REGULATION 2017

COURSE STRUCTURE

SYLLABUS

DEPARTMENT OF CHEMICAL ENGINEERING

GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

(Affiliated to Biju Patnaik University of Technology, Rourkela)

Accredited by NAAC with 'A' Grade with a CGPA of 3.28/4.00
Accredited by NBA

4 Year B.Tech Degree Programme

Regulation 2017

Choice Based Credit System

Outcome Based Assessment

Chemical Engineering

Programme Educational Objectives

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Chemical Engineering UG Programme at GIET, Gunupur is framed and designed such that within first few years after graduation, the graduates will be able to:

PEO 1: Acquire the fundamental principles of science and chemical engineering with modern experimental and computational skills.

PEO 2: Face current technical challenges in the society by maintaining a professional and ethical attitude towards the society and also considering impacts on safety, health and environment.

PEO 3: Excel their career as Chemical Engineers or researchers in both traditional and emerging fields of Chemical Engineering such as environmental, material, food, pharmaceutical and energy applications.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To correlate theoretical concepts with real time experimental and field data through application of process simulation and analytical techniques.

PSO2: To develop cutting edge chemical processes, equipment and products for the benefit of the human kind using innovative research and development skills and continuous learning efforts.

PROGRAMME OUTCOMES (POs)

1**. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SEMESTER WISE COURSE STRUCTURE

I SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	BS	BBSBS1010	Engineering Mathematics-I	3	1	0	4
2	BS	BBSBS1021	Engineering Physics	3	0	0	3
		BBSBS1022	Engineering Chemistry				
3	ES	BBSES1031	Basics of Mechanics	3	0	0	3
		BBSES1032	Basics of Thermodynamics				
4	ES	BBSES1041	Basics of Electronics	3	0	0	3
		BBSES1042	Basics of Electrical Engineering				
5	ES	BBSES1050	Programming in 'C'	3	0	0	3
6	HS	BBSHS1060	Communicative English-I	2	0	0	2
			PRACTICAL / SESSIONAL				
7	BS	BBSBS1121	Engineering Physics Lab	0	0	2	1
		BBSBS1122	Engineering Chemistry Lab				
8	ES	BBSES1141	Basics of Electronics Lab	0	0	2	1
		BBSES1142	Basics of Electrical Engineering Lab				
9	ES	BBSES1150	Programming in 'C' Lab	0	0	2	1
10	HS	BBSHS1160	Communicative English-I Lab	0	0	2	1
11	ES	BBSES1171	Engineering Drawing	0	0	2	1
		BBSES1172	Engineering Workshop				
12	MC	BBSHS1180	NSS / NCC	0	0	2	1
TOTAL:				17	1	12	24

II SEMESTER								
SL.No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**QP**
THEORY								
1	BS	BBSBS2010	Engineering Mathematics-II	3	1	0	4	
2	BS	BBSBS1021	Engineering Physics	3	0	0	3	
		BBSBS1022	Engineering Chemistry					
3	ES	BBSES1031	Basics of Mechanics	3	0	0	3	
		BBSES1032	Basics of Thermodynamics					
4	ES	BBSES1041	Basics of Electronics	3	0	0	3	
		BBSES1042	Basics of Electrical Engineering					
5	ES	BBSES2050	Data Structure	3	0	0	3	
6	HS	BBSHS2060	Communicative English-II	2	0	0	2	
PRACTICAL								
7	BS	BBSBS1121	Engineering Physics Lab	0	0	2	1	
		BBSBS1122	Engineering Chemistry Lab					
8	ES	BBSES1141	Basics of Electronics Lab	0	0	2	1	
		BBSES1142	Basics of Electrical Engineering Lab					
9	ES	BBSES2150	Data Structures using ‘C++’ Lab	0	0	2	1	
10	HS	BBSHS2160	Communicative English-II Lab	0	0	2	1	
11	ES	BBSES1171	Engineering Drawing	0	0	2	1	
		BBSES1172	Engineering Workshop					
12	MC	BBSHS2180	YOGA / Project Work	0	0	2	1	
TOTAL				**17**	**1**	**12**	**24**	

III SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC3010	Fluid Dynamics	3	0	0	3
2	PC	BCHPC3020	Mechanical Operations	3	1	0	4
3	PC	BCHPC3030	Physical and Analytical Chemistry	3	0	0	3
4	BS	BBSBS3040	Engineering Mathematics-III	3	1	0	4
5	ES	BCSES3051	OOPS through JAVA	3	0	0	3
		BCSES3052	Database Management Systems				
6	BS/ HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC3110	Fluid Dynamics Lab	0	0	2	1
8	PC	BCHPC3120	Mechanical Operations Lab	0	0	2	1
9	PC	BCHPC3130	Physical and Analytical Chemistry Lab	0	0	2	1
10	ES	BCSES3151	JAVA Programming Lab	0	0	2	1
		BCSES3152	Database Management Systems Lab				
TOTAL				**18**	**2**	**8**	**24**

IV SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC4010	Chemical Process Technology	3	0	0	3
2	PC	BCHPC4020	Mass Transfer-I	3	1	0	4
3	PC	BCHPC4030	Heat Transfer	3	0	0	3
4	PC	BCHPC4040	Chemical Process Calculation	3	1	0	4
5	ES	BCSES3051	Object Oriented Programming through JAVA	3	0	0	3
		BCSES3052	Database Management Systems				
6	BS/ HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC4110	Chemical Technology Lab	0	0	2	1
8	PC	BCHPC4120	Mass Transfer-I Lab	0	0	2	1
9	PC	BCHPC4130	Heat Transfer Lab	0	0	2	1
10	ES	BCSES3151	JAVA Programming Lab	0	0	2	1
		BCSES3152	Database Management Systems Lab				
TOTAL				**18**	**2**	**8**	**24**

V SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC5010	Mass Transfer-II	3	0	0	3
2	PC	BCHPC5020	Chemical Reaction Engineering	3	1	0	4
3	PC	BCHPC5030	Chemical Engineering Thermodynamics	3	0	0	3
4	PE	BCHPE5041	Bio-chemical Engg	3	0	0	3
		BCHPE5042	Process utility &Industrial Safety				
		BCHPE5043	Corrosion Engineering				
		BCHPE5044	Battery Technology				
5	OE	B**OE5051	Open Elective 1	3	0	0	3
		B**OE5052	Open Elective 1				
		B**OE5053	Open Elective 1				
		B**OE5051	Open Elective 1				
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3
		BMSHS5062	Organizational Behaviour				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC5110	Mass Transfer-II Lab	0	0	2	1
8	PC	BCHPC5120	Chemical Reaction Engineering Lab	0	0	2	1
9	PC	BCHPC5130	Biotechnology Lab	0	0	2	1
10	PC	BCHPC5150	*Skill Development Project and Hands on Training	0	0	2	1
11	PC	BCHPC5170	^Summer Internship-I	0	0	2	1
		TOTAL:		**18**	**1**	**10**	**24**

VI SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC6010	Process control and Instrumentation	3	1	0	4
2	PC	BCHPC6020	Process Equipment and Design	3	0	0	3
3	PC	BCHPC6030	Fuel &Energy Technology	3	0	0	3
4	PE	BCHPE6041	Computational Fluid Dynamics	3	0	0	3
		BCHