

Fossil Energy: Overview of fossil fuel resources and energy contents. Cycle analysis (Rankine, Brayton, combined cycles, cogeneration)
Nuclear Energy: nuclear reaction and energy conversion physics (fission and fusion), nuclear power systems

UNIT - III

Solar-thermal energy: solar thermal radiation physics, Active and passive solar-thermal

energy collection and conversion systems
Photoelectric energy: Photoelectric physics. Solar photovoltaic cell materials and technology
Wind Energy: Wind interaction with objects fluid dynamics. Wind harvesting devices and systems

UNIT - IV
Biomass and Waste to Energy: Potential and resources of biomass and waste energy. Thermal-chemical and bio-chemical conversion methods
Overview of Climate Control, CO_2 Sequestration and Energy Sustainability

UNIT - V
Basic of Electrochemical energy conversion and storage, Fundamentals of Fuel Cells, Basics of Fusion power, Energy Storage Technologies, Mechanical storage, Chemical storage, Electrical storage

Textbooks:
Energy Systems Engineering, F.M. Vanek, L.D Albright, and LargusAngenent, Second Edition, McGraw-Hill, Inc., 2012,

Reference Books:

- Angèle Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Photovoltaic Solar Energy:From Fundamentals to Applications, JOHN WILEY.
- Alexander P. Kirk, Solar Photovoltaic Cells: Photons to Electricity, ELSEVIER
- Francesco Dalena, Angelo Basile, Claudio Rossi, Bioenergy Systems For The Future: Prospects ForBiofuels And Biohydrogen, 1st Edition, ELSEVIER
- Jean-Marie Tarascon, Patrice Simon, ELECTROCHEMICAL ENERGY STORAGE,
- Electrochemistry by Carl H. Hamann, Andrew Hamnett and Wolf Vielstich, Wiley VCH, 1998.
- Modern Electrochemistry 1. Volume 1 and 2, by J. O'M. Bockris and A. K. N. Reddy, Kluwer Academic,2000.
- Electrochemical Methods, by A. J. Bard and L. R. Faulkner, John Willey, 1980
- John Love and John A. Bryant, Biofuels and Bioenergy, John Wiley
- Anju Dahiya, Bioenergy: Biomass to Biofuels, Elsevier

Online Learning Resources:

Course Code	**ENVIRONMENTAL ENGINEERING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
20A50806	**Semester - V**				

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Able to analyze the acidity and alkalinity of water sample
CO2	Able to understand the knowledge on pH, hardness, turbidity and solid matter of water sample
CO3	Able to evaluate the, flash and fire point and calorific value of fuel and proximate analysis of coal
CO4	Able to evaluate the PM 2.5 concentration of atmospheric air
CO5	Able to apply the procedures for determination of dissolved oxygen and COD of waste water sample

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

List of Experiments:

1. Estimation of chemical and physical parameters of Ground and Surface water:
   P^H, TDS & Conductivity, Hardness, Turbidity, Fluoride, Color analysis.
   Pesticide Microbial analysis: e-coli/ total coli forms bacteria
2. Estimation of physical parameters of waste water:
   P^H, TDS, Hardness, Turbidity, Alkalinity etc.
3. Estimation of chemical parameters of waste water:
   COD, BOD, TSS
4. Water and waste water treatment:
   Small RO system for treatment of ground water.
   Same above system with UF membrane for turbidity removal and water disinfection
5. Analysis of Air:
   Estimation of SPM, RSPM, SO_x, NO_x, CO and ozone in atmospheric air to study air pollution.
7. Fuel cell Test Kit [Energy]
   A small ½ watt to 1 watt fuel cell with water electrolysis kit (H_2 and O_2 Generation) plus small voltmeter and ammeter for measuring fuel cell performance.
7. Measurement of Flash point, fire point and calorific value of any fuel

References:

Online Learning Resources/Virtual Labs:

Course Code	CHEMICAL REACTION ENGINEERING LAB	L	T	P	C
		0	0	3	1.5
20A50807	Semester				

Course Objectives:

- Operate lab equipments like CSTR, Batch, PFR reactors.
- Analyze the concentration versus time data and determine the specific rate constant and the order of the reaction.
- Compare theoretical and experimental conversions in a CSTR and PFR.
- Estimate RTD and model parameters in a CSTR, PFR, packed bed and CSTRin-series.

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Determine the specific rate constant and the order of the reaction using the experimental data obtained for CSTR, Batch and PFR.
CO2	Express the temperature dependency of rate of reaction using the experimental data obtained.
CO3	Able to determine space times and volumes of reactors both experimentally and theoretically
CO4	Estimate the mass transfer coefficients in solid-liquid and liquid-liquid systems.
CO5	Obtain RTD from experiment and use the data to estimate model parameters in a CSTR, PFR, packed bed and CSTRs in-series

Course Articulation Matrix

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

List of Experiments:

1. Determination of the order of a reaction using a batch reactor and analyzing the data by (a) differential method (b) integral method.
2. Determination of the activation energy of a reaction using a batch reactor.
3. To determine the effect of residence time on conversion and to determine the rate constant using a CSTR.
4. To determine the specific reaction rate constant of a reaction of a known order using a batch reactor.
5. To determine the order of the reaction and the rate constant using a tubular reactor.
6. CSTRs in series- comparison of experimental and theoretical values for space times and volumes of reactors.
7. Mass transfer with chemical reaction (solid-liquid system) – determination of mass transfer coefficient.
8. Mass transfer with chemical reaction (liquid-liquid system) – determination of mass transfer coefficient
9. Axial mixing in a packed bed. Determination of RTD and dispersion number for a packed-bed using tracer
10. Determination of RTD and dispersion number in a tubular reactor using a tracer

References:

Online Learning Resources/Virtual Labs:

Course Code		L	T	P	C
20A50808	COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING Semester - V	1	0	2	2

Course Objectives:

-

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Solve the algebraic, simultaneous equations, ODEs and PDEs using the basic mathematical science.
CO2	Apply regression analysis, interpolation, extrapolation, numerical differentiation andnumericalintegration
CO3	Evaluate the properties of Chemical Engineering Unit Operation problems
CO4	Solve initial value problems, boundary value problems using C programming and MATLAB software's.
CO5	Computer applications for chemicalengineeringproblems (either C or MATLAB coding)

Course Articulation Matrix

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

List of Experiments:

Numericalproblemsrequiredtobesolvedusing C Programming andMATLAB.

Numerical Methods: Roots of algebraic equations and solution of simultaneous equations.Regression analysis,InterpolationandExtrapolation,Differentiation and NumericalIntegration.Solutionofordinarydifferentialequations,InitialandBoundaryValueProblems.Solutionsofpartial differential equations.

Applications of Numerical Methods to Chemical Engineering Problems: Material andEnergyBalance,Fluidflowoperations,Heattransfer,MassTransfer,Thermodynamics,Mechanicaloperations,Predictionofproperties.

1. Programme to determine the roots of Non-linear Algebraic/Transcedental Equation by using Bisection Method
2. Programme to determine the roots of Non-linear Algebraic/Transcedental Equation by using Regula-Falsi Method
3. Programme to determine the roots of Non-linear Algebraic/Transcedental Equation by

using Newton-Raphson Method

4. Programme to perform Regression Analysis to fit a curve with examples
5. Programme to Interpolate the data with and without equal intervals
6. Programme for the Numerical integration by using Trapezoidal and Simpson's Rules
7. Programme for the Solution of Ordinary Differential Equations by using Euler Method
8. Programme for the Solution of Ordinary Differential Equations by using R-K fourth order Method
9. Programme for the Application of Numerical Methods to find the pressure drop in a pipe and terminal velocity & minimum fluidization velocity of a particle in momentum transfer
10. Programme for the Application of Numerical Methods to solve problems involving mechanical unit operations
11. Programme for the Application of Numerical Methods to solve problems involving material and energy balances
12. Programme for the Application of Numerical Methods to solve problems involving chemical engineering thermodynamics such as estimation of bubble point and dew point Temperatures & Pressures
13. Programme for the Application of Numerical Methods to solve problems involving chemical reaction engineering such as solving the rate equations in case of batch reactor, CSTR and PFR

List of programmes:

1. MATLAB – Matrices/ Polynomials/ Integral/ Differential/ Plots
2. Data handling and regression using MS-Excel
3. Non-linear algebraic equation
4. Problems on general material balance
5. Numerical Integration- Simpson's 1/3 Rule
6. Ordinary Differential Equation- R-K Method
7. Curve Fitting-Least Square
8. Calculation of Bubble Point and Dew Point for Ideal multi-component system
9. P-xy and T-xy data generation from the given vapor pressure data
10. Flash Vaporization for multi-component system
11. Design of Batch Reactor/ PFR/ CSTR
12. Double pipe heat exchanger (Area, Length and Pressure drop)

LearningResources:

TextBooks:

1. ComputationalTechniquesforProcessSimulationandAnalysisusingMATLAB,NiketS. Kaisare,Taylor& Francis,CRCpress,2018.
2. *ProblemSolvingwithC++,*WalterSavitch,Pearson,2014,9th Edition.
3. LabManuals

References:

1. AppliedNumericalAnalysisusingMATLAB,LaureneV.Fausett,Pearson,2009,2nd Edition.
2. Numerical Methods for Chemical Engineers with MATLAB Applications,AlkisConstantinides,NavidMoustoufi, Prentice Hall,1999.
3. GettingstartedwithMATLAB:Aquickintroductionforscientists&Engineers,RudraPratap,OxfordUniversityPress,2010.

Online Learning Resources/Virtual Labs:

https://nptel.ac.in/courses/103/106/103106118/
https://nptel.ac.in/courses/111/102/111102137/

Course Code	EVALUATION OF COMMUNITY SERVICE	L	T	P	C
20A50809	PROJECT				1.5
Pre-requisite	Semester				

Course Objectives:

.

Course Outcomes (CO):

UNIT - I

UNIT - II

UNIT - III

UNIT - IV

UNIT - V

Textbooks:

Reference Books:

Online Learning Resources:

Mandatory Non – Credit Course

Course Code **INDIAN CONSTITUTION** **L T P C**
20A55401
Pre-requisite **Common to Civil, MECH & CHEM**

Course Objectives:

1. To Enable the student to understand the importance of constitution
2. To understand the structure of executive, legislature and judiciary
3. To understand philosophy of fundamental rights and duties
4. To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and Election Commission of India.

To understand the central-state relation in financial and administrative control

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	State the historical background of the constitution making and its importance for building a democratic India.
CO2	Understand the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO3	Demonstrate the value of the fundamental rights and duties for becoming good citizen of India and analyse the decentralization of power between central, state and local self-government
CO4	Appraise the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy
CO5	Develop themselves as responsible citizens and pave way to build a democratic country.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I
Introduction to Indian Constitution
Constitution -Meaning of the term - Indian Constitution- Sources and constitutional history - Features– Citizenship – Preamble - Fundamental Rights and Duties - Directive Principles of State Policy.

UNIT - II
Union Government and its Administration
Structure of the Indian Union - Federalism - Centre-State relationship – President's Role, power and position - PM and Council of ministers - Cabinet and Central Secretariat –Lok

Sabha - Rajya Sabha - The Supreme Court and High Court - Powers and Functions

UNIT - III

State Government and its Administration

Structure of the State Govt. - Governor - Role and Position-CM and Council of Ministers - State Secretariat- Organization Structure and Functions

UNIT - IV

Local Administration

District's Administration Head - Role and Importance - Municipalities - Mayor and role of Elected Representatives -CEO of Municipal Corporation Panchayati Raj - Functions– PRI – Zilla Parishath - Elected officials and their roles – CEO, Zilla Parishath - Block level Organizational Hierarchy - (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy

UNIT - V

Local Administration

District's Administration Head - Role and Importance - Municipalities - Mayor and role of Elected Representatives -CEO of Municipal Corporation Panchayati Raj - Functions– PRI – Zilla Parishath - Elected officials and their roles – CEO, Zilla Parishath - Block level Organizational Hierarchy - (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Textbooks:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd. New Delhi
2. Subash Kashyap, Indian Constitution, National Book Trust

Reference Books:

1. J.A. Siwach, Dynamics of Indian Government & Politics,
2. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
3. J.C. Johari, Indian Government and Politics, Hans India
4. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd. New Delhi

Online Learning Resources:

nptel.ac.in/courses/109104074/8

2.nptel.ac.in/courses/109104045/

3.nptel.ac.in/courses/101104065/

4.www.hss.iitb.ac.in/en/lecture-details

5.www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS):: ANANTHAPURAMU

III B. Tech- II Semester

Course Code	**CHEMICAL PLANT DESIGN & ECONOMICS**	**L**	**T**	**P**	**C**
20A60801		**3**	**0**	**0**	**3**
Pre-requisite	**Semester-VI**				

Course Objectives:

- To familiarize the students about various economic aspects of chemical processes
- Learn basics of Cost estimation, Working Capital and Capital Investment and understand the time value of money
- Learn the importance of Cash flow diagrams and Break-even analysis.
- Study depreciation methods and methods of estimation of profitability of an industry
- Study the procedures adopted for Replacement and Selection from Alternatives.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	*Understand* design considerations, cash flow and various costs involved in process Industries
CO2	*Apply* the knowledge on different types of interest studied &*Predict* the Present worth and annuities
CO3	*Solve* problems on depreciation using various methods as well able to explain types of taxes
CO4	*Analyse* alternative investments, pay out period for an investment and rate of return
CO5	*Evaluate* linear programming problems (LPP) by graphical and algebraic methods

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Introduction, Process Design development.General design considerations, Cost and asset accounting.Cash flow for industrial operations, factors effecting investment and production cost, capital investments, estimation of capital investments, cost indices, cost factors in capital investment

UNIT - II

Organizations for presenting capital investments, estimates by compartmentalization, estimation of total product of cost direction, production costs, fixed charges, plant overhead costs, financing.
Interest and investment cost, type interest, nominal and effective interest rates, continuous interest, present worth and discount annuities, cost due interest on investment, source of capital.

UNIT - III
Taxes and insurances, type of taxes: federal income taxes, insurance-types of insurance, self insurance.
Depreciation: types of depreciation, services life, salvage value, present value, methods for determining depreciation, single unit and group depreciation.

UNIT - IV
Profitability: alternative investments and replacements, profitability standards, discounted cash flow, capitalized cost, pay out period,alternative investments, analysis with small investments, increments and replacements.

UNIT - V
Optimum design and design strategy, incremental cost, general procedure for determining optimum condition, comparison of graphical and analytical methods, optimum production rates, semi continuous cyclic operation, fluid dynamics, mass transfer strategy of linearization

Textbooks:
1. Plant Design and Economics for Chemical Engineering, 4^{th} ed., M.S. Peters and K.D. Timmerhaus, McGraw-Hill,1991

Reference Books:
1. Process Engineering Economics, Schweyer

Online Learning Resources:

Course Code	MASS TRANSFER OPERATIONS - II	L	T	P	C
2060802		3	0	0	3
Pre-requisite	Semester				

Course Objectives:

- To introduce stage wise mass transfer operations, principles of various stage wise contact processes like distillation, extraction and leaching and drying
- To appraise design aspects of the equipment for utilized for distillation, extraction and leaching and drying.
- To coach the importance of VLE for ideal non-ideal systems (miscible and immiscible liquids) in mass transfer operations.
- To enlighten on different types of distillation such as: batch & continuous, flash vaporization, steam distillation and differential distillation.
- To impart distillation column design using McCabe Thiele and Ponchon-Savarit methods.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Remember the stage wise contact processes absorption; distillation, extraction and leaching that are used in separation processes in industries.
CO2	Understand the underlying principles related separation processes in industries
CO3	Apply for various mass transfer operations mentioned above to equipment's
CO4	Analyse these separation processes for specific purposes by using the experience obtained while conducting experiments in laboratory
CO5	Design and debug any problems emanating in equipment used in industries for the above operations

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Distillation: Fields of applications, VLE for miscible liquids, immiscible liquids, steam distillation, Positive and negative deviations from ideality, enthalpy-concentration diagrams, flash vaporization and differential distillation for binary and multi component mixtures, Batch distillation with Reflux.

UNIT - II

Continuous rectification-binary systems, multistage tray towers –method of Mc Cabe and Thiele, enriching section, stripping section, feed introduction, total reflux, minimum and optimum reflux ratios, use of open steam, types of condensers, partial condensers, effect of cold reflux, multiple feeds, tray efficiencies, continuous-contact equipment (packed towers)
Multistage (tray) towers –the method of Ponchon and Savarit, the enriching and stripping sections, feed tray location, total reflux, minimum and optimum reflux ratios, types of reboilers, use of open steam, condenser and reflux accumulators, Azeotropic distillation, extractive distillation, comparison of Azeotropic and extractive distillation.

UNIT - III

Liquid-Liquid operations: fields of usefulness, liquid-liquid equilibrium, equilateral triangular co-ordinates, choice of solvent, stage wise contact, multistage cross-current extraction, Multi stage counter current without reflux
Multi stage counter current with reflux, Differential (continuous contact) extractors, spray towers, packed towers, mechanically agitated counter-current extractors, centrifugal extractors, dilute solutions, super critical fluid extraction, fractional extraction.

UNIT - IV

Leaching: Fields of applications, preparation of solid for leaching, types of leaching, leaching equilibrium, single stage and multi stage leaching calculations, constant under flow conditions, equipment for leaching operation.

UNIT - V

Adsorption: Adsorption, types of adsorptions, nature of adsorbents, adsorption equilibrium, single gases and vapors, Adsorption Hysteresis, effect of temperature, Heat of adsorption, vapor and gas mixtures: One component adsorbed, Effect of change of temperature or pressure. Liquids, Adsorption of solute from dilute solution, The Freundlich equation, Adsorption from concentrated solutions, adsorption operations, stage wise operation, application of Freundlich equation to single and Multistage adsorption (cross current & counter current).
Fluidized and teeter beds, continuous contact, steady state moving bed adsorbers, unsteady state–fixed bed adsorbers, adsorption wave, elution, pressure swing and vacuum swing adsorption (qualitative treatment), ion-exchange: principles of ion exchange, techniques and applications.

Textbooks:

1. Mass transfer operations by R.E. Treybal, 3rd ed. Mc Graw Hill, 1980.

Reference Books:

1. Principles of Mass Transfer and Separation Processes by B K Dutta, Printice Hall of India Pvt Limited, New Delhi
2. Transport processes and unit operations by Christie J. Geankoplis
3. Separation Process Principles, J D Seader and E. J. Henley, John Wiley & Sons, Inc, New York

Online Learning Resources:

Course Code	**TRANSPORT PHENOMENA**	**L**	**T**	**P**	**C**
20A60803		**3**	**0**	**0**	**3**

Pre-requisite **Semester-VI**

Fluid Mechanics for Chemical Engineers, Process heat transfer, Mass Transfer operations- I & II and Chemical Reaction Engineering

Course Objectives:

- Different types of fluids, their flow characteristics and different mathematical models applied to actual situations
- Mechanism of fluids in motion under different conditions.

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand the chemical and physical transport processes and their mechanisms.
CO2	Analyze different fluid flow characteristics and different mathematical models applied to actual situations.
CO3	Evaluate heat, mass and momentum transfer problems.
CO4	Analyze industrial problems along with appropriate approximations and boundary conditions
CO5	Design steady and time dependent solutions along with their limitations

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids. Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density. Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density.

UNIT - II

Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film, flow through a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere.

UNIT - III

Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin, forced convection, free convection.

UNIT - IV

Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, diffusion through a stagnant gas film, diffusion with a heterogeneous chemical reaction, diffusion with a homogeneous chemical reaction, diffusion into a falling liquid film (gas absorption), diffusion into a falling liquid film (solid dissolution), diffusion and chemical reaction inside a porous catalyst.

UNIT - V

The equations of change: Derivation of the equation of continuity in Rectangular and Polar coordinates, the equation of motion, the equation of energy, the equation of continuity of a component in multi component mixture (in rectangular coordinates only) the equations of change in terms of the substantial derivative. Use of equations of change to solve one dimensional steady state problems of momentum, heat and component transfer, Introduction to Turbulent transport, Time smoothing of equation change.

Textbooks:

At the end of the course, the student will be able to:

1. Derive equations of continuity in rectangular and polar coordinates
2. Develop equation of motion, energy and component continuity for rectangular coordinate system.
3. Solve one dimensional steady state problems of momentum, heat and mass transfer using equations of change
4. Formulate time smoothing of equations of change for turbulent transport.

Reference Books:

1. Transport phenomena for engineers by L. Theodore, International text book company, U.S.A.1971.
2. Transport processes and unit operations by C.J. Geankoplis, PHI, 3rd ed. 1997.
3. Fundamental of heat, momentum and mass transfer, Welty, Wicks and Wilson, John Wiley.

Online Learning Resources:

Professional Elective Course -II

Course Code	**PE1. FLUIDIZATION ENGINEERING**	**L**	**T**	**P**	**C**
20A60804a		**3**	**0**	**0**	**3**
Pre-requisite	**Semester-VI**				

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand the basic knowledge on fluidization engineering and industrial applications of fluidization
CO2	Implement the knowledge on mapping of regimes of fluidization
CO3	Derivebubble formation in both dense and fluidized beds by various models
CO4	Relate high velocity fluidization and Derive minimum fluidization mass velocity and pressure drop equation for minimum fluidization.
CO5	Estimation of gas interchange coefficients.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Introduction: The phenomenon of fluidization; liquid like behavior of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds.
Industrial applications of fluidized beds: Coal gasification; gasoline from other petroleum fractions; Gasoline from natural and synthesis gases; Heat exchange; Coating of metal objects with plastics; Drying of solids; Synthesis of phthalic anhydride; Acrylonitrile; Polymerization of olefins; FCCU; Fluidized combustion of coal; incineration of solid waste; Activation of carbon; gasification of waste; bio-fluidization.

UNIT - II

Fluidization and mapping of regimes: Minimum fluidization velocity; Pressure

drop vs. velocity diagram; effect of temperature and pressure on fluidization; Geldart classification of particles; terminal velocity of particles, Transport disengaging height; turbulent fluidization; pneumatic transport of solids; fast fluidization; solid circulation systems; Voidage diagram; Mapping of regimes of fluidization.

UNIT - III

Bubbles in dense bed: Single rising bubbles; Davidson model for gas flow at bubbles; Evaluation of models for gas flow at bubbles.
Bubbling Fluidized beds: Experimental findings; Estimation of bed Voidages; Physical models: simple two-phase model; K-L model.

UNIT - IV

High velocity Fluidization: Turbulent fluidized bed; Fast fluidization pressure drop in turbulent and fast fluidization.
Solids Movement, Mixing, Segregation and staging: Vertical movement of solids; Horizontal movement of solids; Staging of fluidized beds.

UNIT - V

Gas Dispersion and Gas interchange in Bubbling Beds: Dispersion of gas in beds; Gas interchange between bubble and emulsion; Estimation of gas interchange coefficients.
Particle to Gas Mass Transfer: Experimental interpolation of mass transfer coefficients; Heat transfer; Experimental heat transfer from the bubbling bed model.

Textbooks:

1. Fluidization Engineering by Kunil, Diazo and Octave Levenspiel, John Weiley& Sons Inc, Newyork, 1969.
2. Fluidization Engineering by J.R. Howard, Adam Heilgar.

Reference Books:

Online Learning Resources:

Professional Elective Course - II

Course Code	**PE2. NUMERICAL METHODS IN CHEMICAL**	**L**	**T**	**P**	**C**
20A60804b	**ENGINEERING**	**3**	**0**	**0**	**3**
Pre-requisite	**Semester-VI**				

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration and numerical differentiation.
- To introduce curve fitting using method of least squares
- To teach different methods to solve ordinary differential equations.

To explain the importance of numerical methods to solve chemical engineering problems.
Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Able to solve nonlinear algebraic quations
CO2	Able to perform Regression Analysis and interpolation
CO3	Able to use numerical integration and differentiation techniques
CO4	Able to solve ordinary differential equations
CO5	Able to solve partial differential equations

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Elementary row transformations - Rank, Eigen Values, Solution of system of linear equations by Gauss elimination and Gauss Jordan, Gauss-Seidel and LU decomposition methods.

UNIT - II

Solution of Nonlinear Algebraic Equations: Introduction, Bisection method, Newton-Raphson, Regula-Falsi and Secant method. Chemical engineering problems involving solution of linear and Non-linear algebraic equations.

UNIT - III

Regression Analysis: Introduction, least squares curve-fitting methods, Newton's forward formulae, Newton's backward formulae. Interpolation Polynomial, Lagrangian Interpolation (Unequal Intervals), cubic spline interpolation

UNIT - IV

Numerical differentiation: Three-point Lagrangian formulae.

Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rules, integration with unequal segments, Chemical engineering problems involving numerical differentiation and

integration.

UNIT - V

Solution of ordinary Differential Equations- Introduction to ordinary Differential Equations, Initial and boundary value problems, Euler method, modified Euler, Runge-Kutta 4^{th} order method, Predictor Corrector method, Milne's method, Chemical engineering problems involving single, and a system of ODEs.

Introduction to Partial Differential Equations: elliptic, parabolic and hyperbolic equations and their applications in chemical engineering.

Textbooks:

1. Numerical methods for Engineers, S.K. Gupta, New Age International (P) Limited, Publishers, 1998
2. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI publisher.

Reference Books:

1. Mathematical methods in Chemical Engineering, S. Puspavanam, Prentice Hall of India PHI,1998 ISBN 81-203-1262-7
2. Mathematical methods in Chemical and environmental
3. Engineering, Ajay K. Roy, Thomson Learning, 2000 ISBN 981-240-375-2
4. Engineering Mathematics, Volume - II, E. Rukmangadachari& E. Keshava Reddy, Pearson Publisher.
5. Engineering Mathematics, Volume - II, by G.S.S.Raju, CENGAGE publisher.
6. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S. Chand publication.
7. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
8. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

Online Learning Resources:

Professional Elective Course - II

Course Code	**PE3. SOLID – FLUID REACTIONS**	**L**	**T**	**P**	**C**
20A60804c		**3**	**0**	**0**	**0**
Pre-requisite	**Semester**				

Course Objectives:

- Knowledge of rate law given the rate controlling step in catalytic reactions, internal and external diffusion effects.
- Learn the factors influencing catalyst decay, the role of pore diffusion on catalyst activity rate.
- Shrinking core model for spherical particles of unchanging size and design the fluid-solid reactors.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Understand the reactor performance for reactors when the temperature is not uniform within the reactor
CO2	Analyze the rate law and the rate controlling step in catalytic reactions, internal and external diffusion effects.
CO3	Understand the factors influencing catalyst decay
CO4	Evaluate the role of pore diffusion on catalyst activity rate.
CO5	Able to design the fluid – solid reactors and analyse the changing and unchanging size

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Temperature and Pressure effects- single reactions- heats of reaction from thermodynamics, heats of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non-adiabatic operations, comments and extensions. Exothermic reactions in mixed flow reactors-A special problem, multiple reactions.

UNIT - II

Temperature and Pressure effects- optimum temperature progression, heat effects, adiabatic operations, non-adiabatic operations, comments and extensions. Exothermic

reactions in mixed flow reactors-A special problem, multiple reactions.

UNIT - III

Catalysis and Catalytic reactors: catalysts, steps in catalytic reactions, synthesizing a rate law, mechanism and rate limiting step.

Heterogeneous reactions: Introduction to Solid catalyzed reactions: The rate equation for Surface Kinetics- Pore diffusion resistance combined with surface kinetics, porous catalyst particles, heat effects during reaction, Performance equations for reactors containing porous catalyst particles.

UNIT - IV

Solid catalyzed reactions- Experimental methods for finding rates. Deactivating catalysts-mechanisms of catalyst deactivation, the rate and performance equations.

UNIT - V

Fluid-fluid reactions: kinetics- the rate equation.

Fluid-particle reactions: kinetics- selection of a model, shrinking core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, extensions, determination of rate controlling step

Textbooks:

Reference Books:

Online Learning Resources:

Open Elective Course - II

Course Code	**OE2. GREEN TECHNOLOGY**	**L**	**T**	**P**	**C**
20A60805		**3**	**0**	**0**	**3**
Pre-requisite	**Common to All Branches**	**Semester**			

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand the basic knowledge of environmental issues and estimate the risk
CO2	Evaluate the exposures
CO3	To discuss the type of wastes and emissions that drive the environmental impacts
CO4	Estimation of the environmental properties, persistence, ecosystem risk,
CO5	To present approaches and methodologies for evaluating and improving the environmental performance of chemical processes and chemical products.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I
An introduction to environmental issues: Role of chemical processes and chemical products, Global environmental issues, Air and water quality issues, Ecology.
Risk concept: Description of risk, Risk assessment concept, Dose-response, Exposure assessment.

UNIT - II
Evaluating exposures: Occupational exposures: recognition, evaluation, control, Exposure assessment for chemicals in the ambient environment, Designing safer chemicals.
Green chemistry:Green chemistry methodologies, Optimization based frameworks for the design of green chemical synthesis pathway.

UNIT - III
Evaluating environmental fate: Chemical and physical property estimation, estimating environmental persistence, estimating ecosystem risk, classifying environmental risk based on chemical structure.

UNIT - IV

Life-cycle concepts: Life-cycle assessment, Life-cycle impact assessment

UNIT - V
Material flows in chemical manufacturing, Assessing opportunities for waste exchanges and by-product synergies.

Textbooks:

SHONNARD, DALLEN, D. Green Engineering: Environmentally Conscious Design of Chemical Processes.

Reference Books:

Online Learning Resources:

Course Code	MASS TRANSFER OPERATIONS LABORATORY	L	T	P	C
		0	0	3	1.5

20A60806 **Semester**

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Able to calculate diffusivity coefficients for different systems
CO2	Able to evaluate Mass transfer coefficients for different systems
CO3	Able to calculate Tie line data for VLE, LLE, systems
CO4	Able to perform adsorption studies
CO5	Able to understand drying characteristics

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

List of Experiments:

1. Estimation of diffusivity coefficients for vapor in gas
2. Estimation of solid diffusion coefficient in air
3. Steam distillation
4. Simple distillation
5. Evaluation of HETP in packed towers
6. Vapor Liquid Equilibria
7. Batch Drying
8. Evaluation of Mass transfer coefficients for Surface Evaporation
9. Evaluation of Mass transfer coefficients for Wetted wall column
10. Liquid- Liquid Equilibria (Tie line data)
11. Ternary Liquid Equilibria (binodal curve)
12. Leaching
13. Adsorption studies

References:

1. Principles of Mass Transfer and Separation Processes by B K Dutta, Printice Hall of India Pvt Limited, New Delhi
2. Transport processes and unit operations by Christie J.Geankoplis
3. Separation Process Principles, J D Seader and E. J. Henley, John Wiley & Sons, Inc,. New York
4. Mass transfer operations Laboratory manual by Mr.M.kalyan kumar, lambert publications, June 2019.

Online Learning Resources/Virtual Labs:

Course Code	CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING LABORATORY	L	T	P	C
		0	0	3	1.5
20A60807	Semester				

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Design and use the data to draw a pressure vessel
CO2	Design and use the data to draw a standard vertical short tube evaporator
CO3	Design and use the data to draw a sieve tray type distillation column
CO4	Design and use the data to draw a reaction vessel with a plane jacket
CO5	Sketch memory diagrams pertaining to attachments, supports and internal parts of heat exchangers, tall vessels and reaction vessel.
CO6	Sketch memory diagrams pertaining to attachments, supports, and internal parts of pressure vessels, distillation column and packed column

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

List of Experiments:
References:

Online Learning Resources/Virtual Labs:

Course Code	CHEMICAL PROCESS	L	T	P	C
20A60808	SIMULATION LAB	0	0	3	1.5
	Semester				

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Able to understand the fundamentals of process simulation	
CO2	Able to solve Initial value problems (IVP)	
CO3	Able to solve Boundary value problems (BVP)	
CO4	Able to simulate CSTR, PFR and Batch reactors	
CO5	Able to simulate Distillation column, vaporizer etc	

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

List of Experiments:

1. Simulation of Initial Value Problem (Ex: Gravity Flow tank).
2. Simulation of Boundary Value Problem (Ex: Tubular Reactor with axial Diffusion)
3. Simulation of Three CSTRs in series – open and Closed loop
4. Simulation of Control system design for a Non isothermal CSTR
5. Simulation of Binary Distillation column
6. Simulation of Batch Reactor isothermal and Non isothermal – closed loop
7. Simulation of Interacting and Non interacting System- two tank liquid level
8. Simulation of Plug flow reactor
9. Non linear Regression: Fitting a catalytic rate model
10. Constrained Optimization using Matlab
11. Stability analysis using Bode diagrams for control systems
12. Dynamic modeling of Single Component Vaporizer

References:

Online Learning Resources/Virtual Labs:

Skill Oriented Course -

Semester-VI

Course Code	**Soft Skills**	**L**	**T**	**P**	**C**
20A65502		**1**	**0**	**2**	**2**

Pre-requisite

Common to CIVIL,MECH, CHEM

Course Objectives:

- ➢ To encourage all round development of the students by focusing on soft skills
- ➢ To make the students aware of critical thinking and problem-solving skills
- ➢ To develop leadership skills and organizational skills through group activities
- ➢ To function effectively with heterogeneous teams

Course Outcomes (CO):

By the end of the program students should be able to

- Define various elements of effective communicative skills
- Understanding people using emotional intelligence
- apply critical thinking skills in problem solving
- analyse the needs of an organization for team building
- Assess the situation and take necessary decisions as a leader
- Creating a productive work place atmosphere using social and work-life skills ensuring personal and emotional well-being

UNIT – I **Soft Skills & Communication Skills** Lecture Hrs

Introduction, meaning, significance of soft skills – definition, significance, types of communication skills - Intrapersonal & Inter-personal skills - Verbal and Non-verbal Communication

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity

(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

Inter personal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

UNIT – II Lecture Hrs

Critical Thinking

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking

Activities

:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT – III Lecture Hrs

Problem Solving & Decision Making

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution –

Methods of decision making – Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.

Case Study & Group Discussion

UNIT – IV **Emotional Intelligence & Stress Management** Lecture Hrs

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.

Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT – V **Leadership Skills** Lecture Hrs

Team-Building – Decision-Making – Accountability – Planning – Public Speaking – Motivation – Risk-Taking - Team Building - Time Management

Activities

Forming group with a consensus among the participants- choosing a leader- encouraging the group members to express views on leadership- democratic attitude- sense of sacrifice – sense of adjustment – vision – accommodating nature- eliciting views on successes and failures of leadership using the past knowledge and experience of the participants, Public Speaking, Activities on Time Management, Motivation, Decision Making , Group discussion etc.

NOTE-:

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.

2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear or for good Leadership – Mahendar Singh Dhoni etc.

Textbooks:

1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.)Publisher : Oxford University Press; Pap/Cdr edition (July 22, 2012)
2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr Shikha KapoorPublisher : I K International Publishing House; 0 edition (February 28, 2018)

1. Reference Books:

1.Soft skills: personality development for life success by prashantsharma, BPB publications 2018.

2. Soft Skills By Alex K. Published by S.Chand

3. Soft Skills: An Integrated Approach to Maximise Personality Gajendra Singh Chauhan, Sangeetha Sharma Published by Wiley.

4. Communication Skills and Soft Skills (Hardcover, A. Sharma) Publisher: Yking books

5. SOFT SKILLS for a BIG IMPACT (English, Paperback, RenuShorey)

Publisher: Notion Press

6. Life Skills Paperback English Dr. Rajiv Kumar Jain, Dr. Usha Jain
   Publisher : Vayu Education Of India

Online Learning Resources:

1. **https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q**
2. **https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ**
3. **https://youtu.be/-Y-R9hDl7lU**
4. **https://youtu.be/gkLsn4ddmTs**
5. **https://youtu.be/2bf9K2rRWwo**
6. **https://youtu.be/FchfE3c2jzc**

(Mandatory Non-Credit Course) (CIVIL, ME, CHEM))

INTELLECTUAL PROPERTY RIGHTS AND PATENTS

20A69901

Course code

L	T	P	C
2	0	0	0

CourseObjectives:

This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws,

Cyber Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.

CourseOutcomes: At the end of the course the students will be able to

UnderstandIPRlaw&Cyberlaw

Discussregistration process,maintenance andlitigations associatedwith trademarks

Illustrate thecopyright law

Enumerate thetrade excretal.

UNIT I

Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics – Types of Intellectual Property – Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement – Regulatory – Overuse or Misuse of Intellectual Property Rights – Compliance and Liability Issues.

UNIT II

Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers – Copyright Formalities and Registration–Limitations–Infringement of Copyright –International Copyright Law-Semiconductor Chip Protection Act.

UNIT III

IntroductiontoPatentLaw–RightsandLimitations–RightsunderPatentLaw–Patent Requirements

–Ownership and Transfer –Patent Application Process and Granting of Patent –Patent InfringementandLitigation–InternationalPatentLaw–DoublePatenting–PatentSearching– Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

UNIT IV

Introduction to Trademark – Trademark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trademark– Likelihood of confusion –Trademark claims – Trademarks Litigation – International Trade Mark Law.

UNIT V

Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law. Introduction to Cyber Law – Information Technology Act – Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy – International aspects of Computer and Online Crime.

Textbooks:

Deborah E. Bouchoux: "Intellectual Property". Cengage learning, New Delhi

KompalBansal&ParishitBansal "Fundamentals of IPR for Engineers" S Publications

(Press)

Cyber Law. Texts& Cases, South-Western"s Special Topics Collections

References:

PrabhuddhaGanguli: „Intellectual Property Rights" Tata Mc-Graw–Hill, New Delhi

Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.

R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights",

Excel Books. New Delhi.

M.Ashok Kumar and Mohd. Iqbal Ali: "Intellectual property Right "Serials Pub

JNTUA COLLEGE OF ENGINEERING (Autonomous): ANANTAPURAMU

B. Tech (CHEM)–IV-I Sem (R20)

Professional Elective Course - III

Course Code	**PE1. PETROLEUM REFINING &**	**L**	**T**	**P**	**C**
20A70801a	**PETROCHEMICAL TECHNOLOGY**	**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

- Learn the formation, refining of crude oil and products of refinery.
- Understand the means of processing data including thermal properties, important products characteristics.
- Develop skills in drawing neat flow diagrams of different petroleum refining processes
- (cracking/reforming/alkylation/isomerization / hydrocracking etc.,) that are aimed at producing high value/demand products.
- Identify important testing methods for important petroleum products.
- Have idea on Indian standards for major petroleum products

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Able to the overall scenario of quality of crude oil.
CO2	Able to calculate different Petroleum Products and their specifications.
CO3	Able to know the different processes involving for up gradation of petroleum fractions.
CO4	Able to do Thermal & Catalytic cracking processes.
CO5	Able to understand chemicals from ethane, ethylene, and acetylene

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT – I

Origin, formation and composition of petroleum: Origin and formation of petroleum, Reserves and deposits of world, Indian Petroleum Industry. Petroleum processing data: Evaluation of petroleum, thermal properties of petroleum fractions, important products, properties and test methods.

UNIT – II

Fractionation of petroleum: Dehydration and desalting of crudes, heating of crude pipe still heaters, distillation of petroleum, blending of gasoline. Treatment techniques: fraction-impurities, treatment of gasoline, treatment of kerosene, treatment of lubes.

UNIT – III

Thermal and catalytic processes: Cracking, catalytic cracking, catalytic reforming, Naphtha cracking, coking, Hydrogenation processes, Alkylation processes, Isomerization process.

UNIT – IV

Petrochemical Industry – Feed stocks Chemicals from methane: Introduction, production of Methanol, Formaldehyde, Ethylene glycol, PTFE, Methylamines.

UNIT – V

Chemicals from Ethane-Ethylene-Acetylene: Oxidation of ethane, production of Ethylene, Manufacture of Vinyl Chloride monomer, vinyl Acetate manufacture, Ethanol from Ethylene, Acetylene manufacture, Acetaldehyde from Acetylene.

Textbooks:

1. Nelson. W.L. “Petroleum refining Engineering”, 4 Edition, Mc Graw Hill, New York, 1969.

2. Rao, B.K.B. “Modern Petroleum Refining Processes”, 4 Edition, Oxford and IBH Publishing, 2002.

Reference Books:

1. Goldstine. R.F. “The Petroleum Chemicals Industry”, Taylor and Francis, London, 1967.

2. Gruese. W.S.and Stevens, D.R. “Chemical Technology of Petroleum”, McGraw Hill, 1980.

3 Chauvel. A. and Lefevrev, “Petro Chemicals”, Volume 1 and 2, Gulf Publishing company 1989.

Online Learning Resources:

Professional Elective Course - III

Course Code	**PE2. ENERGY ENGINEERING**	**L**	**T**	**P**	**C**
20A70801b		**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

- To acquaint the student with the conventional energy sources and their utilization.
- To understand the importance of heat recovery and energy conservation methods and energy audit

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Associate the basic energy sources, fuels and their utilization requirements with reference to Indian Scenario
CO2	Estimate steam production cost and its quality
CO3	Describe energy production and storage for solar and wind
CO4	Explain heat recovery from processes and effective utilization of waste heat
CO5	Describe different types of energy audit and energy conversion

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Sources of energy, types of fuels- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with reference to India.

Coal: origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and by-product recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

UNIT - II

Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of

petroleum products, burning of liquid fuels.
Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel, fuel cells, flue gas, analysis: orsat apparatus.

UNIT - III

Steam Plant: Run time cycle, boiler plant, steam cost, steam distribution and utilization, combined heat and power systems, energy from biomass and biogas plants, gas purification, solar energy, wind energy, energy storage.

UNIT - IV

Waste heat recovery, sources of waste heat and potential application, various types of heat recovery systems, regenerators, recuperators, waste heat boilers

Energy conservation: conservation methods in process industries, theoretical analysis, practical limitations.

UNIT - V

Energy auditing: short term, medium-term, long-term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

Textbooks:

1. Fuels, Furnaces and Refractories, O.P.Gupta
2. Fuels and Combustion, 3rd ed., Samir Sarkar, Universities Press, 2009

Reference Books:

1. Non-conventional Energy Resources, G.D.Rai, Khanna Publishers
2. Fuel and Energy, Harker and Backhurst, Academic press London 1981
3. Fuel Science- Harker and Allen, Oliver and Boyd, 1972

Online Learning Resources:

Professional Elective Course - III

Course Code	**PE3. BASICS OF NANOTECHNOLOGY**	**L**	**T**	**P**	**C**
20A70801c		**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

- Basic knowledge of nanotechnology, classification and properties of nanomaterials
- Various methods of synthesis of nanomaterials.
- Applications of nanomaterials

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand the importance of nanotechnology and its interdisciplinary nature
CO2	Understand the methods of fabrications and applications of nanomaterials
CO3	Understand the Unique properties of nanomaterials
CO4	Able to analyse different synthesis methodologies of nanoparticles
CO5	Able to distinguish top down and bottom up approaches

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I
Introduction:History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

UNIT - II
Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations. Effect of Nano-dimensions on Materials Behaviour: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility.

UNIT - III
Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

UNIT - IV

Synthesis Routes: Bottom-up approaches:Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly

UNIT - V

Top-down approaches: Mechanical alloying, Nano-lithography.

Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

Applications of Nanomaterials:Nano-electronics, Nano sensors, Nano catalysts, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications

Textbooks:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

Reference Books:

1. Nano: The Essentials by T.Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. ChallaS.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

Online Learning Resources:

Professional Elective - IV

Course Code	**PE1. CORROSION ENGINEERING**	**L**	**T**	**P**	**C**
20A70802a		**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

1. Be introduced to the principles of electrochemistry as well as the essential elements of electrochemical corrosion.
2. Lay a foundation for understanding the forms of corrosion, the mechanisms of corrosion, electrochemical methods.
3. Develop the thermodynamic and kinetic aspects of electrochemistry, including potential-pH
4. (Pourbaix) diagrams, mixed potential theory, and the theory and application of polarization.
5. Design methods for combating corrosion, the principles and methods leading to mitigation of corrosion problems that might occur in engineering practice.

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand the electrochemical behaviour of corroding systems
CO2	Classify Various corrosion forms and the mechanisms involved
CO3	Apply the electrochemical aspects of combating eight forms of corrosion
CO4	Design of suitable materials & methods of combat corrosion
CO5	Evaluate the polarization behaviour of corroding systems

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Introduction

Definitions of Corrosion - Overall classification of types of corrosion-Basic electrochemistry – Galvanic and electrolytic cells – Potential measurements - EMF and Galvanic series – Galvanic corrosion and bimetallic contacts – Eh – pH diagrams, Cost of Corrosion, Metallurgical properties influencing corrosion.

UNIT - II

Forms of Corrosion

Uniform attack, galvanic, crevice, pitting, inter granular, selective leaching, erosion and stress corrosion – Mechanisms, testing procedures and their protection.

UNIT - III

Electrode kinetics and polarization phenomena

Electrode – solution interface – Electrode kinetics and polarization phenomena – Exchange current density – Polarization techniques to measure corrosion rates – Mixed potential theory – Activation and diffusion controlled mixed electrodes.

UNIT - IV

Methods of corrosion prevention and control

Design, coatings and inhibition – Cathodic protection – Stray current corrosion – Passivity phenomena and development of corrosion resistant alloys – Anodic control.

UNIT - V

Industry Approach

Selection for a given Chemical Engineering Service Environment- Materials for Chemical Engineering Industry to resist the given chemical Environment. -Ferritic, Austenitic steels and stainless steels- Copper and its alloys-Brasses, bronzes, Nickel and its alloys- Monel alloys-materials for a petroleum refinery industry.

Textbooks:

1. M. G. Fontana, Corrosion Engineering (Third Edition) McGraw-Hill Book Company.
2. Denny A Jones, Principles and Prevention of Corrosion (second edition), Prentice-Hall, N. J. (1996).

Reference Books:

1. H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley (NY) (1985).

Online Learning Resources:

Professional Elective Course - IV

Course Code	**PE2. OPTIMIZATION OF CHEMICAL**	**L**	**T**	**P**	**C**
20A70802b	**PROCESSES**	**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

- To learn problem formulation of optimization.
- To realize the numerical methods of un-constrained optimization.
- To learn linear programming and its applications
- To understand the use of genetic algorithms in optimization
- To know the applications of numerical optimization.

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Define, understand and explain the concept of Optimization of Chemical Processes
CO2	Formulate Optimization Problems with given constraints
CO3	Apply and analyse the optimization criterion for solving problems
CO4	Investigate constrained and unconstrained optimization techniques
CO5	Investigate different methods of optimization and to suggest a technique for specific problem

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Nature and organization of optimization problems: Introduction to optimization, scope and hierarchy of optimization, examples of applications of optimization, essential features of optimization problems, general procedure for solving optimization problems, Optimization of a manufacturing problem with a stepwise procedure, obstacles of optimization, constraints in optimization, examples and formulation of constrained optimization problems.

Basic concepts of optimization: Continuity of functions, unimodal versus Multimodal functions. Convex and Concave functions, convex region, Necessary and sufficient conditions for an extremum of an unconstrained function.

UNIT - II

Optimization of unconstrained single variable functions: Region elimination methods: Fibonacci search, Golden section search. Polynomial approximation methods- Sequential search

Methods specifying optimum by a point: Newton's method, Secant method, Quadratic interpolation, Cubic interpolation. Applications of one- dimensional search methods to chemical engineering problems.

UNIT - III

Unconstrained multivariable optimization: Random search methods, grid search, uni-variate search, multivariable Newton's method, steepest descent method, Conjugate search directions, Conjugate gradient method

UNIT - IV

Optimization of Unit operations: Optimal pipe diameter, optimizing recovery of waste heat, optimization of multiple effect evaporator, Determination of optimal reflux ratio for staged distillation column, shell and tube heat exchanger.

UNIT - V

Linear programming and applications: Basic concepts in linear programming, graphical solution, artificial variable technique, exceptional cases in LPP, non-existing feasible solution, degeneracy, duality in linear programming, dual simplex method, revised simplex method.

Textbooks:

1. Optimization of Chemical Processes, T.F. Edgar and D.M. Himmelblau, McGraw-Hill, New York, 2001.
2. Optimization for Engineering Design, Kalyan Moy Deb, PHI Pvt. Ltd., New Delhi, 2000

Reference Books:

Online Learning Resources:

Professional Elective Course - IV

Course Code	**PE3. PHARMACEUTICALS &**	**L**	**T**	**P**	**C**
20A70802c	**FINE CHEMICALS**	**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Able to understand the principle of pharmaceuticals and their properties
CO2	Able to understand the principle of fine chemicals and their properties
CO3	Able to analyse the pharmaceuticals like aspirin, penicillin, calcium gluconate
CO4	Able to understand principle of tablet manufacture and granulation equipment's
CO5	Able to understand sterilization process

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I
A brief outline of grades of chemicals, sources of impurities in chemicals, principles (without going into details of individual chemicals) of limit test for arsenic, lead, iron, chloride and sulfate in Pharmaceuticals.

UNIT - II
Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals - sulfacetamide, paracetamol, riboflavin, nicotinamide,
Outlines of Preparation, properties, uses and testing of the following fine chemicals - Methyl orange, fluorescence, procaine hydrochloride, paramino salicylic acid, isonicatinic acid hydrazide.

UNIT - III
Manufacture with flowsheets, properties, uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate.

UNIT - IV

Manufacture with flowsheets, properties, uses and testing of the following ferric ammonium citrate, pthallic anhydride and phenol fluorobenzene process and benzene sulfate process, other processes in outline only.

UNIT - V

Tablet making and coating, granulation equipments, Preparation of capsules, extraction of crude drugs. Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization, suitable example to be discussed.

Textbooks:

1. Remington's Pharmaceutical Science,16th ed, Mac publishing company, 1980.
2. Industrial Chemicals, 3rd ed., Faith, Kayes and Clark, John Wiley &Sons,. 1965.

Reference Books:

1. Blently's Text Book of Pharmaceutical Chemistry, 8th ed, H A Rawlins,
2. B Tindell and Box,. Oxford University Press, London, 1977

Online Learning Resources:

Professional Elective Course - V

Course Code	**MOOCs course offered by Swayam/ NPTEL**	**L**	**T**	**P**	**C**
20A70803		**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

UNIT - II

UNIT - III

UNIT - IV

UNIT - V

Textbooks:

Reference Books:

Online Learning Resources:

Common to All Branches

Course Code	**MANAGEMENT SCIENCE**	L T P C
20A75401a		3 0 0 3

Pre-requisite Semester

COURSE OBJECTIVES: The objectives of this course are

1 To provide fundamental knowledge on Management, Administration, Organization & its concepts.

2 To make the students understand the role of management in Production

3 To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts

4 To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management

5 To make the students aware of the contemporary issues in management

Course Outcomes (CO): At the end of the course, students will be able to

1 Define the Management, and its Functions

2 Understand the concepts & principles of management and designs of organization in a practical world

3 Apply the knowledge of Work-study principles & Quality Control techniques in industry

4 Analyse the concepts of HRM in Recruitment, Selection and Training & Development.

5 Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyse the business through SWOT.

6 Create Modern technology in management science.

UNIT - I INTRODUCTION TO MANAGEMENT

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor’s Scientific Theory-Henry Fayol’s principles - Elton

Mayo’s Human relations - Systems Theory - Organizational Designs - Line organization - Line &

Staff Organization - Functional Organization - Committee form of Organization - Social

responsibilities of Management.

LEARNING OUTCOMES: At the end if the Unit, the learners will be able to

 Understand the concept of management and organization

 Analyze the organization chart & structure for an enterprise.

 Apply the concepts & principles of management in real life industry.

 Evaluate and interpret the theories and the modern organization theory.

UNIT - II OPERATIONS MANAGEMENT

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), -

Statistical Quality Control - Materials Management - Objectives - Inventory-Functions - Types,

Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure - Marketing Management -

Concept - Meaning - Nature- Functions of Marketing - Marketing Mix - Channels of Distribution
-

Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

LEARNING OUTCOMES: At the end of the Unit, the learners will be able to

 Understand the core concepts of Management Science and Operations Management

 Apply the knowledge of Quality Control, Work-study principles in real life industry.

 Analyze Marketing Mix Strategies for an enterprise

R 20 Regulations

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS), ANANTAPUR

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR, A.P. INDIA

 Evaluate Materials departments & Determine EOQ

 Create and design advertising and sales promotion

UNIT - III HUMAN RESOURCES MANAGEMENT (HRM)

HRM - Evolution of HRM - Definition and Meaning – Nature - Managerial and Operative functions -

- Job Analysis - Human Resource Planning (HRP) – Process of Recruitment & Selection - Training

and Development - Performance Appraisal - Methods of Performance Appraisal – Placement -

Employee Induction - Wage and Salary Administration.

LEARNING OUTCOMES: At the end if the Unit, the learners will

 Understand the concepts of HRM in Recruitment, Selection, Training & Development

 Apply Managerial and operative Functions

 Analyze the need of training

 Evaluate performance appraisal

 Design the basic structure of salaries and wages

UNIT - IV STRATEGIC & PROJECT MANAGEMENT

Strategy Definition & Meaning - Vision - Mission - Goals - Steps in Strategy Formulation and

Implementation - SWOT Analysis Project Management - Network Analysis - Programme

Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path -

Project Crashing (Simple problems).

LEARNING OUTCOMES: At the end of the Unit, the learners will be able to

 Understand Mission, Objectives, Goals & strategies for an enterprise

 Apply SWOT Analysis to strengthen the project

 Analyze Strategy formulation and implementation

 Evaluate PERT and CPM Techniques

 Creative in completing the projects within given time

UNIT - V Contemporary Issues In Management

The concept of Management Information System (MIS) - Materials Requirement Planning (MRP) -

Customer Relations Management (CRM) - Total Quality Management (TQM) - Six Sigma Concept -

Supply Chain Management (SCM) - Enterprise Resource Planning (ERP) - Business Process

Outsourcing (BPO) - Business Process Re-engineering - knowledge Management.

LEARNING OUTCOMES At the end if the Unit, the learners will be able to

 Understand modern management techniques

 Apply Knowledge in Understanding in modern

 Analyze CRM, MRP, TQM

 Evaluate Six Sigma concept and SCM

Textbooks:

1. A.R Aryasri, Management Science, TMH, 2013

2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

Reference Books:

1. Koontz & Weihrich, Essentials of Management, 6/e, TMH, 2005.

2. Thomas N.Duening & John M.Ivancevich, Management Principles and Guidelines, Biztantra.

R 20 Regulations

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS), ANANTAPUR

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR, A.P. INDIA

3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.

4. Samuel C.Certo, Modern Management, 9/e, PHI, 2005

Online Learning Resources:

www.slideshare.net/jhayabesamis/chapter-1-the-nature-and-concept-of-management-122625641 ?

www.slideshare.net/vivekpratapsingh14/school-of-management-thoughts ?

https://www.slideshare.net/89ajpaul/organizational-design-anf-structure

https://www.slideshare.net/sujeet2685/plant-layout-46555840#

https://www.slideshare.net/drmadhurverma/materials-38395397

https://www.slideshare.net/ShaliniShetty3/introduction-to-marketing-management-72210724 ?

https://www.slideshare.net/srinidhiraman/human-resource-management-ppt-43320777

https://www.slideshare.net/wicaksana/training-and-development-33535063

https://www.slideshare.net/ayushijain107/strategic-management-ppt-58012275

Course Code	BUSINESS ENVIRONMENT	L	T	P	C
20A75401b		3	0	0	3
Pre-requisite	Semester				

Course Objectives:

1.	To make the student understand about the business environment
2.	To enable them in knowing the importance of fiscal and monitory policy
3	To facilitate them in understanding the export policy of the country
4.	To Impart knowledge about the functioning and role of WTO
5.	To Encourage the student in knowing the structure of stock markets

Course Outcomes (CO): At the end of the course, students will be able to

1.	Define Business Environment and its Importance.
2.	Understand various types of business environment.
3	Apply the knowledge of Money markets in future investment
4	Analyze India's Trade Policy
5	Evaluate fiscal and monitory policy
6	Develop a personal synthesis and approach for identifying business opportunities

UNIT - I **Overview of Business Environment**

Introduction – meaning Nature, Scope, significance, functions and advantages. Types - Internal & External, Micro and Macro. Competitive structure of industries - Environmental analysis - advantages & limitations of environmental analysis & Characteristics of business.

Learning Outcomes: - After completion of this unit student will

- Understand the concept of Business environment
- Classify various types of business environment
- Evaluate the environmental analysis in business
- Discuss the Characteristics of Business.

UNIT - II **Fiscal Policy**

Introduction – Nature, meaning, significance, functions and advantages. Public Revenues - Public Expenditure - Public debt - Development activities financed by public expenditure - Evaluation of recent fiscal policy of GOI. Highlights of Budget - Monetary Policy - Demand and Supply of Money – RBI - Objectives of monetary and credit policy - Recent trends - Role of Finance Commission.

Learning Outcomes: - After completion of this unit student will

- Understand the concept of public revenue and public Expenditure
- Identify the functions of RBI and its role
- Analyze the Monitory policy in India
- Know the recent trends and the role of Finance Commission in the development of our country
- Differentiate between Fiscal and Monitory Policy

UNIT - III **India's Trade Policy**

Introduction – Nature, meaning, significance, functions and advantages. Magnitude and direction of Indian International Trade - Bilateral and Multilateral Trade Agreements - EXIM policy and role of EXIM bank - Balance of Payments– Structure & Major components - Causes for Disequilibrium in Balance of Payments - Correction measures.

Learning Outcomes: - After completion of this unit student will

- Understand the role of Indian international trade
- Understand and explain the need for Export and EXIM Policies
- Analyze causes for Disequilibrium and correction measure
- Differentiate between Bilateral and Multilateral Trade Agreements

UNIT - IV **World Trade Organization**

Introduction – Nature, meaning, significance, functions and advantages. Organization and Structure - Role and functions of WTO in promoting world trade - Agreements in the Uruguay Round – TRIPS, TRIMS, and GATT - Disputes Settlement Mechanism - Dumping and Anti-dumping Measures.

Learning Outcomes: - After completion of this unit student will

- Understand the role of WTO in trade
- Analyze Agreements on trade by WTO
- Understand the Dispute Settlement Mechanism
- Compare and contrast the Dumping and Anti-dumping Measures.

UNIT - V **Money Markets And Capital Markets**

Introduction – Nature, meaning, significance, functions and advantages. Features and components of Indian financial systems - Objectives, features and structure of money markets and capital markets - Reforms and recent development – SEBI - Stock Exchanges - Investor protection and role of SEBI.

Learning Outcomes: - After completion of this unit student will

- Understand the components of Indian financial system
- Know the structure of Money markets and Capital markets
- Analyze the Stock Markets
- Apply the knowledge in future investments
- Understand the role of SEBI in investor protection.

Textbooks:

1. Francis Cherunilam (2009), International Business: Text and Cases, Prentice Hall of India.
2. K. Aswathappa, Essentials of Business Environment: Texts and Cases & Exercises 13th Revised Edition.HPH2016

Reference Books:

1.K. V. Sivayya, V. B. M Das (2009), Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.
2. Sundaram, Black (2009), International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.
3. Chari. S. N (2009), International Business, Wiley India.
4.E. Bhattacharya (2009), International Business, Excel Publications, New Delhi.

Online Learning Resources:

Course Code	ORGANIZATIONAL BEHAVIOUR	L	T	P	C
20A75401c		3	0	0	3
Pre-requisite	Semester				

Course Objectives:

1	**To enable student's comprehension of organizational behavior**
2	**To offer knowledge to students on self-motivation, leadership and management**
3	**To facilitate them to become powerful leaders**
4	**To Impart knowledge about group dynamics**
5	**To make them understand the importance of change and development**

COURSE OUTCOMES: At the end of the course, students will be able to

1	Define the Organizational Behavior, its nature and scope
2	Understand the nature and concept of Organizational behavior
3	Apply theories of motivation to analyze the performance problems
4	Analyze the different theories of leadership
5	Evaluate group dynamics
6	Develop as powerful leader

UNIT - I **Introduction**

Meaning, definition, nature, scope and functions - Organizing Process – Making organizing effective - Understanding Individual Behavior – Attitude - Perception - Learning – Personality.

LEARNING OUTCOMES: - After completion of this unit student will

- Understand the concept of Organizational Behavior
- Contrast and compare Individual & Group Behavior and attitude
- Evaluate personality types

UNIT - II **Motivation and Leading**

Theories of Motivation - Maslow's Hierarchy of Needs - Hertzberg's Two Factor Theory - Vroom's theory of expectancy - McClelland's theory of needs – Mc Gregor's theory X and theory Y – Adam's equity theory – Locke's goal setting theory – Alderfer's ERG theory - Leadership – research, theories, traits - Leaders Vs Managers.

LEARNING OUTCOMES: - After completion of this unit student will

- Understand the concept of Motivation
- Analyze the Theories of motivation
- Explain how employees are motivated according to Maslow's Needs Hierarchy

UNIT - III **Organizational Culture**

Introduction – Meaning, scope, definition, Nature - Organizational Climate - Leadership - Traits Theory–Managerial Grid - Transactional Vs Transformational Leadership - Qualities of good Leader - Conflict Management - Evaluating Leader - Women and Corporate leadership.

LEARNING OUTCOMES: - After completion of this unit student will

- Understand the concept of Leadership
- Contrast and compare Trait theory and Managerial Grid
- Distinguish the difference between Transactional and Transformational Leadership
- Evaluate the qualities of good leaders

UNIT - IV **Group Dynamics**

Introduction – Nature, Meaning, scope, definition and functions - Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization's change and development

LEARNING OUTCOMES: - After completion of this unit student will

- Understand the importance of organizational change and development
- Apply change management in the organization
- Analyze work stress management
- Evaluate Managerial implications of organization

UNIT - V **Organizational Change and Development**

Introduction – Nature, Meaning, scope, definition and functions - Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization's change and development

LEARNING OUTCOMES: - After completion of this unit student will

- Understand the importance of organizational change and development
- Apply change management in the organization
- Analyze work stress management
- Evaluate Managerial implications of organization

Textbooks:

1. Luthans, Fred, Organisational Behaviour, McGraw-Hill, 12 Th edition 2011 2. P Subba Rao, Organisational Behaviour, Himalya Publishing House 2017

Reference Books:

- McShane, Organizational Behaviour, TMH 2009
- Nelson, Organisational Behaviour, Thomson, 2009.
- Robbins, P.Stephen, Timothy A. Judge, Organisational Behaviour, Pearson 2009.
- Aswathappa, Organisational Behaviour, Himalaya, 2009

Open Elective Course - III

Course Code	**INDUSTRIAL POLLUTION CONTROL**	**L**	**T**	**P**	**C**
20A70804	**ENGINEERING**	**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Common to All Branches

Course Objectives:

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Understand the different types of wastes generated in an industry, their effects on living and non-living things & environmental regulatory legislations and standards and climate changes.
CO2	Quantify, analyse and treat wastewater
CO3	Apply the different unit operations and unit processes involved in conversion of highly polluted water to potable standards
CO4	Apply the operating principles, design calculations of particulate control devices.
CO5	Estimate the different waste generated from the industries

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Types of emissions from chemical industries and effects of environment, environment legislation, Type of pollution, sources of wastewater, Effluent guidelines and standards. Characterization of effluent streams, oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

UNIT - II

General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry. Air pollution sampling and measurement: Types of pollutant and sampling and measurement,ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants. Stack sampling: sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and ozones, hydrocarbons, particulate matter

UNIT - III

Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipments particulate emission control: collection efficiency, control equipment like gravitational settling chambers, Cyclone separators, fabric filters, ESP and their constructional details and design aspects. Scrubbers: wet scrubbers, spray towers, centrifugal scrubbers, packed beds and plate columns, venturi scrubbers, their design aspects. Control of gaseous emissions: absorption by liquids, absorption equipments, adsorption by solids, equipment and the design aspects

UNIT - IV

Introduction to waste water treatment, biological treatment of wastewater, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds, attached growth processes, trickling filters, rotary drum filters, anaerobic processes.

UNIT - V

Methods of primary treatments: screening, sedimentation, flotation, neutralization, and methods of tertiary treatment. A brief study of carbon absorption, ion exchange, reverse osmosis, ultra-filtration, chlorination, ozonation, treatment and disposal. Hazardous waste management: nuclear wastes: health and environment effects, sources and disposal methods. Chemical wastes: health and environmental effects, treatment and disposal: treatment and disposal by industry, off site treatment and disposal, treatment practices in various countries. Biomedical wastes: types of wastes and their control.

Textbooks:

1. Environmental Pollution and Control Engineering, C. S. Rao – Wiley Eastern Limited, India, New Delhi, 1993.
2. Pollution Control in Process Industries, S.P. Mahajan, Tata McGraw-Hill, New Delhi, 1985.

Reference Books:

1. Wastewater Treatment, M. Narayana Rao and A.K.Datta, Oxford and IHB publ. New Delhi.

Online Learning Resources:

Open Elective - IV

Course Code	**SOLID WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
2070805		**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Common to All Branches

Course Objectives:

- Material flow in society and generation of solid waste source
- Clarification of solid waste on characterization of the same
- Understand the sense of onsite handling storage and collection systems including transportation
- Understand processing technologies with mechanical volume reduction and thermal volume reduction corporate land filling, deep well injections.
- Learn to estimate material recovery energy recovery from a given waste data using case standing

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Identify sources and relationship between various functional elements of solid waste management and methods of storage and collection and transport of solid wastes.
CO2	Know the importance of transfer station and suggest suitable methods of solid waste disposal based on the composition of solid waste.
CO3	Suggest suitable methods for the management of plastic and E-wastes
CO4	Identify hazardous wastes and suggest suitable management techniques for radioactive wastes and Bio-medical wastes.
CO5	Adopt the suitable management method for a given industry

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Introduction: Definition, characteristics and perspectives of solid waste. Types of solid waste. Physical and chemical characteristics. Variation of composition and characteristics. Municipal, industrial, special and hazardous wastes.

General aspects Overview of material flow in society. Reduction in raw material usage. Reduction in solid waste generation. Reuse and material recovery. General effects on health and

environment. Legislations.

UNIT - II

Engineered systems: Typical generation rates. Estimation and factors effecting generation rates. On site handling. Storage and processing. Collection systems and devices. Transfer and transport.

UNIT - III

Processing Techniques: Mechanical volume reduction. Thermal volume reduction. Component separation. Land filling and land forming. Deep well injection.

UNIT - IV

Material recovery: Mechanical size alteration. Electromagnetic separation. Drying and dewatering. Other material recovery systems. Recovery of biological conversion products. Recovery of thermal conversion products.

Energy recovery: Energy recovery systems and efficiency factors. Determination of output and efficiency. Details of energy recovery systems. Combustion incineration and heat recovery. Gasification and pyrolysis. Refuse derived fuels (RDF).

UNIT - V

Case studies: Major industries and management methods used in typical industries – Coal fired power stations, textile industry, oil refinery, distillery, sugar industry, and radioactive waste generation units.

Textbooks:

1. Howard S. Peavy, Environmental Engineering, McGraw Hill International Edition, 1986.
2. Dutta, Industrial Solid Water Management and Land Filling Practice, Narose Publishing House, 1999.

Reference Books:

1. Sastry C.A., Waste Treatment Plants, Narose Publishing House, 1995.
2. Lagrega, Hazardous Waste Management, McGraw Hill, 1994.

Online Learning Resources:

Skill Oriented Course - V

Course Code	**APPLICATIONS OF AI & ML IN CHEMICAL**	**L**	**T**	**P**	**C**
20A70806	**ENGINEERING**	**3**	**0**	**0**	**3**
Pre-requisite	**SemesterVII**				

Course Objectives:

-

Course Outcomes (CO):
At the end of the course, the student will be able to:

CO1	Able to understand Artificial Intelligence (AI) principles to Chemical Engineering
CO2	Able to understand Machine Learning (ML) principles to Chemical Engineering
CO3	Able to understand the principle of Game Theory
CO4	Ablet to use Probability and Bays' Theorem to real problems
CO5	Able to use search techniques

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Introduction to Artificial Intelligence and Problem-Solving Agent: Problems of AI, AI technique, Tic – Tac – Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, and issues in the design of search programs.

UNIT - II

Search Techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best -first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

UNIT - III

Constraint Satisfaction Problems and Game Theory: Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening

UNIT - IV

Knowledge & Reasoning: Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. AI for knowledge representation, rule-based knowledge representation, procedural and declarative knowledge, Logic programming, Forward and backward reasoning

UNIT - V

Introduction to Machine Learning: Exploring sub-discipline of AI: Machine Learning, Supervised learning, Unsupervised learning, Reinforcement learning, Classification problems, Regression problems, Clustering problems, Introduction to neural networks and deep learning

Textbooks:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2015.
2. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", 1st Edition, Morgan-Kaufmann, 1998.

Reference Books:

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, "Artificial Intelligence", McGraw Hill, 3rd ed.,2017.
2. Patterson, "Introduction to Artificial Intelligence & Expert Systems", Pearson, 1st ed. 2015.
3. Saroj Kaushik, "Logic &Prolog Programming", New Age International, Ist edition, 2002.
4. Joseph C. Giarratano,Gary D. Riley, "Expert Systems: Principles and Programming", 4th Edition, 2007.

Online Learning Resources:

Course Code **EVALUATION OF INDUSTRY INTERNSHIP** **L T P C**
20A70807

SemesterVII

Course Objectives:

Course Outcomes (CO):

List of Experiments:

References:

Online Learning Resources/Virtual Labs:

Course Code	**FULL INTERNSHIP & PROJECT WORK**	**L**	**T**	**P**	**C**
20A80101					

SemesterVIII

Course Objectives:

Course Outcomes (CO):

List of Experiments:

References:

Online Learning Resources/Virtual Labs:

Course Code **TITLE OF THE COURSE** **L T P C**

Semester

Course Objectives:

Course Outcomes (CO):

List of Experiments:

References:

Online Learning Resources/Virtual Labs:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – I Civil

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	Experimental Stress Analysis	L	T	P	C
20A50105		3	0	0	3
	Semester	V			

Course Objectives:

1. To understand different methods of experimental stress analysis
2. To understand the use of strain gauges for measurement of strain
3. To be exposed to different Non destructive methods of concrete
4. To understand the theory of photo elasticity and its applications in analysis of structures
5. To understand different methods of photo elasticity

Course Outcomes (CO):

1. Understand different methods of experimental stress analysis
2. Understand the use of strain gauges for measurement of strain
3. Expose to different Non destructive methods of concrete
4. Understand the theory of photo elasticity and its applications in analysis of structures
5. Understand different methods of photo elasticity

UNIT - I

PRINCIPLES OF EXPERIMENTAL APPROACH:Merits of Experimental Analysis Introduction, uses of experimental stress analysisAdvantages of experimental stress analysis, Different methods –Simplification of problems.

UNIT - II

STRAIN MEASUREMENT USING STRAIN GAUGES :Definition of strain and its relation of experimental Determinations Properties of Strain-

Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical strain gauges - Inductance strain gauges – LVDT – Resistance strain gauges – Various types –Gauge factor – Materials of adhesion base.

UNIT - III

STRAIN ROSSETTES AND NON – DESTRUCTIVE TESTING OF CONCRETE: Introduction – The three elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge.

Ultrasonic Pulse Velocity method –Application to Concrete. Hammer Test – Application to Concrete.

UNIT - IV

THEORY OF PHOTOELASTICITY: Introduction –Temporary Double refraction – The stress Optic Law –Effects of stressed model in a polar scope for various arrangements – Fringe Sharpening. Brewster's Stress Optic law.

UNIT - V

TWO DIMENSIONAL PHOTOELASTICITY:Introduction – Isochramic Fringe patterns-Isoclinic Fringe patterns passage of light through plane Polariscope and Circular polariscope Isoclinic Fringe patterns – Compensation techniques – Calibration methods – Separation methods – Scaling Model to prototype Stresses – Materials for photo – Elasticity Properties of Photoelastic Materials.

Textbooks:

1. Experimental stress analysis by J.W.Dally and W.F.Riley, College House Enterprises2005
2. Experimental stress analysis by Dr.SadhuSingh.khanna Publishers 4th edition

Reference Books:

1. Experimental Stress analysis by U.C.Jindal, Pearson Pubilications 2012 edition
2. Experimental Stress Analysis by L.S.Srinath, MC.Graw Hill Company Publishers.

Online Learning Resources:

Open Elective Course – I EEE

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	ELECTRIC VEHICLE ENGINEERING (OE-I) EEE		L	T	P	C
20A50205			3	0	0	3
Pre-requisite	AC & DC Machines	**Semester**	**V**			

Course Objectives: The student will be able to:

- Understand latest trends in Electric Vehicles; parameters used in EV and types of EVs.
- Analyze various energy sources available to run EV like batteries, fuels cells etc.
- Analyze the dynamics and the propulsion system used in EVs, working of fuel cells, battery charging concept.
- Design a electromechanical system using various control techniques.

Course Outcomes (CO): At the end of the course, the student will be able to:

CO1: Understand the difference between conventional and latest trends in Electric Vehicles; understand the various parameters used in EV, types of HEVs.

CO2: Analyze various energy sources available to run EV like batteries, fuels cells etc.

CO3: Analyze the propulsion system of EV, its dynamics and the concept of battery charging.

CO4: Design EV system with battery charger using various fundamental concepts.

UNIT - I	**INTRODUCTION TO EV SYSTEMS AND PARAMETERS**	**Lecture Hrs: 10**

Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters.

UNIT - II	**EV AND ENERGY SOURCES**	**Lecture Hrs: 08**

Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems

UNIT - III	**EV PROPULSION AND DYNAMICS**	**Lecture Hrs: 10**

Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors, vehicle acceleration.

UNIT - IV	FUEL CELLS	Lecture Hrs: 10
Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle. Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples		
UNIT - V	**BATTERY CHARGING AND VEHICLE CONTROL**	**Lecture Hrs: 10**
Battery charging: Battery Chemistry, Basic requirements, charger architecture, charger functions, wireless charging, power factor correction. **Battery Management System:** Introduction and BMS functionality, Battery pack topology, Voltage, Temperature and Current Sensing. **Control:** Introduction, modelling of electro mechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation, acceleration of battery electric vehicle		
Textbooks:C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001. 1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.		
Reference Books:		
1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2005. 2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015. 3. Tom Denton, "Electric and Hybrid Vehicles", TAYLOR & FRANCIS; 2nd edition, CBS PUBLISHERS, 2nd Edition, 2020. 4. MehrdadEhsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010. 5. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.		
Online Learning Resources:		
1. https://onlinecourses.nptel.ac.in/noc22_ee53/preview		

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – I Mechanical

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Subject Code	Title of the Subject	L	T	P	C
2050305	**OPTIMIZATION TECHNIQUES**	3	0	0	3

Course Objectives:

To introduce various optimization techniques i.e classical, linear programming,

Transportation problem, simplex algorithm, dynamic programming Constrained and unconstrained optimization techniques for solving and optimizing.

Electrical and electronic engineering circuits design problems in real world situations.

To explain the concept of Dynamic programming and its applications to project

Learn the knowledge to formulate optimization problems

UNIT - I

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints– method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT - II

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT - III

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems

UNIT – IV

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam and general optimization model of a machining process.

Course Outcomes:

After completion of this course, the student will be able to explain the need of optimization of engineering systems

understand optimization of electrical and electronics engineering problems

apply classical optimization techniques, linear programming, simplex algorithm,

• transportation problem apply unconstrained optimization and constrained non-linear programming anddynamic programming Formulate optimization problems.

TEXT BOOKS:

Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers

Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers

Engineering Optimization – S.S.Rao, New Age Publishers

REFERENCES:

1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers

Genetic Programming- Koza

Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – I ECE

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	BASICS OF ELECTRONICS AND	L	T	P	C
20A50405	COMMUNICATION ENGINEERING	3	0	0	3
	Semester	V			

Pre-requisite
Applied Physics

Course Objectives:

- To study the basic principle, construction and operation of semiconductor devices.
- To learn the real time applications of semiconductor devices.
- To introduce binary number systems, logic gates and digital logic circuits.
- To get an idea about the basic principles of communication systems and their applications.
- To learn the measurement of physical parameters using Sensors and Transducers.

Course Outcomes (CO): At the end of this course, the students will be able to

- Understand the basic principle, construction and operation of semiconductor devices.
- Learn the real time applications of semiconductor devices.
- Comprehend the binary number systems, logic gates and digital logic circuits.
- Understand the basic principles of communication systems and their applications.
- Measure the physical parameters using Sensors and Transducers.

UNIT - I

Introduction to Electronics Engineering: Overview, scope and objective of studying Electronics Engineering. Introduction to semiconductor devices: Bond structure of semiconductors, intrinsic and extrinsic semiconductors; Basic principle and operation of semiconductor devices – diode, bipolar junction transistor, field effect transistors; Introduction to VLSI.

UNIT - II

Applications of semiconductor devices: Basic concepts of rectifiers, voltage regulators, amplifiers and oscillators; Basic concepts of operational amplifier and their applications.

UNIT - III

Introduction to digital systems: Binary number system, Boolean algebra, Logic gates, adders, one-bit memory, flip-flops (SR, JK), shift registers, Asynchronous counter.

UNIT - IV

Introduction to Communication Systems: Elements of a communication system – transmitter and receiver; Signal types in communication; FDM and TDM; Processing of signals for transmission – basic concepts of amplitude and frequency modulation; Examples of telecommunication systems – telephone, radio, television, mobile communication and satellite communication.

UNIT - V

Sensors and Transducers - Active and passive transducers: Measurement of displacement (Resistance, capacitance, inductance; LVDT) Force (strain gauges) Pressure (piezoelectric transducers) Temperature (resistance thermometers, thermocouples and thermistors), Velocity, Acceleration, Vibration, pH measurement Signal Conditioning Circuits.

Textbooks:

1. Millman J, Halkias C.C and Jit S, “Electronic Devices and Circuits”, Tata McGraw-Hill, 2nd 2007 Edition.
2. Mano M.M., “Digital Design”, Prentice-Hall, 3rd Edition. 2002
3. A.K. Sawhney, “A course in Electrical and Electronics Measurements and Instrumentation”, DhanpatRai& Co. 3rd edition Delhi, 2010.
4. Kennedy G. and Davis B., “Electronic Communication Systems”, Tata McGraw-Hill, 4th 2008 Edition.

Reference Books:

1. Tomasi W., “Advanced Electronic Communication Systems”, Pearson/Prentice-Hall, 6th 2004 Edition.
2. Boylstead R.L. and Nashelsky L., “Electronic Devices and Circuit Theory”, Pearson, 10th 2009 Edition.

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – I CSE

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

INTRODUCTION TO JAVA PROGRAMMING

Course Code:20A50505 Semester V(R20) L T P C : 3 0 0 3

Course Objectives:

- To understand object-oriented concepts and problem-solving techniques
- To obtain knowledge about the principles of inheritance and polymorphism
- To implement the concept of packages, interfaces, exception handling and concurrency mechanism.
- To design the GUIs using applets and swing controls.
- To understand the Java Database Connectivity Architecture

Course Outcomes:

CO1: Solve real-world problems using OOP techniques.
CO2: Apply code reusability through inheritance, packages and interfaces

CO3: Solve problems using java collection framework and I/O classes.
CO4: Develop applications by using parallel streams for better performance and develop applets for web applications.
CO5: Build GUIs and handle events generated by user interactions and Use the JDBC API to access the database.

UNIT – I: **Introduction**

Introduction to Object Oriented Programming, The History and Evolution of Java, Introduction to Classes, Objects, Methods, Constructors, this keyword, Garbage Collection, Data Types, Variables, Type Conversion and Casting, Arrays, Operators, Control Statements, Method Overloading, Constructor Overloading, Parameter Passing, Recursion, String Class and String handling methods.

UNIT – II: **Inheritance, Packages, Interfaces**

Inheritance: Basics, Using Super, Creating Multilevel hierarchy, Method overriding, Dynamic Method Dispatch, Using Abstract classes, Using final with inheritance, Object class,
Packages: Basics, Finding packages and CLASSPATH, Access Protection, Importing packages.
Interfaces: Definition, Implementing Interfaces, Extending Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.

UNIT – III: **Exception handling, Stream based I/O**

Exception handling - Fundamentals, Exception types, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built-in exceptions, creating own exception subclasses.

Stream based I/O (java.io) – The Stream classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and Writing Files, Random access file operations, The Console class, Serialization, Enumerations, Autoboxing, Generics.

UNIT – IV: **Multithreading, The Collections Framework**

Multithreading: The Java thread model, Creating threads, Thread priorities, Synchronizing threads, Interthread communication.

The Collections Framework (java.util): Collections overview, Collection Interfaces, The Collectionclasses- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Hashtable, Properties, Stack, Vector, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner.

UNIT – V: **Applet, GUI Programming with Swings, Accessing Databases with JDBC**

Applet: Basics, Architecture, Applet Skeleton, requesting repainting, using the status window, passing parameters to applets

GUI Programming with Swings – The origin and design philosophy of swing, components and containers, layout managers, event handling, using a push button, jtextfield, jlabel and image icon, the swing buttons, jtext field, jscrollpane, jlist, jcombobox, trees, jtable, An overview of jmenubar, jmenu and jmenuitem, creating a main menu, show message dialog, show confirmdialog, show input dialog, show option dialog, jdialog, create a modeless dialog.

Accessing Databases with JDBC:

Types of Drivers, JDBC Architecture, JDBC classes and Interfaces, Basic steps in developing JDBC applications, Creating a new database and table with JDBC.

Textbooks:

1. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2. Java How to Program, 10th Edition, Paul Dietel, Harvey Dietel, Pearson Education.

Reference Books:

1. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
2. Core Java Volume – 1 Fundamentals, Cay S. Horstmann, Pearson Education.
3. Java Programming for core and advanced learners, Sagayaraj, Dennis, KarthikandGajalakshmi, University Press
4. Introduction to Java programming, Y. Daniel Liang, Pearson Education

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – I Chemical

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code		L	T	P	C
20A50805	ENERGY CONVERSION AND STORAGE DEVICES	3	0	0	3

Pre-requisite

Course Objectives:

4. Understand the fundamentals of fossil energy sources, solar, biomass and electrochemical energy etc
5. Understand the basics of photosynthetic, photocatalytic and photoelectrochemical systems and devices for the efficient energy and fuels production.
6. Learn the principles and operations of electrochemical energy storage devices,

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1 Understand the need of energyconversion and the various methods of energy storage

CO2 Identify Winds energy as alternateform of energy and to know how itcan be tapped

CO3 Understand the nuclear and bio energy, its mechanism of production and its applications

CO4 Analyse chemical, electrochemical energy storage devices and interpret the conversion efficiencies

CO5 Explain bio gas generation and itsimpact on environment

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Outline of the course. Introduction and scope of energy conversion. World Energy Production and Balance. Motivations for studying future energy systems (e.g. pollution, climate change, energy security).

UNIT - II

Fossil Energy: Overview of fossil fuel resources and energy contents. Cycle analysis (Rankine, Brayton, combined cycles, cogeneration)

Nuclear Energy: nuclear reaction and energy conversion physics (fission and fusion), nuclear power systems

UNIT - III

Solar-thermal energy: solar thermal radiation physics, Active and passive solar-thermal energy collection and conversion systems

Photoelectric energy: Photoelectric physics. Solar photovoltaic cell materials and technology

Wind Energy: Wind interaction with objects fluid dynamics. Wind harvesting devices and systems

UNIT - IV

Biomass and Waste to Energy: Potential and resources of biomass and waste energy. Thermal-chemical and bio-chemical conversion methods

Overview of Climate Control, CO_2 Sequestration and Energy Sustainability

UNIT - V

Basic of Electrochemical energy conversion and storage, Fundamentals of Fuel Cells, Basics of Fusion power, Energy Storage Technologies, Mechanical storage, Chemical storage, Electrical storage

Textbooks:

Energy Systems Engineering, F.M. Vanek, L.D Albright, and LargusAngenent, Second Edition, McGraw-Hill, Inc., 2012,

Reference Books:

- AngèleReinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Photovoltaic Solar Energy:From Fundamentals to Applications, JOHN WILEY.
- Alexander P. Kirk, Solar Photovoltaic Cells: Photons to Electricity, ELSEVIER
- Francesco Dalena, Angelo Basile, Claudio Rossi, Bioenergy Systems For The Future: Prospects ForBiofuels And Biohydrogen, 1st Edition, ELSEVIER
- Jean-Marie Tarascon, Patrice Simon, ELECTROCHEMICAL ENERGY STORAGE,
- Electrochemistry by Carl H. Hamann, Andrew Hamnett and Wolf Vielstich, Wiley VCH, 1998.
- Modern Electrochemistry 1. Volume 1 and 2, by J. O'M. Bockris and A. K. N. Reddy, Kluwer Academic,2000.
- Electrochemical Methods, by A. J. Bard and L. R. Faulkner, John Willey, 1980
- John Love and John A. Bryant, Biofuels and Bioenergy, John Wiley
- Anju Dahiya, Bioenergy: Biomass to Biofuels, Elsevier

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – I Mathematics

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	Optimization Methods		L	T	P	C
20A55101	B.Tech III Year (Common for all) Open elective course -1		0	3	0	3
Pre-requisite	--	Semester	I			

Course Objectives:

This course enables the students to classify and formulate real-life problem for modeling as optimization problem, solving and applying for decision making.

Course Outcomes (CO): Student will be able to

- formulate a linear programming problem and solve it by various methods.
- give an optimal solution in assignment jobs, give transportation of items from sources to destinations.
- identify strategies in a game for optimal profit.
- implement project planning.

UNIT - I	8 Hrs

Introduction to operational research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method.

UNIT - II	8 Hrs

Transportation problems- assignment problems-Game theory.

UNIT - III	9 Hrs

CPM and PERT –Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations.

UNIT - IV	8 Hrs

Sequencing Problems-Replacement problems-Capital equipment- Discounting costs-Group replacement .

UNIT - V	9 Hrs

Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models- Single period inventory models with shortage cost.

Textbooks:

1. Operations Research , S.D. Sharma. **2.** Operations Research, An Introduction, Hamdy A. Taha, Pearson publishers. **3.** Operations Research, Nita H Shah, Ravi M Gor, HardikSoni, PHI publishers
Reference Books:
1. Problems on Operations Research, Er. Premkumargupta, Dr.D.S. Hira, Chand publishers 2. Operations Research, CB Gupta, PK Dwivedi, Sunil kumaryadav
Online Learning Resources:
https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L2slides.pdf https://slideplayer.com/slide/7790901/ https://www.ime.unicamp.br/~andreani/MS515/capitulo12.pdf

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Subject Code	Title of the Subject	L	T	P	C
20A55201	**MATERIALS CHARACTERIZATION TECHNIQUES**	3		-	3

COURSE OBJECTIVES	
1	To provide an exposure to different characterization techniques.
2	To explain the basic principles and analysis of different spectroscopic techniques.
3	To elucidate the basic principle of Scanning electron microscope along with its limitations and applications.
4	To identify the Resolving power and Magnification of Transmission electron microscope and its applications.
5	To educate the uses of advanced electric and magnetic instruments for characterization.
COURSE OUTCOMES	
At the end of the course the student will be able	
CO1	To explain the structural analysis by X-ray diffraction.
CO2	To understand the morphology of different materials using SEM and TEM.
CO3	To recognize basic principles of various spectroscopic techniques.
CO4	To apprehend the electric and magnetic properties of the materials.
CO5	To make out which technique has to be used to analyse a material

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

Credit: 3 **Hours of teaching: - 45 H**

UNIT-I **9H**

Structure analysis by Powder X-Ray Diffraction: Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of

polycrystalline Aggregates, Determination of crystal structure,Crystallite size by Scherrer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

UNIT-II **9H**

Microscopy technique -1 –Scanning Electron Microscopy (SEM)

Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (SecondaryElectron and Backscatter Electron), Advantages, limitations and applications of SEM.

UNIT-III **9H**

Microscopy Technique -2 - Transmission Electron Microscopy (TEM): Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy,Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy.

UNIT-IV **9H**

Spectroscopy techniques – Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy(ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

UNIT-V **9H**

Electrical & Magnetic Characterization techniques: Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method,Vibrating sample Magnetometer (VSM) and SQUID.

TEXT BOOKS:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods –Yang

Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008

2. Hand book of Materials Characterization -by **Sharma** S. K. - S**pringer**

REFERENCES:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville BanwellandElaine M.

McCash, Tata McGraw-Hill, 2008.

2. Elements of X-ray diffraction – Bernard Dennis Cullity& Stuart R Stocks, PrenticeHall, 2001 – Science

3. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods-Yang Leng- John Wiley & Sons

4. Characterization of Materials 2nd Edition, 3 Volumes-Kaufmann E N -John Wiley(Bp)

5. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan,John Wiley & Sons Ltd., 2008.

NPTEL courses

https://nptel.ac.in/courses/115/103/115103030/

https://nptel.ac.in/content/syllabus_pdf/113106034.pdf

https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/

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Open Elective Course – I H & SS

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES

Course Code	E-Business	L	T	P	C
20A55401		3	0	0	3
Pre-requisite					

Course Objectives:

1.	To provide knowledge on emerging concept on E-Business related aspect.
2.	To understand various electronic markets models which are trending in India
3.	To give detailed information about electronic payment systems net banking.
4.	To exact awareness on internet advertising, market research strategies and supply chain management.
5.	To understand about various internet protocols-security related concept.

Course Outcomes (CO):

1	They will be able to identify the priority of E-Commerce in the present globalised world.
2	Will be able to understand E-market-Models which are practicing by the organization
3.	Will be able to recognize various E-payment systems & importance of net banking.
4.	By knowing E-advertisement, market research strategies, they can identify the importance of customer role.
5.	By understanding about E-security, they can ensure better access control to secure the information
6	Develop a personal synthesis and approach towards E-Business

UNIT – I **Electronic Business**

Definition of Electronic Business - Functions of Electronic Commerce (EC) - Advantages of E-Commerce – E-Commerce and E-Business Internet Services Online Shopping-Commerce Opportunities for Industries.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand the concept of E-Business
- Contrast and compare E-Commerce E-Business
- Analyze Advantages of E-Commerce
- Evaluate opportunities of E-commerce for industry

UNIT - II **Electronic Markets and Business Models**

E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals - Advantages of Portals - Business Models-Business to Business(B2B)-Business to Customers(B2C)-Business to Government(B2G)-Auctions-B2B Portals in India

LEARNING OUTCOMES:- After completion of this unit student will

- Understand the concept of business models
- Contrast and compare Vertical portal and Horizontal portals
- Analyze Advantages of portals

- Explain the B2B,B2C and B2G model

UNIT - III **III Electronic Payment Systems**

Digital Payment Requirements-Designing E-payment System- Electronic Fund Transfer (EFT)-Electronic Data Interchange (EDT)-Credit Cards-Debit Cards-E-Cash-Electronic Cheques -Smart Cards-Net Banking-Digital Signature.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand the Electronic payment system
- Contrast and compare EFT and EDT
- Analyze debit card and credit card
- Explain the on Digital signature

UNIT - IV **E-Security**

Internet Protocols - Security on the Internet –Network and Website Security – Firewalls – Encryption – Access Control – Secure Electronic transactions.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand E-Security
- Contrast and compare security and network
- Analyze Encryption
- Evaluate electronic transitions

UNIT - V **E-Marketing**

Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Online Market Research– Data mining and Marketing Research Marketing Strategy On the Web – E-Customer Relationship Management(e-CRM) –E- Supply Chain Management.(e-SCM) –New Trends in Supply Chain Management.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand the concept of online marketing
- Analyze advantages of online marketing
- Compare the e-CRM and e-SCM
- Explain the New trends in supply chain management

Textbooks:

1. **E-Commerce by C.S.V Murthy** Himalaya publication house, 2002.
2. **E-Commerce by** P.T.S Joseph, Fourth Edition, Prentice Hall of India 2011

Reference Books:

1. **E-Commerce: by** KamaleshKBajaj,DebjaniNa, Second Edition TataMcGrwHills 2005
2. **E-Commerce E-Management: by Dave Chaffey** – Second Edition, Pearson, 2012.
3. **E-Commerce Fundamentals and Application; by** Henry Chan, Raymond Lee,Tharm Wiley India 2007
4. **E-Commerce: by** S. Jaiswall Galgotia Publication Pvt Ltd 2003.

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – I

III B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF CHEMISTRY

Subject Code	Title of the Subject	L	T	P	C
20A55301	**CHEMISTRY OF ENERGY MATERIALS**	2	1	-	3

COURSE OBJECTIVES	
1	To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.

2	To understand the basic concepts of processing and limitations of fossil fuels and Fuel cells & their applications.
3	To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method
4	Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
5	To understand and apply the basics of calculations related to material and energy flow in the processes.

COURSE OUTCOMES	
CO1	Solve the problems based on electrode potential,Describe the Galvanic Cell Differentiate between Lead acid and Lithium ion batteries, Illustrate the electrical double layer
CO2	Describe the working Principle of Fuel cell,Explain the efficiency of the fuel cell Discuss about the Basic design of fuel cells,Classify the fuel cell
CO3	Differentiate Chemical and Physical methods of hydrogen storage,Discuss the metal organic frame work, Illustrate the carbon and metal oxide porous structures Describe the liquification methods
CO4	Apply the photo voltaic technology,Demonstrate about solar energy and prospects Illustrate the Solar cells,Discuss about concentrated solar power
CO5	Differentiate between Photo and Photo electrochemical Conversions,Illustrate the photochemical cells, Identify the applications of photochemical reactions, Interpret advantages of photoelectron catalytic conversion

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

UNIT-1: Electrochemical Systems: Galvanic cell, standard electrode potential, application of EMF, electrical double layer, dipole moments, polarization, Batteries-Lead-acid and Lithium ion batterie**s.-**

UNIT-2: Fuel Cells: Fuel cell working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency, Basic design of fuel cell,

UNIT-3: Photo and Photo electrochemical Conversions: Photochemical cells and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions.

UNIT-4: Solar Energy: Solar energy introduction and prospects, photo voltaic (PV) technology, concentrated solar power (CSP), Solar Fuels, Solar cells .

UNIT-5: Hydrogen Storage: Hydrogen Storage, Chemical and Physical methods of hydrogen storage, Hydrogen Storage in metal hydrides, metal organic frame works (MOF), Carbon structures, metal oxide porous structures, hydrogel storage by high pressure methods. Liquifaction method.

References :

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins
4. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services and corporation)
5. Hand book of solar energy and applications by Arvind Tiwari and Shyam.
6. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
7. Hydrogen storage by Levine Klebonoff

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II Civil

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	Disaster Management	L	T	P	C
20A60105		3	0	0	3

Course Objectives:

1. To give knowledge types of disasters and stages in disaster rehabilitation process.
2. To make awareness on change in climates and their impacts on occurrence of environmental disasters.

3. To impart knowledge on Consideration of wind and water effects as per codal provisions to withstand disasters.
4. To familiarize the student with the Causes of earthquake and their effects and remedial methods to be adopted for buildings.
5. To illustrate the methodology in Planning and design considerations of various structures constructing in disaster prone areas.

Course Outcomes (CO):

1. About various types of disasters and stages in disaster rehabilitation process.
2. Impact of change in climates and their impacts on occurrence of environmental disasters.
3. Adopting suitable codal provisions to study the effect of wind and water effects on various structures constructed at disaster prone areas.
4. Causes of earthquake and their effects and remedial methods to be adopted for buildings.
5. Adopt suitable Planning and design considerations of various structures constructing in disaster prone areas.

UNIT - I

Brief introduction to different types of natural disaster, Occurrence of disaster in different climatic and geographical regions, hazard (earthquake and cyclone) map of the world and India, Regulations for disaster risk reduction, Post disaster recovery and rehabilitation (socioeconomic consequences)

UNIT - II

Climate change and its impact on tropical cyclone, Nature of cyclonic wind, velocities and pressure, Cyclone effects, Storm surge, Floods, Landslides. Behavior of structures in past cyclones and wind storms, case studies. Cyclonic retrofitting, strengthening of structures and adaptive sustainable reconstruction. Life–line structures such as temporary cyclone shelter.

UNIT - III

Basic wind engineering, aerodynamics of bluff bodies, vortex shedding and associated unsteadiness along and across wind forces. Lab: Wind tunnel testing, its salient features. Introduction to Computational fluid dynamics. General planning/design considerations under wind storms & cyclones; Wind effects on buildings, towers, glass panels etc, & wind resistant features in design. Codal Provisions, design wind speed, pressure coefficients; Coastal zoning regulation for construction & reconstruction phase in the coastal areas, innovative construction material & techniques, traditional construction techniques in coastal areas.

UNIT - IV

Causes of earthquake, plate tectonics, faults, seismic waves; magnitude, intensity, epicenter, energy release and ground motions. Earthquake effects – On ground, soil rupture, liquefaction, landslides. Performance of ground and building in past earthquakes: Behavior of various types of buildings, structures, and collapse patterns; Behavior of Non-structural elements like services, fixtures, mountings- case studies. Seismic retrofitting- Weakness in existing buildings, aging, concepts in repair, restoration and seismic strengthening.

UNIT - V

General Planning and design consideration; Building forms, horizontal and vertical eccentricities, mass and stiffness distribution, soft storey etc.; Seismic effects related to building configuration. Plan and vertical irregularities, redundancy and setbacks. Various

Types and Construction details of: Foundations, soil stabilization, retaining walls, plinth fill, flooring, walls, openings, roofs, terraces, parapets, boundary walls, under-ground – overhead tanks, staircases and isolation of structures; innovative construction material and techniques; Local practices: traditional regional responses; Computational investigation techniques.

Textbooks:

1. Disaster Management by Rajib Shah, Universities Press, India, 2003
2. Disaster Management by R.B. Singh (Ed) Rawat Publication, New Delhi, 2000

Reference Books:

1. Natural disasters. By Abbott, L. P. (2013) 9th Ed. McGraw-Hill.
2. Earthquake Resistant Design of Structures. By Agarwal, P. and Shrikhande, M. (2009). New Delhi : PHI Learning.
3. Mapping Vulnerability: Disasters, Development and People. byBankoff, G., Frerks, G. and Hilhorst, D. (2004). London :Earthscan.
4. Improving Earthquakes and Cyclone Resistance of Structures:Guidelines for the Indian Subcontinent. TERI
5. Disaster Mitigation, preparedness, recovery and Response. By Sinha, P. C. (2006). New Delhi : SBS Publishers.
6. World Bank. (2009). Handbook for Reconstructingafter Natural Disasters.

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II EEE

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	**RENEWABLE ENERGY SYSTEMS**		**L**	**T**	**P**	**C**
20A60205	**(OE-II)**		**3**	**0**	**0**	**3**
Pre-requisite		**Semester**	**VI**			
Course Objectives: To make the students learn about:						
• Various sources of Energy and the need of Renewable Energy Systems. • The concepts of Solar Radiation, Wind energy and its applications.						

- Operation of Solar thermal and solar PV systems
- The concept of geo thermal energy and its applications, biomass energy, the concept of Ocean energy and fuel cells.

Course Outcomes (CO): At the end of the course the student will be able to:

CO 1 Understand various alternate sources of energy for different suitable application requirements.
CO 2 Analyze the concepts of solar energy generation strategies and wind energy system
CO 3 Design Solar and Wind energy systems.
CO 4 Apply the concepts of Geo Thermal Energy, Ocean Energy, Bio mass and Fuel Cells for generation of power.

UNIT - I	**SOLAR ENERGY**	Lecture Hrs: 10

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

UNIT - II	**PV ENERGY SYSTEMS**	Lecture Hrs: 10

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems.

UNIT - III	**WIND ENERGY**	Lecture Hrs: 10

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

UNIT - IV	**GEOTHERMAL ENERGY**	Lecture Hrs: 8

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

UNIT - V	**MISCELLANEOUS ENERGY TECHNOLOGIES**	Lecture Hrs: 10

Ocean Energy: Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations.
Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration
Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.

Text books:

1. Stephen Peake, "Renewable Energy Power for a Sustainable Future", Oxford International Edition, 2018.
2. G. D. Rai, "Non-Conventional Energy Sources", 4th Edition, Khanna Publishers, 2000.

Reference Books:

1. S. P. Sukhatme, "Solar Energy",3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
2. B H Khan , " Non-Conventional Energy Resources", 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.

3. S. Hasan Saeed and D.K.Sharma,"Non-Conventional Energy Resources",3rd Edition, S.K.Kataria& Sons, 2012.
4. G. N. Tiwari and M.K.Ghosal, "Renewable Energy Resource: Basic Principles and Applications", Narosa Publishing House, 2004.

Online Learning Resources:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/108108078

https://www.slideshare.net/fatimahAlkreem/e-businessppt-67935771
https://www.slideshare.net/VikramNani/e-commerce-business-models
https://www.slideshare.net/RiteshGoyal/electronic-payment-system
https://www.slideshare.net/WelingkarDLP/electronic-security
https://www.slideshare.net/Ankitha2404/emarketing-ppt

JNTUA College of Engineering (Autonomous), Ananthapuramu
Open Elective Course – II Mechanical
III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Subject Code	Title of the Subject	L	T	P	C
20A60305	**SOLAR ENERGY SYSTEMS**	3	0	0	3

Course objectives

Learning the fundamental principles of solar radiation and geographic distribution of solar radiation.

Study of various solar energy technologies with different types of concentrating collectors.

Comparative study of different solar cells with respect to properties and applications of solar cells in nano technology.

Understanding the basics of economics involves in the solar system.

Learning the concepts and designing aspects in thermal power. 6. Study of solar pond and solar stills and their applications.

UNIT – I

SOLAR RADIATION:

Sources of radiation –sun earth relationship, Solar Time and angles, day length, angle of incidence on tilted surface; Sun path diagram, Solar Radiation: Extraterrestrial Radiation; Effect of earth atmosphere; Estimation of solar radiation on horizontal and tilted surfaces. Geographic Distribution of solar radiation, Phyrellio, pyranometer, equation of time-estimation of average radiation falling on tilled.

UNIT-II

SOLAR ENERGY TECHNOLOGIES:

Performance analysis of a liquid Flat-plate collector, Total loss coefficient and heat losses: Top loss coefficient, Bottom loss coefficient, Side loss coefficient. Solar concentrating collectors, types of concentrating collectors, Parabolic Dish System, The central power tower system, The Parabolic Trough System, Tracking CPC and Solar Swing, Performance analysis of cylindrical parabolic collector, Compound parabolic concentrator (CPC).

UNIT-III

SOLAR CELLS:

Solar cell fundamentals, solar cell classification, solar cell, module, panel array construction, maximum power pint trackers(MPPT), solar PV applications, The Recent developments in Solar cells, Role of Nano-Technology in Solar cells.

UNIT – IV

ECONOMICS:

Discounted Cash Flow-light cycle, coasting of solar system, production function and optimization

UNIT – V

THERMAL POWER:

The power concepts- design aspects, thermo-chemical reactor.

SOLAR POND AND SOLAR STILLS:

Working Principle-Construction-operating difficulties and remedies, Agriculture and Domestic applications: Still, timber drying, crop drying, cooker.

Course Outcomes :

Illustrate the fundamental principles of solar radiation and geographic distribution of solar radiation.

Obtaining the performance analysis of liquid flat plate collector and cylindrical parabolic collector.

Developing solar cells in the field of nano technology.

Calculating the cash flow and costs involves in the solar energy systems.

Designing and developing of thermo chemical reactor with respect to thermal power.

Reference Books:

Solar Energy Thermal Process Diffice and Beckman
Solar Heating and Cooling by Kreith and Kreider
Solar Energy Utilization by G.D.Rai
Solar Energy Utilization by G.D.Rai , Khanna Publishers.
Renewable Energy Sources and Emerging Technologies- By D.P. Kothari, PHI Pub.,
Applied Solar Energy by Meinel and Meinel
Non-Conventional Energy Resources by B.H . Khan, Tata McGraw Hill
Energy Resources Utilization and Technologies ByAnjaneyulu, BS Pub.

JNTUA College of Engineering (Autonomous), Ananthapuramu
Open Elective Course – II ECE
III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	BASICS OF INTEGRATED CIRCUITS	L	T	P	C
20A60405	APPLICATIONS	3	0	0	3

\Pre-requisite
Basics of Electronics and Communication Engineering

Course Objectives:

- To introduce the basic building blocks of linear & digital integrated circuits.
- To learn the linear and non - linear applications of operational amplifiers.
- To introduce the theory and applications of 555 and PLL.

- To learn the theory of ADC and DAC
- To understand different families of digital integrated circuits and their characteristics.

Course Outcomes (CO): At the end of this course, the students will be able to

- Understand the basic concepts of Op -AMPs, characteristics and specifications.
- Design circuits using operational amplifiers for various applications.
- Develop, apply and analyze circuits for advanced applications using Op-Amps, PLL, VCO and Analog multipliers.
- Understand different families of digital integrated circuits and their characteristics
- Design various and sequential circuits using digital ICs.

UNIT - I

Operational Amplifier: Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, Features of 741 Op-Amp, Modes of Operation - Inverting, Non-Inverting, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Features of 723 Regulator, Three Terminal Voltage Regulators.

UNIT - II

Op-Amp, IC-555 & IC 565 Applications: Introduction to Active Filters, Characteristics of Band pass, Band reject and All Pass Filters, Analysis of 1st order LPF & HPF Butterworth Filters, Waveform Generators – Triangular, Sawtooth, Square Wave, IC555 Timer - Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL - Block Schematic, Description of Individual Blocks, Applications.

UNIT - III

Data Converters: Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.

UNIT - IV

Digital Integrated Circuits: Classification of Integrated Circuits, Comparison of Various Logic Families, CMOS Transmission Gate, IC interfacing- TTL Driving CMOS & CMOS Driving TTL

Combinational Logic ICs – Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs - Code Converters, Decoders, Demultiplexers, LED & LCD Decoders with Drivers, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Priority Generators/Checkers, Parallel Binary Adder/Subtractor, Magnitude Comparators.

UNIT - V

Sequential Logic ICs and Memories: Familiarity with commonly available 74XX & CMOS 40XX Series ICs – All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers. Memories - ROM Architecture, Types of ROMS & Applications, RAM Architecture, Static & Dynamic RAMs.

Textbooks:

1. Ramakanth A. Gayakwad, “Op-Amps & Linear ICs”, PHI, 2003.
2. Floyd and Jain, “Digital Fundamentals”, Pearson Education, 8th Edition, 2005.

Reference Books:

1. D. Roy Chowdhury, “Linear Integrated Circuits”, New Age International (p) Ltd, Second Edition, 2003.
2. James M. Fiore, “Op Amps and Linear Integrated Circuits-Concepts and Applications”, Cengage Learning/ Jaico, 2009.
3. K.Lal Kishore, “Operational Amplifiers with Linear Integrated Circuits”, Pearson, 2009.
4. John. F. Wakerly, “Digital Design Principles and Practices”, Pearson, Third Edition, 2005.

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II CSE

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Introduction to Linux Programming

Course Code:20A60505 **L T P C : 3 0 0 3**

Course Objectives:

- To study the commands according to user requirements.
- To utilize Shell scripts to perform the given task.
- To enable writing own programs in UNIX.
- To know AWK programs.

Course Outcomes:

CO1: Develop text data processing applications using Unix commands and filters.

CO2: Design and develop text based user interface components

CO3: Understand user management, network management and backup utilities

CO4: Use the system calls for file management

CO5: Understands the Concept of Process Threads and File Structure.

UNIT-I: Introduction,Unix File System,Unix Commands

Operating System, History of UNIX, Overview and Features of Unix System,Structure of Unix System, Unix Environment. **Unix File System**: Introduction of Files, Organization of File Systems, Accessing File Systems, Structure of File Systems. **Unix Commands**: Basic Commands, Advanced Unix Commands: File Access Permissions, Pipe Operator, cut, paste, wc, sort, head, tail, diff, cmp, uniq, comm, time, Conversions between DOS and Unix, man.

UNIT-II: File management and Compression Techniques,Manipulating Processes and Signals

Managing and Compressing Files, Computer Devices, Disk related Commands, Compression and Uncompressing Files, Important Unix System Files, Shell Variables, Export of Local and Global Shell Variables.

Manipulating Processes and Signals: Process Basics, Processes States and Transitions, Zombie Process, Context switching, Threads, ps-status of Process.

UNIT-III: System calls

Introduction, File-related System calls (open, create, read, write, lseek), File-related System calls (close, mknod, link and unlink, access, and chown, chmod), Directory Handling System calls (mkdir, rmdir, chdir, opendir, readdir, telldir, closedir), Process related System calls (exec, fork, wait,exit).

Editors in Unix: introduction, Stream editor, Emacs Editor.

UNIT-IV: AWK Script,Burne Shell

AWK Command, print, printf, Displaying Content of Specified Patterns, Comparison Operators, Compound Expressions, Arithmetic Operators, Begin and end Sections, User-defined Variables, if else Statement, Built-in Variables, Changing Input Filed Separator, Functions, Loops, Getting Input from User, Search and Substitute Functions, Copying results into Another file.

Bourne Shell: Introduction, beginning Bourne Shell Scripting, Writing Shell Scripts, Command Line Parameters, read, for Loop, While Loop, if Statement, Bourne Shell Commands.

UNIT-V: InterprocessCommunicaation, Unix System Administration and Networking

Interprocess Communication, Synchronization, Filters.

Unix System Administration and Networking: Unix Booting Procedure,Mounting Unix File System, Unmounting Unix File System, Managing User Accounts, Networking Tools, mail Command, Distributed File System, Firewalls, Backup and Restore.

TEXT BOOKS

1. “UNIX and SHELL Programming”, B.M. HARWANI, OXFORD UNIVERSITY PRESS.

REFERENCES

1. “UNIX and Linux System Administration Handbook”, Evi Nemeth, Garth Snyder, Trent R. Hein and Ben Whaley, PHI

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II Chemical

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	**OE2. GREEN TECHNOLOGY**	**L**	**T**	**P**	**C**
20A60805		**3**	**0**	**0**	**3**

Pre-requisite

Course Objectives:

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1 Understand the basic knowledge of environmental issues and estimate the risk

CO2 Evaluate the exposures

CO3 To discuss the type of wastes and emissions that drive the environmental impacts

CO4 Estimation of the environmental properties, persistence, ecosystem risk,

CO5 To present approaches and methodologies for evaluating and improving the environmental performance of chemical processes and chemical products.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

An introduction to environmental issues: Role of chemical processes and chemical products, Global environmental issues, Air and water quality issues, Ecology.

Risk concept: Description of risk, Risk assessment concept, Dose-response, Exposure assessment.

UNIT - II

Evaluating exposures: Occupational exposures: recognition, evaluation, control, Exposure assessment for chemicals in the ambient environment, Designing safer chemicals.

Green chemistry:Green chemistry methodologies, Optimization based frameworks for the design of green chemical synthesis pathway.

UNIT - III

Evaluating environmental fate: Chemical and physical property estimation, estimating environmental persistence, estimating ecosystem risk, classifying environmental risk based on chemical structure.

UNIT - IV

Life-cycle concepts: Life-cycle assessment, Life-cycle impact assessment

UNIT - V

Material flows in chemical manufacturing, Assessing opportunities for waste exchanges and

by-product synergies.

Textbooks:

SHONNARD, DALLEN, D. Green Engineering: Environmentally Conscious Design of Chemical Processes.

Reference Books:

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF MATHEMATICS

Course Code	**Mathematical Modelling & Simulation**		**L**	**T**	**P**	**C**
20A65101	**(Common for CIVIL,MECH&CHEM)**		**0**	**3**	**0**	**3**
Pre-requisite		**Semester**	**II**			
Course Objectives:						
This course focuses on what is needed to build simulation software environments, and not just building simulations using preexisting packages.						
Course Outcomes (CO): Student will be able to						
• understand basic Model Forms. • understand basic Simulation Approaches. • evaluate handling Stepped and Event-based Time in Simulations. • distinguish Discrete versus Continuous Modeling. • apply Numerical Techniques. • calculate Sources and Propagation of Error.						
UNIT - I			8 Hrs			
Simulation Basics-Handling Stepped and Event-based Time in Simulations-Discrete versus Continuous Modelling-Numerical Techniques-Sources and Propagation of Error						

UNIT - II		9 Hrs
Dynamical, Finite State, and Complex Model Simulations-Graph or Network Transitions Based Simulations-Actor Based Simulations-Mesh Based Simulations-Hybrid Simulations		
UNIT - III		8 Hrs
Converting to Parallel and Distributed Simulations-Partitioning the Data-Partitioning the Algorithms-Handling Inter-partition Dependencies		
UNIT - IV		8 Hrs
Probability and Statistics for Simulations and Analysis-Introduction to Queues and Random Noise-Random Variates Generation-Sensitivity Analysis		
UNIT - V		9 Hrs
Simulations Results Analysis and Viewing Tools-Display Forms: Tables, Graphs, and Multidimensional Visualization-Terminals, X and MS Windows, and Web Interfaces-Validation of Model Results.		
Textbooks:		
1. Mathematical modeling, JN Kapur, Newage publishers 2. Mathematical Modeling and Simulation: Introduction for Scientists and Engineers by Kai Velten, Wiley Publishers		
Reference Books:		
1. Introduction to Mathematical Modeling and Computer Simulations By Vladimir Mityushev,WojciechNawalaniecNataliaRylko Published by Chapman and Hall/CRC.		
Online Learning Resources:		
http://www.cse.chalmers.se/~dag/docs/matmodReport6.pdf https://www.slideshare.net/arupparia/introduction-to-mathematical-modelling-42588379 https://www.slideshare.net/mailrenuka/simulation-for-queuing-problems-using-random-numbers		

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF MATHEMATICS

Course Code	**Wavelet transforms and its Applications (Common for EEE&ECE)**		**L**	**T**	**P**	**C**
20A65102			**0**	**3**	**0**	**3**
Pre-requisite	Fourier Series	**Semester**	**II**			
Course Objectives:						
This course provides the students to understand Wavelet transforms and its applications.						
Course Outcomes (CO): Student will be able to						
• understand wavelets and wavelet expansion systems. • illustrate the multi resolution analysis ad scaling functions. • form fine scale to coarse scale analysis. • find the lattices and lifting. • perform numerical complexity of discrete wavelet transforms. • find the frames and tight frames using Fourier series.						
UNIT - I	Wavelets	9 Hrs				
Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems - Haar Scaling Functions and Wavelets -effectiveness of Wavelet Analysis -The Discrete Wavelet Transform The Discrete-Time and Continuous Wavelet Transforms.						
UNIT - II	A Multiresolution Formulation of Wavelet Systems	8 Hrs				

Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.		
UNIT - III	Filter Banks and the Discrete Wavelet Transform	9 Hrs
Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - -Different Points of View.		
UNIT - IV	Time-Frequency and Complexity	9 Hrs
Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.		
UNIT - V	Bases and Matrix Examples	8 Hrs
Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.		
Textbooks:		
1. C. Sidney Burrus, Ramesh A. Gopinath, “Introduction to Wavelets and Wavelets Transforms”,Prentice Hall, (1997). 2. James S. Walker, “A Primer on Wavelets and their Scientific Applications”, CRC Press, (1999).		
Reference Books:		
1. Raghuveer Rao, “Wavelet Transforms”, Pearson Education, Asia.		
Online Learning Resources:		
https://www.slideshare.net/RajEndiran1/introduction-to-wavelet-transform-51504915		

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF MATHEMATICS

Course Code	**Statistical Methods for Data Science**		**L**	**T**	**P**	**C**
20A65103	**CSE (Data Science)**			**3**		**3**
Pre-requisite		**Semester**	**II**			

Course Objectives:

This course aims at providing knowledge on basic concepts of Statistics, Estimation and testing of hypotheses for large and small samples.

Course Outcomes (CO): Student will be able to

- Understand the basic concepts of Statistics
- Analyze data and draw conclusion about collection of data under study using Point estimation
- Analyze data and draw conclusion about collection of data under study using Interval estimation
- Analyzing the tests and types of errors for large samples
- Apply testing of hypothesis for small samples.

UNIT - I	**Basic Concepts**	**9 Hrs**

Population, sample, parameter and statistic; characteristics of a good estimator; Consistency – Invariance property of Consistent estimator, Sufficient condition for consistency; Unbiasedness; Sufficiency – Factorization Theorem – Minimal sufficiency; Efficiency – Most efficient estimator, likelihood equivalence, Uniformly minimum variance unbiased estimator,applications of Lehmann-Scheffe's Theorem, Rao - Blackwell Theorem and applications

UNIT - II	**Point Estimation**	**8 Hrs**

Point Estimation- Estimator, Estimate, Methods of point estimation – Maximum likelihood method (the asymptotic properties of ML estimators are not included), Large sample properties of ML estimator(without proof)- applications , Method of moments, method of least squares, method of minimum chi-square and modified minimum chi-square-Asymptotic Maximum Likelihood Estimation and applications.

UNIT - III	**Interval Estimation**	**8 Hrs**

Confidence limits and confidence coefficient; Duality between acceptance region of a test and a confidence interval; Construction of confidence intervals for population proportion (small and large samples) and between two population proportions(large samples); Confidence intervals for mean and variance of a normal population; Difference between the mean and ratio of two normal populations.

UNIT - IV	**Testing of hypotheses**	**9 Hrs**

Types of errors, power of a test, most powerful tests; Neyman-Pearson Fundamental Lemma and its applications; Notion of Uniformly most powerful tests; Likelihood Ratio tests: Description and property of LR tests - Application to standard distributions.

UNIT - V	**Small sample tests**	**9 Hrs**

Student's t-test, test for a population mean, equality of two population means, paired t-test, F-test for equality of two population variances,CRD,RBD,LSD; Chi-square test for goodness of fit and test for independence of attributes, $\chi 2$ test for testing variance of a normal distribution

Sign test, Signed rank test, Median test, Mann-Whitney test, Run test and One sample Kolmogorov –Smirnov test ,Kruskal – Wallis H test(Description, properties and applications only).

Textbooks:

1. Manoj Kumar Srivastava and Namita Srivastava, Statistical Inference – Testing of
   Hypotheses, Prentice Hall of India, 2014.
2. Robert V Hogg, Elliot A Tannis and Dale L.Zimmerman, Probability and Statistical Inference,9th edition,Pearson publishers,2013.

Reference Books:

1. S.P.Gupta, Statistical Methods, 33rd Edition, Sultan Chand & Sons.
2. Miller and John E Freund, Probability and Statistics for Engineers, 5th Edition.

Online Learning Resources:

1. https://www.statstutor.ac.uk/resources/uploaded/1introduction3.pdf
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2996198/

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

PHYSICS OF ELECTRONIC MATERIALS AND DEVICES

COURSE OBJECTIVES

1 To impart the fundamental knowledge on various materials, their properties and

Applications.

2 To provide insight into various semiconducting materials and their properties.

3 To elucidate the characteristic behavior of various semiconductor devices.

4 To provide the basics of dielectric and piezoelectric materials and their properties.

5 To explain different categories of magnetic materials, mechanism and their

advanced applications.

COURSE OUTCOMES

At the end of the course the student will be able

CO1 To understand the fundamentals of various materials.

CO2 To exploit the physics of semiconducting materials

CO3 To familiarize with the working principles of semiconductor-based devices.

CO4 To understand the behavior of dielectric and piezoelectric materials.

CO5 To make use of the magnetic materials for advanced applications.

Mapping between Course Outcomes and Programme Outcomes

PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12

CO1

CO2

CO3

CO4

CO5

SYLLABUS **Credit: 3 Hours of teaching: - 45 H**

UNIT-1 Fundamentals of Materials Science: 9H

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Basic idea of point, line and planar defects.Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).

UNIT-2: Semiconductors: 9H

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

UNIT-3: Physics of Semiconductor Devices: 9H

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium.and under bias, Construction and working principles of: Light emitting diodes, Heterojunctions, Transistors, FET and MOSFETs.

UNIT-4: Dielectric Materials and their Applications: 9H

Introduction, Dielectric properties, Electronic polarizability and susceptibility, Dielectric constant and frequency dependence of polarization, Dielectric strength and dielectric loss, Piezoelectric properties- Ferroelectricity-Applications.

UNIT-5: Magnetic Materials and their Applications: 9H

Introduction, Magnetism & various contributions to para and dia magnetism, Ferro and Ferri magnetism and ferrites, Concepts of Spin waves and Magnons, Anti-ferromagnetism, Domains and domain walls, Coercive force, Hysteresis, Nano-magnetism, Super-paramagnetism – Properties and applications.

Text Books

1. Principles of Electronic Materials and Devices-S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd.,3rd edition, 2007.

2. Electronic Components and Materials- Grover and Jamwal, DhanpatRai and Co.

Reference Books:

1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning,6th edition

2. Electronic Materials Science- Eugene A. Irene, , Wiley, 2005

3. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd., , 2nd Edition,2011

4. A First Course In Material Science- by Raghvan, McGraw Hill Pub.

5. The Science and Engineering of materials- Donald R.Askeland,Chapman& Hall Pub.

6. Electrical Engineering Materials-by A.J. Dekker, PHI Pub

NPTEL courses links

https://nptel.ac.in/courses/113/106/113106062/

https://onlinecourses.nptel.ac.in/noc20_mm02/preview

https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-mm07

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II H& SS

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	Academic Writing and Public Speaking		L	T	P	C
20A65501			3	0	0	3
Pre-requisite						
Course Objectives:						
➢ To encourage all round development of the students by focusing on writing skills ➢ To make the students aware of non-verbal skills ➢ To develop analytical skills						

➢ To deliver effective public speeches

Course Outcomes (CO):

By the end of the program students will be able to

- Define various elements of Academic Writing
- Understand how to paraphrase sources and avoid plagiarism
- Demonstrate the knowledge in writing a Research paper
- Analyse different types of essays
- Assess the speeches of others and know the positive strengths of speakers
- Build confidence in giving an impactful presentation to the audience

UNIT - I	Introduction to Academic Writing	Lecture Hrs

Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence – Completeness – Types – Descriptive, Analytical, Persuasive, Critical writing

UNIT - II	**Academic Journal Article**	Lecture Hrs

Art of condensation- summarizing and paraphrasing - Abstract Writing, writing Project Proposal, writing application for internship, Technical/Research/Journal Paper Writing – Conference Paper writing - Editing, Proof Reading - Plagiarism

UNIT - III	**Essay & Writing Reviews**	Lecture Hrs

Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review-

UNIT - IV	Public Speaking	Lecture Hrs

Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of Presentation – Stage Dynamics – Answering Strategies –Analysis of Impactful Speeches- Speeches for Academic events

UNIT - V	Public Speaking and Non-Verbal Delivery	Lecture Hrs

Body Language – Kinesics – Oculesics – Proxemics – Haptics – Paralanguage

Textbooks:

3. **Critical Thinking, Academic Writing and Presentation Skills: Mg University Edition Paperback – 1 January 2010 Pearson Education; First edition (1 January 2010)**
4. **A Course In Academic Writing Paperback – 1 January 2017Publisher : The Orient Blackswan; Second edition (1 January 2017)**

Reference Books:

1. **A Handbook For Academic Writing and Composition Paperback – 1 January 2014**

by Nzanmongi Jasmine PattonPublisher : Pinnacle Learning; 1st edition (1 January 2014) 2. Critical Thinking, Academic Writing and Presentation Skills: Mg University Edition Paperback – 1 January 2010Publisher : Pearson Education; First edition (1 January 2010) by Marilyn Anderson (Author) 3. Effective Academic Writing Second Edition: 1: Student Book: The Paragraph Paperback – Student Edition, 9 June 2014 by Alice Savage (Author), MasoudShafiei (Author)Publisher : Oxford University Press; Student, Workbook edition (9 June 2014) 4. A Course In Academic Writing Paperback – 1 January 2017 by Renu Gupta (Author) Publisher : The Orient Blackswan; Second edition (1 January 2017)
Online Learning Resources:
1. https://youtu.be/NNhTIT81nH8 2. phttps://www.youtube.com/watch?v=478ccrWKY-A 3. https://www.youtube.com/watch?v=nzGo5ZC1gMw 4. https://www.youtube.com/watch?v=Qve0ZBmJMh4

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – II

III B.TECH – II SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF CHEMISTRY

Subject Code	Title of the Subject	L	T	P	C
	CHEMISTRY OF POLYMERS AND ITS APPLICATIONS	2	1	-	3

COURSE OBJECTIVES	
1	To understand the basic principles of polymers
2	To synthesize the different polymeric materials and their characterization by

	various instrumental methods.
3	To impart knowledge to the students about fundamental concepts of Hydro gels of polymer networks, surface phenomenon by micelles
4	To enumerate the applications of polymers in engineering

COURSE OUTCOMES	
CO1	Classify the polymers, Explain polymerization mechanism, Differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer
CO2	Differentiate Bulk, solution, Suspension and emulsion polymerization, Describe fibers and elastomers, Identify the thermosetting and thermo polymers, Characterize the properties of polymers by IR, NMR, XRD etc.
CO3	Describe the properties and applications of polymers, Interpret the properties of cellulose, lignin, starch, rosin, latex etc., Discuss the special plastics of PES, PAES, PEEK etc., Explain modified cellulosics
CO4	Identify types of polymer networks, Describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery, Demonstrate the advanced drug delivery systems and controlled release
CO5	Demonstrate electrical phenomena at interfaces including electrokinetics, miselles, reverse micelles etc., Explain photoelectron spectroscopy, Discuss ESCA and Auger spectroscopy to the study of surfaces, Differentiate micelles and reverse micelles

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

Unit – I: Polymers-Basics and Characterization :-

Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, co polymerization and coordination. Average molecular weight concepts: number, weight and

viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: end group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

Unit – II: Synthetic Polymers

Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties, Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers, Diene polymers, nylons, Urea - formaldehyde, phenol – formaldehyde. Melamine Epoxy and Ion exchange resins. Characterization of polymers by IR, NMR, XRD

Unit – III : Natural Polymers & Modified cellulosics

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins. Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

Unit-IV: Hydrogels of Polymer networks and Drug delivery

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels**,** Applications of hydrogels in drug delivery.

Introduction to drug systems including, drug development, regulation, absorption and disposition, routes of administration and dosage forms. Advanced drug delivery systems and controlled release.

Unit – V: Surface phenomena

Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles, solubilization. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

References :

1. A Text book of Polymer science, Billmayer
2. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
3. Advanced Organic Chemistry, B.Miller, Prentice Hall
4. Polymer Chemistry – G.S.Mishra
5. Polymer Chemistry – Gowarikar
6. Physical Chemistry –Galston
7. Drug Delivery- Ashim K. Misra

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III CIVIL

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	Building Technology for Engineers	L	T	P	C
20A70104		3	0	0	3

Course Objectives :

1. To make the student familiar with varioustypes of Buildings and its components
2. To teach the students about general requirements of building regarding safety and transportation
3. To impart knowledge on various special requirements of buildings regarding ventilation, insulation acoustics, etc,.
4. To make the student familiar with the concepts of various Prefabrication systems.
5. To Teach the students about various construction equipments used in building.

Course Outcomes:

By the end of this course the student will be able to

1. Classify various types of buildings and its components.
2. Understand the general requirements of building regarding safety and transportation.

3. Understand the Special requirements of buildings regarding ventilation, insulation acoustics, etc,.
4. Familiarize with the concepts of various Prefabrication systems.
5. Understand various construction equipments used in building.

UNIT-1

Building planning: Types of Buildings — components, definitions, economy and design, Principles and aspects of building planning, Definitions and importance of Grouping and circulation; Lighting and ventilation; Sustainability and Green Buildings.

UNIT-II

General requirements: Requirements for safety against fire, termite, damping, earthquakes, Vertical transportation in building — planning of vertical transportation, Stairs, different forms of stairs, Other modes of vertical transportation.

UNIT-III

Special Requirements: Air conditioning — process and classification of air conditioning, Dehumidification. Systems of air-conditioning, ventilation, functional requirements of ventilation. Thermal insulation. Acoustics, effect of noise, properties of noise and its measurements, Principles of acoustics of building. Sound insulation.

UNIT-IV

Prefabrication systems: Prefabricated walls, openings, cupboards, shelves etc., planning and modules and sizes of components in prefabrication. Plumbing services — water supply system, maintenance of building pipe line, Sanitary fittings, Design of building drainage.

UNIT-V

Construction Equipment: Introduction and Planning for construction Equipment, Earthmoving and Excavating equipment, Pile driving equipment, Lifting and Concreting Equipment.

Learning Resources:

Text Books:

1. Building Construction, Punmia B. C., Jain A.J., and Jain A.J., Laxmi Publication, 2016, Eleventh Edition.
2. The Text book for Building Construction, Arora S. P., and Bindra S. P., Dhanpat Rai Pubications, 2010.

Reference Books:

1. Building Construction, Varghese P.C., PHI Learning Pvt. Ltd., 2017, 2nd Edition.
2. Construction Planning, Equipment and Methods, Robert P., Clifford J. S., and Aviad S., McGrawHiII Education, 2010

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III EEE

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

Course Code	**BATTERY MANAGEMENT SYSTEMS**		**L**	**T**	**P**	**C**
20A70204	**(OE-III)**		**3**	**1**	**0**	**4**
Pre-requisite	**Basic Electrical Engineering**	**Semester**	**VI**			

Course Objectives: To make the students learn about:

- Understand the role of battery management system and the requirements of BMS.
- Interpret the concept associated with battery charging / discharging process
- Analyze various parameters of battery and battery pack
- Design the model of battery pack

Course Outcomes (CO): After completion of this course, student will be able to

CO1: Understand and remember the basic concepts and terminologies of Cells and Batteries, charging, discharging methods, concept of cell balancing.

CO2: Analyze BMS functionality, various sensors used, control techniques, Sate of Charge estimation, cell total energy and cell total power.

CO3: Apply the equivalent circuits, physical models, empirical modelling of BMS.

CO4: Design of Battery management system considering various parameters and through simulation.

UNIT - I	INTRODUCTION	Lecture Hrs: 14
Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging		
UNIT - II	**BATTERY MANAGEMENT SYSTEM**	Lecture Hrs: 14
Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power		
UNIT - III	**BATTERY STATE OF CHARGE AND STATE OF HEALTH ESTIMATION**	Lecture Hrs: 12
Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing		
UNIT - IV	**MODELLING AND SIMULATION**	Lecture Hrs: 12
Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, Simulating an electric vehicle, Vehicle range calculations, Simulating constant power and voltage, Simulating battery packs		
UNIT - V	**DESIGN OF BATTERY MANAGEMENT SYSTEMS**	Lecture Hrs: 12
Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system		

Textbooks:

1. Plett, Gregory L. Battery management systems, Volume I: Battery modelling. Artech House, 2015.

2. Plett, Gregory L. Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.

Reference Books:

1. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.
2. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010
3. Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery-powered applications. Vol. 9. Springer Science & Business Media, 2008.
4. RuiXiong, "Battery management Algorithm for Electric Vehicles", China Machine Press, Springer,2020.
5. Bergveid, Krujit, Notten, " Battery Management Systems: Design by Modelling", Philips Research Book Series, Kluwer Academic Publishers.

Online Learning Resources:
1. https://www.coursera.org/learn/battery-management-systems

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code	Title of the Subject	L	T	P	C
20A70304	**MODERN MANUFACTURING METHODS**	3	0	0	3

Course Objectives:

To learn the importance and basics of unconventional machining.
To understand the rapid prototyping processes.

To have the knowledge of different micro machining methods
To understand the working principles of various Non-traditional machining methods.

To learn about Non-traditional forming processes.

UNIT-I

Need for Modern Manufacturing Methods: Non-traditional machining methods and rapid prototyping methods - their relevance for precision and lean manufacturing. Classification of non-traditional processes - their selection for processing of different materials and the range of applications.

Introduction to rapid prototyping - Classification of rapid prototyping methods - sterolithography, fused deposition methods - materials, principle of prototyping and various applications.

UNIT-II

Ultrasonic machining – Elements of the process, mechanics of material removal, process parameters, applications and limitations, Abrasive jet, Water jet and abrasive water jet machining: Basic mechanics of material removal, descriptive of equipment, process variables, applications and limitations.

UNIT-III

Electro –Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, metal removal rate in ECM, Tooling, process variables, applications, economic aspects of ECM.

Chemical Machining: Fundamentals of chemical machining- Principle of material removal-maskants – etchants- process variables, advantages and applications.

UNIT-IV

Thermal Metal Removal Processes: Basic principle of spark erosion (EDM), Wire cut EDM, and Electric Discharge Grinding processes - Mechanics of machining, process parameters, selection of tool electrode and dielectric fluids, choice of parameters for improved surface finish and machining accuracy - Applications of different processes and their limitations.

Plasma Machining: Principle of material removal, description of process and equipment, process variables, scope of applications and the process limitations.

UNIT-V

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations.

Laser Beam Machining: Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations.

Course Outcomes:

At the end of this course the student should be able to understand

Technical aspects of precision machining.
Applications of rapid prototyping technologies.
Tool selection for non traditional processes.
Knowledge of economic aspects of Non traditional processes.
Fabrication of microelectronic devices.

TEXT BOOKS:

Manufacturing processes for engineering materials by SeropeKalpakjian and Steven R Schmid, 5edn, Pearson Pub.
Advanced machining processes, VK Jain, Allied publishers.

REFERENCE:

New Technology , Bhattacharya A, The Institution of Engineers, India 1984
Manufacturing Technology, Kalpakzian, Pearson
Modern Machining Process, Pandey P.C. and Shah H.S., TMH.

JNTUA College of Engineering (Autonomous), Ananthapuramu
Open Elective Course – III
IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch
DEPARTMENT OF Electronic & Communication Engineering

Course Code	DIGITAL ELECTRONICS	L	T	P	C
20A70404		3	0	0	3
Pre-requisite	Semester	VII			

Basics of Electronics and Communication Engineering

Course Objectives:

- To learn simplification methods for minimizing Boolean functions and their realization using logic gates.
- To understand and design various combinational logic circuits like adders and code converters.
- To know the design of various combinational circuits useful to implement logic functions.
- To study the design of sequential logic circuits in synchronous and asynchronous modes.
- To introduce programmable logic devices.

Course Outcomes (CO): At the end of this course, the students will be able to

- Learn simplification methods for minimizing Boolean functions and their realization using logic gates.
- Understand and design various combinational logic circuits like adders and code converters.
- Know the design of various combinational circuits useful to implement logic functions.
- Gain knowledge on the design of sequential logic circuits in synchronous and asynchronous modes.
- Understand the operation and uses of programmable logic devices.

UNIT - I

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Quine –McCluskey Tabular Minimization Method. Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

UNIT - II

Introduction to Combinational Design 1: Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display.

UNIT - III

Combinational Logic Design 2: Decoders (3 to 8, octal to decimal), Encoders, Priority Encoders, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.

UNIT - IV

Sequential Logic Design: Latches, Flipflops, S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, flipflop conversions, set up and hold times, Ripple and Synchronous counters, Shift registers.

UNIT - V

Programmable Logic Devices:ROM, Programmable Logic Devices (PLDs), Introduction to logic families and their comparisons.

Textbooks:

1. Digital Design, M. Morris Mano & Michel D. Ciletti, 5th Edition, Pearson Education, 1999.
2. Switching theory and Finite Automata Theory, ZviKohavi and Nirah K. Jha, 2nd Edition, Tata McGraw Hill, 2005.

Reference Books:

1. Fundamentals of Logic Design, Charles H Roth, Jr., 5th Edition, Brooks/coleCengage Learning, 2004.
2. Digital & State Machine Design, Comer, 3rd Edition, OXFORD.

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Compute Science & Engineering

Cyber Security

Course Code:20A70504 **L T P C : 3 0 0 3**

Course Objectives:

- To introduce the concepts of Java.
- To Practice object-oriented programs and build java applications.
- To implement java programs for establishing interfaces.
- To implement sample programs for developing reusable software components.
- To establish database connectivity in java and implement GUI applications.

Course Outcomes:

CO1: Recognize the Java programming environment.
CO2: Select appropriate programming constructs to solve a problem.
CO3: Develop efficient programs using multithreading.
CO4: Design reliable programs using Java exception handling features.
CO5: Extend the programming functionality supported by Java.

UNIT-I: Cybercrime

Cybercrime and information security, Cybercriminals, Classifications of cybercrimes, Need for Cyberlaws in Indian context, Legal perspectives of cybercrime, Indian perspective of cybercrimes, Cybercrime and the Indian ITA 2000, Positive aspects and weak areas of ITA 2000, Amendments made in Indian ITA 2000 for admissibility of e- records, Amendments to the Indian IT Act, Global perspective on cybercrimes, Intellectual property in cyberspace, Ethical dimension of cybercrimes.

UNIT-II: Cyber Offenses

Cybercrime and information security, Cybercriminals, Classifications of cybercrimes, Need for Cyberlaws in Indian context, Legal perspectives of cybercrime, Indian perspective of cybercrimes, Cybercrime and the Indian ITA 2000, Positive aspects and weak areas of ITA 2000, Amendments made in Indian ITA 2000 for admissibility of e- records, Amendments to the Indian IT Act, Global perspective on cybercrimes, Intellectual property in cyberspace, Ethical dimension of cybercrimes.

UNIT-III: Cybercrime in Mobile and Wireless Devices

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

UNIT-VI: Tools and Methods Used in Cybercrime

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

UNIT-V: Cyber Forensics, Cybercrime in Real-World

Forensics of Computer and Handheld Devices: Cyber forensics, Cyber forensics and digital evidence, Forensics analysis of e-mail, Forensics and social networking sites, Forensics of handheld devices – Smartphone forensics, EnCase, Device Seizure, MOBIL edit.

Cybercrime examples, mini-cases, online scams: Real-life examples - Official website of Maharashtra Government hacked, Indian banks lose millions of rupees, Game source code stolen; Mini-cases - Indian Case of online gambling, Indian case of intellectual property crime; Online scams - Cheque cashing scam, Charity scams.

References:

1. K. A. Navas, “Electronics Lab Manual”, Volume I, PHI, 5th Edition, 2015, ISBN:9788120351424
2. Cyril Prasanna Raj P., “CMOS digital circuit design manual”, Volume 1, MSEC E-publication, Edition 2016

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Chemical Engineering

Course Code	INDUSTRIAL POLLUTION CONTROL ENGINEERING	L	T	P	C
20A70804		3	0	0	3

Pre-requisite

Course Objectives:

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1 Understand the different types of wastes generated in an industry, their effects on living and non-living things & environmental regulatory legislations and standards and climate changes.

CO2 Quantify, analyse and treat wastewater

CO3 Apply the different unit operations and unit processes involved in conversion of highly polluted water to potable standards

CO4 Apply the operating principles, design calculations of particulate control devices.

CO5 Estimate the different waste generated from the industries

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT - I

Types of emissions from chemical industries and effects of environment, environment legislation, Type of pollution, sources of wastewater, Effluent guidelines and standards. Characterization of effluent streams, oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self

purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

UNIT - II

General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry. Air pollution sampling and measurement: Types of pollutant and sampling and measurement,ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants. Stack sampling: sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and ozones, hydrocarbons, particulate matter

UNIT - III

Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipments particulate emission control: collection efficiency, control equipment like gravitational settling chambers, Cyclone separators, fabric filters, ESP and their constructional details and design aspects. Scrubbers: wet scrubbers, spray towers, centrifugal scrubbers, packed beds and plate columns, venturi scrubbers, their design aspects. Control of gaseous emissions: absorption by liquids, absorption equipments, adsorption by solids, equipment and the design aspects

UNIT - IV

Introduction to waste water treatment, biological treatment of wastewater, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds, attached growth processes, trickling filters, rotary drum filters, anaerobic processes.

UNIT - V

Methods of primary treatments: screening, sedimentation, flotation, neutralization, and methods of tertiary treatment. A brief study of carbon absorption, ion exchange, reverse osmosis, ultra-filtration, chlorination, ozonation, treatment and disposal. Hazardous waste management: nuclear wastes: health and environment effects, sources and disposal methods. Chemical wastes: health and environmental effects, treatment and disposal: treatment and disposal by industry, off site treatment and disposal, treatment practices in various countries. Biomedical wastes: types of wastes and their control.

Textbooks:

1. Environmental Pollution and Control Engineering, C. S. Rao – Wiley Eastern Limited, India, New Delhi, 1993.

2. Pollution Control in Process Industries, S.P. Mahajan, Tata McGraw-Hill, New Delhi, 1985.

Reference Books:

1. Wastewater Treatment, M. Narayana Rao and A.K.Datta, Oxford and IHB publ. New Delhi.

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF MATHEMATICS

Course Code	Numerical Methods for Engineers (Common for all Branches)		L	T	P	C
20A75101			0	3	0	3
Pre-requisite	---					
Course Objectives:						
This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral						

equations and solution of differential equations.		
Course Outcomes (CO): Student will be able to		
• apply numerical methods to solve algebraic and transcendental equations. • understand fitting of several kinds of curves. • derive interpolating polynomials using interpolation formulae. • Solve differential and integral equations numerically.		
UNIT - I	**Solution of Algebraic & Transcendental Equations:**	8 Hrs
Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method. System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.		
UNIT - II	**Curve Fitting**	8 Hrs
Principle of Least squares- Fitting of curves- Fitting of linear, quadratic and exponential curves.		
UNIT - III	**Interpolation**	9 Hrs
Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula		
UNIT - IV	**Numerical Integration**	8 Hrs
Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule		
UNIT - V	**Solution of Initial value problems to Ordinary differential equations**	9 Hrs
Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.		
Textbooks:		
4. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers. 5. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole,PNIE. 6. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India		
Reference Books:		
3. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers. 4. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.		
Online Learning Resources:		

https://slideplayer.com/slide/8588078/

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Physics

Subject Code	Title of the Subject	L	T	P	C
20A75201	**SMART MATERIALS AND DEVICES**	3		-	3

COURSE OBJECTIVES	
1	To provide exposure to smart materials and their engineering applications.
2	To impart knowledge on the basics and phenomenon behind the working of smart materials
3	To explain theproperties exhibited by smart materials
4	To educate various techniques used to synthesize and characterize smart materials

5	To identify the required smart material for distinct applications/devices
COURSE OUTCOMES	
At the end of the course the student will be able	
CO1	To recognize the need of smart materials
CO2	To understand the working principles of smart materials
CO3	To know different techniques used to synthesize and characterize smart materials
CO4	To exploit the properties of smart materials
CO5	To make use of smart materials for different applications

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

Credit: 3 **Hours of teaching: - 45 H**

UNITI : Introduction to Smart Materials: 9H

Historical account of the discovery and development of smart materials, Two phases: Austenite and Martensite, Temperature induced phase changes, Shape memory effect, Pseudoelasticity, One-way shape memory effect, Two-way shape memory effect.

UNIT II: Properties of Smart Materials: 9H

Physical principles of optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials.

UNIT III: Synthesis of Smart materials: 9H

Solid state reaction technique, Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method,Co-precipitaiton.Green synthesis, Mechanical alloying and Thin film deposition techniques: Chemical etching, Spray pyrolysis.

UNIT IV: Characterization Techniques: 9H

X-ray diffraction, Raman spectroscopy (RS), Fourier-transform infrared reflection (FTIR), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy, Atomic force microscopy (AFM) and Differential Scanning Calorimetry (DSC).

UNIT V:Smart Materials and Devices: 9H

Characteristics of shape memory alloys, Magnetostrictive, Optoelectronic, Piezoelectric, Metamaterials, Electro-rheological and Magneto-rheological materials and Composite materials.

Devices based on smart materials: Sensors & Actuators, MEMS and intelligent devices, Future scope of the smart materials.

Text Books:

1.Encyclopaediaof Smart Materials- Mel Schwartz, John Wiley & Sons, Inc.2002

2. Smart Materials and Structures - M. V. Gandhi and B.S. Thompson, Champman and Hall, 1992

Texts/References:

1. Smart Materials and Technologies- M. Addington and D. L. Schodek, , Elsevier, 2005.

2. Characterization and Application of smart Materials -R. Rai, Synthesis, , Nova Science, 2011.

3. Electroceramics: Materials, Properties, Applications -A.J. Moulson and J.M. Herbert, , 2nd Edn., John Wiley & Sons, 2003.

4. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic 1. Emission Sensors, Materials and Amplifiers,G.Gautschi, Springer, 2002.

5. Optical Metamaterials: Fundamentals and Applications-W. Cai and V. Shalaev, ,springer,2010.

6. Smart Materials and Structures - P. L Reece, New Research, Nova Science, 2007

NPTEL courses links

https://nptel.ac.in/courses/112/104/112104173/
https://nptel.ac.in/courses/112/104/112104251/
https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_1.pdf

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF H &SS

Course Code	**Employability Skills**		**L**	**T**	**P**	**C**
20A75501			**3**	**0**	**0**	**3**
Pre-requisite		**Semester-VII**				

Course Objectives:

- To encourage all round development of the students by focusing on productive skills
- To make the students aware of Goal setting and writing skills
- To enable them to know the importance of presentation skills in achieving desired goals.
- To help them develop organizational skills through group activities

To function effectively with heterogeneous teams

Course Outcomes (CO):

CO1: Define goals and try to achieve them
CO2: Understand the significance of self-management
CO3: Apply the knowledge of writing skills in preparing eye-catchy resumes
CO4: Analyse various forms of Presentation skills
CO5: Judge the group behaviour
CO6: Develop skills required for employability.

UNIT - I	Goal Setting and Self-Management	Lecture Hrs

Definition, importance, types of Goal Setting – SMART Goal Setting – Motivation – Intrinsic and Extrinsic Motivation – Self-Management - Knowing about self – SWOT Analysis

UNIT - II	Writing Skills	Lecture Hrs

Definition, significance, types of writing skills – Resume writing, E-Mail writing, Cover Letters, - E-Mail Etiquettes

UNIT - III	Technical Presentation Skills	Lecture Hrs

Nature, meaning & significance of Presentation Skills – Planning, Preparation, Presentation, Stage Dynamics – PPT & Poster Presentation

UNIT - IV	Group Presentation Skills	Lecture Hrs

Body Language – Group Behaviour - Team Dynamics – Leadership Skills – Personality Manifestation- Group Discussion		
UNIT - V	Job Cracking Skills	Lecture Hrs
Nature, characteristics, importance & types of Interviews – Job Interviews – Skills for success - Answering Strategies – Mock Interviews		
Textbooks:		
• 1. Soft Skills & Employability Skills (English, Paperback, SABINA PILLAI, AGNA FERNANDEZ)Publisher: Cambridge 2.Personality Development and Soft Skills (English, Paperback, MitraBarun K.)		
Reference Books:		
1. Learning How To Fly - Life Lessons for the Youth (English, Paperback, Kalam Abdul A. P. J.), Rupa& Co 2. Personality Development and Soft Skills - Preparing for Tomorrow 1 Edition (English, Paperback, Shikha Kapoor)Publisher: Dreamtech Press 3. Skills for Employability - Skills for Employability with 0 Disc (English, Paperback, Dr. M. Sen Gupta)Publisher: Innovative Publication		
Online Learning Resources:		
7. https://youtu.be/gkLsn4ddmTs 8. https://youtu.be/2bf9K2rRWwo 9. https://youtu.be/FchfE3c2jzc 10. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ		

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – III

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Chemistry

Subject Code	Title of the Subject	L	T	P	C
20A75301	**GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT**	2	1	-	3

COURSE OBJECTIVES	
1	Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry and the redesign of chemicals, industrial processes and products.
2	Understand the use of alternatives

	assessments that combine chemical, environmental health, regulatory, and business considerations to develop safer products.

COURSE OUTCOMES	
CO1	Apply the Green chemistry Principles for day to day life as well as synthesis, Describe the sustainable development and green chemistry, Explain economic and un-economic reactions, Demonstrate Polymer recycling.
CO2	Explain Heterogeneous catalyst and its applications in Chemical and Pharmaceutical Industries, Differentiate Homogeneous and Heterogeneous catalysis, Identify the importance of Bio and Photo Catalysis, Discuss Transition metal and Phase transfer Catalysis
CO3	Demonstrate Organic solvents and importance of solvent free systems, Discuss Super critical carbondioxide, Explain Super critical water and water as a reaction solvent, Interpret Ionic Liquids as Catalyst and Solvent
CO4	Describe importance of Biomass and Solar Power, Illustrate Sonochemistry and Green Chemistry, Apply Green Chemistry for Sustainable Development , Discuss the importance of Renewable resources
CO5	Discuss green Chemistry Principles for practicing Green nano synthesis, Illustrate Microwave Assisted Synthesis, Differentiate Hydrothermal and Reflux synthesis, Demonstrate Green Chemistry applications of Inorganic nanomaterials

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

UNIT 1: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

UNIT 2: CATALYSIS AND GREEN CHEMISTRY

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogeneous and Homogenous catalysts, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide, Bio-catalysis and photo-catalysis with examples,

UNIT 3: ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water based coatings, Ionic liquids as catalyst and solvent.

UNIT 4: EMERGING GREENER TECHNOLOGIES

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable Feedstocks, Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency, Industrial applications of alternative environmentally benign catalytic systems for carrying out the important reactions such as selective oxidation, reduction and C-C bond formations (specific reactions)

UNIT 5: ALTERNATIVE ENERGY SOURCES

Photo redox catalysis, single electron transfer reactions (SET), Advantages and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry: Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis.

Text Books :

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.

2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition,

Oxford University Press, USA

References :

1. Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
2. Edited by Alvise Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8:

Green Nanoscience, wiley-VCH, 2013.

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – IV

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Civil Engineering

		L	T	P	C
20A70105	**Environmental Impact Assessment**	**3**	**0**	**0**	**3**

Course Objectives:

1. To impart knowledge on different concepts of Environmental Impact Assessment.
2. To teach procedures of risk assessment.
3. To teach the EIA methodologies and the criterion for selection of EIA methods.
4. To teach the procedures for environmental clearances and audit.
5. To know the impact quantification of various projects on the environment.

Course Outcomes (CO):

1. To prepare EMP, EIS, and EIA report.
2. To identify the risks and impacts of a project.
3. To choose an appropriate EIA methodology.
4. To evaluation the EIA report.
5. To Estimate the cost benefit ratio of a project.

UNIT - I

Concepts and methodologies of EIA :Initial environmental Examination, Elements of EIA, - Factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters- Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods and cost/benefit Analysis.

UNIT - II

Impact of Developmental Activities and Land Use :Introduction and Methodology for the assessment of soil and ground water, Delineation of study area, Identification of actives. Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures. E I A in surface water, Air and Biological environment: Methodology for the assessment of Impacts on surface water environment, Air pollution sources, Generalized approach for assessment of Air pollution Impact.

UNIT - III

Assessment of Impact on Vegetation, Wildlife and Risk Assessment :Introduction - Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation - Risk assessment and treatment of uncertainty-key stages in performing an Environmental Risk Assessment-Advantages of Environmental Risk Assessment

UNIT - IV Environmental audit

Introduction - Environmental Audit & Environmental legislation objectives of Environmental Audit, Types of environmental Audit, Audit protocol, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report.

UNIT - V Environmental Acts and Notifications

The Environmental protection Act, The water preservation Act, The Air (Prevention &Control of pollution Act), Wild life Act - Provisions in the EIA notification, procedure for environmental clearance, procedure for conducting environmental impact assessment report- Evaluation of EIA report. Environmental legislation objectives, evaluation of Audit data and preparation of Audit report. Post Audit activities, Concept of ISO and ISO 14000.

Textbooks:

1. Environmental Impact Assessment, by Canter Larry W., McGraw-Hill education Edi (1996)
2. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B. S. Publication, Hyderabad 2nd edition 2011

Reference Books:

1. Environmental Engineering, by Peavy, H. S, Rowe, D. R, Tchobanoglous, G.Mc-Graw Hill International Editions, New York 1985
2. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers
3. Environmental Science and Engineering, by Suresh K. Dhaneja, S.K., Katania& Sons Publication, New Delhi.
4. Environmental Pollution and Control, by H. S. Bhatia, Galgotia Publication (P) Ltd, Delhi.

Online Learning Resources:

https://nptel.ac.in/courses/124107160

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – IV

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Electrical & Electronic & Engineering

Course Code	**IoT APPLICATIONS IN ELECTRICAL ENGINEERING (OE-IV)**		**L**	**T**	**P**	**C**
20A70205			**3**	**0**	**0**	**3**
Pre-requisite						

Course Objectives: To make the students learn about:

- Basics of Internet of Things and Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process.
- The concept of motion less and motion detectors in IoT applications.
- Applications of IoT in smart grid.
- The concept of Internet of Energy for various applications.

Course Outcomes (CO): After completing the course, the student should be able to do the following:

CO 1 Understand the concept of IoT in Electrical Engineering.
CO 2 Analyze various types of motionless sensors and various types of motion detectors
CO 3 Apply various applications of IoT in smart grid.
CO 4 Design future working environment with Energy internet.

UNIT - I	**SENSORS**	Lecture Hrs: 10

Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

UNIT - II	**OCCUPANCY AND MOTION DETECTORS**	Lecture Hrs: 10

Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors

UNIT - III	**MEMS**	Lecture Hrs: 10

Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors

UNIT - IV	**IoT FOR SMART GRID**	Lecture Hrs: 8

Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and

monitoring applications, Standardization and interoperability, Smart home		
UNIT - V	**INTERNET of ENERGY (IoE)**	Lecture Hrs: 10
Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid .		
Textbooks:		
1. Jon S. Wilson, Sensor Technology Hand book, Newnes Publisher, 2004 2. Tai Ran Hsu, MEMS and Microsystems: Design and manufacture, 1st Edition, Mc Grawhill Education, 2017 3. ErsanKabalci and YasinKabalci, From Smart grid to Internet of Energy, 1st Edition, Academic Press, 2019		
Reference Books:		
1. Raj Kumar Buyya and Amir VahidDastjerdi, Internet of Things: Principles and Paradigms, Kindle Edition, Morgan Kaufmann Publisher, 2016 2. Yen Kheng Tan and Mark Wong, Energy Harvesting Systems for IoT Applications: Generation, Storage and Power Management, 1st Edition, CRC Press, 2019 3. RMD SundaramShriram, K. Vasudevan and Abhishek S. Nagarajan, Internet of Things, Wiley, 2019		
Online Learning Resources:		
1. https://onlinecourses.nptel.ac.in/noc22_cs96/preview 2. https://nptel.ac.in/courses/108108123 3. https://nptel.ac.in/courses/108108179		

JNTUA College of Engineering (Autonomous), Ananthapuramu
Open Elective Course – IV
IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch
DEPARTMENT OF Mechanical Engineering

Subject Code	Title of the Subject	L	T	P	C
20A70305	**MATERIAL HANDLING EQUIPMENTS**	3	0	0	3

Course Objectives:

To understand how the knowledge of materials management can be an advantage to logistics and supply chain operations.

To sensitize the students on the materials management functions – Planning, Purchase, Controlling, Storing, Handling, Packaging, Shipping and Distributing, and Standardizing.

To realize the importance of materials both in product and service.

planning/ production and plant layouts, studying about strategies of material handling and equipments, and selection of site locations.

It also aims to explore the layout planning by computer applications following different algorithms.

UNIT-I

Overview of Material Handling: Principles of Material Handling, Principal groups of Material Handling equipment – General Characteristics and application of Material Handling Equipment, Modern trends in material handling.

UNIT-II

Lifting Equipments: Hoist- Components of Hoist – Load Handling attachments hooks, grabs and clamps – Grabbing attachments for bulk material – Wire ropes and chains.

UNIT-II

Lifting tackle pulleys for gain of force and speed: Tension in drop parts – Drums, Shears and sprockets – Arresting gear and brakes – Block brakes, Band brakes, thrust brakes – Safety and hand cranks. Principle operation of EOT, Gantry and jib cranes Hoisting Mechanisms, Travelling mechanisms, lifting mechanisms – Slewing Mechanisms – Elevators and lifts.

UNIT-IV

CONVEYORS: Types - description -applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors

UNIT-V

ELEVATORS: Bucket elevators: Loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

Course Outcomes :

The students will be able to select appropriate location for establishing industrial plants by applying the concepts of location selection.

The students will be able to plan and design plant and production layouts through basic strategies and with computer applications.

The students will be able to identify and analyse the problems in the existing layout/ material handling system and shall be able to the optimize the layout/ material handling system

The students will be able to develop algorithms for new planning layouts for typical applications in the industries and Suggesting appropriate material handling strategies in the industries.

The students will be able to design of fork lift trucks.

REFERENCES

Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.

Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985.

Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.

Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.

P.S.G. Tech., "Design Data Book", KalaikathirAchchagam, Coimbatore, 2003.

Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol. 1 & 2, Suma Publishers,

Bangalore, 1983

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Open Elective Course – IV

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Electronics & Communication Engineering

Course Code	PRINCIPLES OF DIGITAL SIGNAL	L	T	P	C
20A70405	PROCESSING	3	0	0	3

Pre-requisite
Basics of Electronics and Communication Engineering

Course Objectives:
- To understand the frequency domain analysis of discrete time signals.
- To learn the properties of discrete Fourier series and Fourier transforms.
- To design &analyzeIIR digital filters from analog filters.
- To know various structures used in implementation of FIR digital filters.
- To grasp the importance and applications of Multirate Digital signal processing.

Course Outcomes (CO): At the end of this course, the students will be able to
- Articulate the frequency domain analysis of discrete time signals.
- Understand the properties of discrete Fourier series and Fourier transforms.
- Design &analyzeIIR digital filters from analog filters.
- Design various structures used in implementation of FIR digital filters.
- Summarize the importance and applications of Multirate Digital signal processing.

UNIT - I
Introduction to Digital Signal Processing: Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, LTI system Properties. Solution of Linear constant coefficient difference equations, frequency domain representation of discrete time signals and systems. Review of Z-transforms.

UNIT - II
Discrete Fourier Series and Fourier Transforms: Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.

UNIT - III
Design of IIR Digital Filters and Realizations: Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.

UNIT - IV
Design of FIR Digital Filters and Realizations: Characteristics of FIR Digital Filters, frequency response. Design of FIR digital filters using window techniques and frequency sampling techniques, comparison of IIR & FIR filters, basic structures of FIR systems.
UNIT - V
DSP Applications: Introduction to programmable DSPs, Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor; Adaptive filters: Introduction, Basic principles of Forward Linear Predictive filter and applications such as system identification, echo cancellation, equalization of channels, and beam forming using block diagram representation study only.

Textbooks:

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithmsand Applications", Pearson Education, 2007.
2. A.V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", PHI.

Reference Books:

1. Andreas Antoniou, "Digital Signal Processing", TATA McGraw Hill, 2006
2. MH Hayes, "Digital Signal Processing", Schaum's Outline series, TATA Mc-Graw Hill, 2007.
3. Robert J. Schilling and Sandra L. Harris, "Fundamentals of Digital Signal Processing using MATLAB", Thomson, 2007.
4. B. Venkataramani and M. Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", TATA McGraw Hill, 2002.

Online Learning Resources:

JNTUA College of Engineering (Autonomous), Ananthapuramu

Open Elective Course – IV

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Computer Science & Engineering

Introduction to Database Management Systems

Course Code:20A70505 **L T P C : 3 0 0 3**

Course Objectives:

- To introduce the concept of Internet of Things.
- To Practice programs and build real time applications.
- Students will be explored to the interconnection and integration of the physical world.
- Students will gain practical experience in the development of Cloud-based IoT systems.

- To get knowledge on cloud platforms

Course Outcomes (CO):

CO1: Design reliable real time applications using microcontrollers and microprocessors .
CO2: Extend the programming functionality and design new modules.
CO3: Able to design & develop IOT Devices.

UNIT-I: Introduction

Introduction to database systems; Characteristics of databases, File system V/s Database system, Users of Database

system, approaches to building a database, data models, database management system, Data Independence, DBMS

system architecture, challenges in building a DBMS, various components of a DBMS

Introduction to database systems; Characteristics of databases, File system V/s Database system, Users of Database

system, approaches to building a database, data models, database management system, Data Independence, DBMS

system architecture, challenges in building a DBMS, various components of a DBMS

Introduction to database systems; Characteristics of databases, File system V/s Database system, Users of Database

system, approaches to building a database, data models, database management system, Data Independence, DBMSsystem architecture, challenges in building a DBMS, various components of a DBMS

Introduction to database systems; Characteristics of databases, File system V/s Database system, Users of Database

system, approaches to building a database, data models, database management system, Data Independence, DBMS

system architecture, challenges in building a DBMS, various components of a DBMS.

Introduction to database systems; Characteristics of databases, File system V/s Database system, Users of Database

system, approaches to building a database, data models, database management system, Data Independence,DBMS system architecture, challenges in building a DBMS, various components of a DBMS.

Introduction to database systems; Characteristics of databases, File system V/s Database system, Users of Database system, approaches to building a database, data models, database

management system, Data Independence, DBMSsystem architecture, challenges in building a DBMS, various components of a DBMS.

Introduction to database systems, Characteristics of databases, File system V/s Database system, Users of Database system, approaches to building a database, data models, database management system, Data Independence, DBMS system architecture, challenges in building a DBMS, various components of a DBMS.

UNIT-II: E/R Model

Conceptual Data Modeling – motivation, entities, entity types, various types of attributes, relationships, relationship

types, Entity set types, Participation constraints, E/R diagram notation, Extended E/R Model, Examples

Conceptual Data Modeling – motivation, entities, entity types, various types of attributes, relationships, relationship

types, Entity set types, Participation constraints, E/R diagram notation, Extended E/R Model, Examples

Conceptual Data Modeling - motivation, entities, entity types, various types of attributes, relationships, relationship types, Entity set types, Participation constraints, E/R diagram notation, Extended E/R Model, Examples.

UNIT-III: Relational Data Model

Concepts of relations, schema-instance distinction, keys, referential integrity & foreign keys, converting the database specification in ER notation to the relational schema, Relational algebra operators: selection, projection, cross product, various types of joins, division, set operations, example queries, tuple relational calculus, domain relational calculus, Fundamentals of SQL.

UNIT-VI: Relational Database Design

Importance of a good schema design, problems encountered with bad schema designs, motivation for normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, Normalization, Normal Forms - INF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, multi valued dependencies and 4NF, join dependencies and 5NF, Concept of Denormalization.

UNIT-V: Transaction Processing,Data Storage & Indexing

Transaction processing and Error recovery-Concepts of transaction processing, ACID properties, concurrency control, Serializability, locking based protocols, Timestamp based protocols, recovery and logging methods.

Data Storage and Indexes - File organizations, primary, secondary index structures, various index structures - hasb based, dynamic hashing techniques, multi-level indexes, B and B-trees.

References:

3. K. A. Navas, “Electronics Lab Manual”, Volume I, PHI, 5th Edition, 2015, ISBN:9788120351424
4. Cyril Prasanna Raj P., “CMOS digital circuit design manual”, Volume 1, MSEC E-publication, Edition 2016

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Open Elective Course – IV

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Chemical Engineering

Course Code	**SOLID WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
20A70805		**3**	**0**	**0**	**3**

Pre-requisite

Course Objectives:

- Material flow in society and generation of solid waste source
- Clarification of solid waste on characterization of the same
- Understand the sense of onsite handling storage and collection systems including transportation
- Understand processing technologies with mechanical volume reduction and thermal volume reduction corporate land filling, deep well injections.
- Learn to estimate material recovery energy recovery from a given waste data using case standing

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Identify sources and relationship between various functional elements of solid waste management and methods of storage and collection and transport of solid wastes.
CO2	Know the importance of transfer station and suggest suitable methods of solid waste disposal based on the composition of solid waste.
CO3	Suggest suitable methods for the management of plastic and E-wastes
CO4	Identify hazardous wastes and suggest suitable management techniques for radioactive wastes and Bio-medical wastes.
CO5	Adopt the suitable management method for a given industry

Course Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT - I

Introduction: Definition, characteristics and perspectives of solid waste. Types of solid waste. Physical and chemical characteristics. Variation of composition and characteristics. Municipal, industrial, special and hazardous wastes.
General aspects Overview of material flow in society. Reduction in raw material usage. Reduction in solid waste generation. Reuse and material recovery. General effects on health and environment. Legislations

UNIT - II

Engineered systems: Typical generation rates. Estimation and factors effecting generation rates. On site handling. Storage and processing. Collection systems and devices. Transfer and transport.

UNIT - III

Processing Techniques: Mechanical volume reduction. Thermal volume reduction. Component separation. Land filling and land forming. Deep well injection.

UNIT - IV

Material recovery: Mechanical size alteration. Electromagnetic separation. Drying and dewatering. Other material recovery systems. Recovery of biological conversion products. Recovery of thermal conversion products.
Energy recovery: Energy recovery systems and efficiency factors. Determination of output and efficiency. Details of energy recovery systems. Combustion incineration and heat recovery. Gasification and pyrolysis. Refuse derived fuels (RDF).

UNIT - V

Case studies: Major industries and management methods used in typical industries – Coal fired power stations, textile industry, oil refinery, distillery, sugar industry, and radioactive waste generation units.

Textbooks:

3. Howard S. Peavy, Environmental Engineering, McGraw Hill International Edition, 1986.
4. Dutta, Industrial Solid Water Management and Land Filling Practice, Narose Publishing House, 1999.

Reference Books:

3. Sastry C.A., Waste Treatment Plants, Narose Publishing House, 1995.
4. Lagrega, Hazardous Waste Management, McGraw Hill, 1994.

Online Learning Resources:

DEPARTMENT OF MATHEMATICS

Course Code	**Number theory and its Applications**		**L**	**T**	**P**	**C**
20A75102			**0**	**3**	**0**	**3**
Pre-requisite	**-----**	**Semester**	**I**			

Course Objectives:

This course enables the students to learn the concepts of number theory and its applications to information security.

Course Outcomes (CO): Student will be able to

- understand number theory and its properties.
- understand principles on congruences
- develop the knowledge to apply various applications
- develop various encryption methods and its applications.

UNIT - I	**Integers, Greatest common divisors and prime Factorization**	8 Hrs

The well-ordering property-Divisibility-Representation of integers-Computer operations with integers-Prime numbers-Greatest common divisors-The Euclidean algorithm -The fundamental theorem of arithmetic-Factorization of integers and the Fermat numbers-Linear Diophantine equations

UNIT - II	**Congruences**	8 Hrs

Introduction to congruences -Linear congruences-The Chinese remainder theorem-Systems of linear congruences

UNIT - III	**Applications of Congruences**	9 Hrs

Divisibility tests-The perpetual calendar-Round-robin tournaments-Computer file storage and hashing functions. Wilson's theorem and Fermat's little theorem-Pseudo primes- Euler's theorem- Euler's p hi-function- The sum and number of divisors- Perfect numbers and Mersenne primes.

UNIT - IV	**Finite fields & Primality, factoring**	8 Hrs

Finite fields- quadratic residues and reciprocity-Pseudo primes-rho method-fermat factorization and factor bases.

UNIT - V	**Cryptology**	9 Hrs

Basic terminology-complexity theorem-Character ciphers-Block ciphers-Exponentiation ciphers- Public-key cryptography-Discrete logarithm-Knapsack ciphers- RSA algorithm-Some applications to computer science.
Textbooks:
1. Elementary number theory and its applications, Kenneth H Rosen, AT & T Information systems & Bell laboratories. 2. A course in Number theory & Cryptography, Neal Koblitz, Springer.
Reference Books:
1. An Introduction To The Theory Of Numbers, Herbert S. Zuckerman, Hugh L. Montgomery, Ivan Niven, wiley publishers 2. Introduction to Analytic number theory-Tom M Apostol, springer **3.** Elementary number theory, VK Krishnan, Universities press
Online Learning Resources:
https://www.slideshare.net/ItishreeDash3/a-study-on-number-theory-and-its-applications

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Open Elective Course – IV

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Physics

Subject Code	Title of the Subject	L	T	P	C
20A75202	**SENSORS AND ACTUATORS FOR ENGINEERING**	3		-	3

	APPLICATIONS				

COURSE OBJECTIVES	
1	To provide exposure to various kinds of sensors and actuators and their engineering applications.
2	To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
3	To explain the operating principles of various sensors and actuators
4	To educate the fabrication of sensors
5	To explain the required sensor and actuator for interdisciplinary application
COURSE OUTCOMES	
At the end of the course the student will be able	
CO1	To recognize the need of sensors and actuators
CO2	To understand working principles of various sensors and actuators
CO3	To identify different type of sensors and actuators used in real life applications
CO4	To exploit basics in common methods for converting a physical parameter into an electrical quantity
CO5	To make use of sensors and actuators for different applications

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

Credits: 3 **Hours of teaching:- 45 H**

UNIT – I: Introduction to Sensors and Actuators 9H

Sensors: Types of sensors:temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Materials used and their fabrication process: Deposition:ChemicalVapor Deposition, Pattern: photolithography and Etching: Dry and WetEtching.

Actuators: Functional diagram of actuators, Types of actuators and their basic principle of working: Hydraulic, Pneumatic, Mechanical, Electrical, Magnetic, Electromagnetic, Piezo-electric and Piezo-resistive actuators, Applications of Actuators.

UNIT –II: Temperature and Mechanical Sensors **9H**

Temperature Sensors: Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Resistance temperature sensors, Silicon resistive sensors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors

Mechanical Sensors: Types of Mechanical sensors and their basic principle of working: Force sensors: Strain gauges, Tactile sensors, Pressure sensors: Semiconductor, Piezoresistive, capacitive, Variable Reluctance Sensor (VRP).

UNIT –III: Optical and Acoustic Sensors **9H**

Optical Sensors: Basic principle and working of: Photodiodes, Phototransistors and Photo-resistors based sensors, Photomultipliers, Infrared sensors:thermal, Passive Infra Red, Fiber based sensors and Thermopiles

Acoustic Sensors: Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones.

UNIT –IV: Magnetic, Electromagnetic Sensors and Actuators **9H**

Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magneto-strictive sensors and actuators, Voice coil actuators (speakers and speaker-like actuators).

UNIT –V: Chemical and Radiation Sensors **9H**

Chemical Sensors: Principle and working of Electro-chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.

Radiation Sensors: Principle and working of Ionization detectors, Scintillation detectors, Geiger-Muller counters, Semiconductor radiation detectors and Microwave sensors (resonant, reflection, transmission)

Text Books:

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015
2. Sensors and Actuators, D.A.Hall and C.E.Millar, CRC Press, 1999

Reference Books:

1.Sensors and Transducers- D.Patranabhis, Prentice Hall of India (Pvt) Ltd. 2003
2. Measurement, Instrumentation, and Sensors Handbook-John G.Webster, CRC press 1999
3. Sensors – A Comprehensive Sensors- Henry Bolte, John Wiley.
4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch.
5. Principles of Industrial Instrumentation By D. Patranabhis

NPTEL courses links

https://onlinecourses.nptel.ac.in/noc21_ee32/preview

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IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF H & SS

Subject Code	Title of the Subject	L	T	P	C
20A79102	English Literary Spectrum	3		0	3

COURSE OBJECTIVES	
1	To develop aesthetic sense to appreciate the beauty of life
2	To introduce to Elizabethan drama and be able to appreciate the nuances of humour
3	To familiarize with Victorian novel and industrialization
4	To expose to the historical significance of ideas of different periods
5	To give exposure to the vicissitudes of life through short stories

COURSE OUTCOMES	
CO1	Awareness to lead a life of quality than quantity
CO2	Able to understand humour and Elizabethan culture
CO3	Enable to appreciate human relations in this mechanized world
CO4	Tolerant and receptive to different ideas
CO5	Be imaginative and understanding of human aspirations

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

UNIT I: Poetry

1. Ode to a Grecian Urn- John Keats
2. To a Skylark- P.B.Shelley
3. Satan's Speech from Paradise Lost Book I- 140-170 lines- John Milton
4. My Last Duchess- Robert Browning

UNIT II: Drama

1. Twelfth Night- William Shakespeare
   a) Elizabethan theatre
   b) Shakespearean tragedy
   c) Shakespearean Comedy
   d) Themes of Shakespearean Dramas

UNIT III: Novel

1. Hard Times- Charles Dickens

a) Rise of the English Novel
b) Victorian Novel
c) Utilitarianism
d) Humanism

UNIT IV: Prose

1. Of Studies – Francis Bacon
2. On Seeing People Off- A.G.Gardiner
3. Sweetness and Light- Mathew Arnold
4. I too have a Dream- Martin Luther King Junior

UNIT V: Short Stories

1. The Last Leaf- O.Henry
2. Useless Beauty- Guy de Maupassant
3. After the Dance – Leo Tolstoy
4. The Selfish Giant- Oscar Wilde

Text Books:

The Oxford Book of English Verse by Christopher Ricks (Editor)

Twelfth Night (2010 edition): Oxford School Shakespeare (Oxford School Shakespeare Series)

Dickens Charles, Hard Times (Penguin Classics)

The Art of the Personal Essay: An Anthology from the Classical Era to the Present, Anchor Books Publication

References:

Legois and Cazamian, *A History of English Literature*

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Open Elective Course – IV

IV B.TECH – I SEMESTER (R20) (common to all branches) - 2020 Admitted Batch

DEPARTMENT OF Chemistry

Subject Code	Title of the Subject	L	T	P	C
20A75302	**CHEMISTRY OF NANOMATERIALS AND APPLICATIONS**	2	1	-	3

COURSE OBJECTIVES	
1	To understand synthetic principles of Nanomaterials by various methods
2	And also characterisae the synthetic nanomaterials by various instrumental methods
3	To enumerate the applications of nanomaterials in engineering

COURSE OUTCOMES	
CO1	Classify the nanostructure materials, Describe scope of nano science and technology, Explain different synthetic methods of nano materials, Identify the synthetic methods of nanomaterial which is suitable for preparation of particular material
CO2	Describe the top down approach, Explain aerosol synthesis and plasma arc technique, Differentiate chemical vapour deposition method and electrodeposition method, Discuss about high energy ball milling.

CO3	Discuss different technique for characterization of nanomaterial, Explain electron microscopy techniques for characterization of nanomaterial, Describe BET method for surface area analysis, Apply different spectroscopic techniques for characterization
CO4	Explain synthesis and properties and applications of nanaomaterials, Discuss about fullerenes and carbon nanotubes, Differentiate nanomagnetic materials and thermoelectric materials, Describe liquid crystals
CO5	Illustrate applications of nanaomaterials, Discuss the magnetic applications of nanomaterials, list the applications of non-linear optical materials, Describe the applications fullerenes, carbon nanotubes

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

SYLLABUS

Unit – I

Basics and Characterization of Nanomaterials : Introduction**,** Scope of nanoscience and nanotecnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials.

Unit – II

Synthesis of nanomaterials : Top-Down approach**,** Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling method.

Synthetic Methods**:** Bottom-Up approach**:-** Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

UNIT-III

Techniques for characterization: Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterilas, BET method for surface area analysis, dynamic light scattering for particle size determination-

UNIT-IV

Studies of Nano-structured Materials: Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, self- assembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials and liquid crystals.

UNIT-V

Engineering Applications of Nanomaterials : Applications of Nano Particle, nano rods of nano wires, Fullerenes, carbon nano tubes, Graphines nanoparticles and other applications of nonmaterials and uses.

TEXT BOOKS:

1. **NANO: The Essentials:** T Pradeep, MaGraw-Hill, 2007.
2. **Textbook of Nanoscience and nanotechnology:** B S Murty, P Shankar, Baldev Rai, BB Rath and James Murday, Univ. Press, 2012.

REFERENCE BOOKS:

1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.
2. **Nanostructures & Nanomaterials; Synthesis, Properties & Applications:** Guozhong Cao, Imperial College Press, 2007.
3. **Nanomaterials Chemistry**, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.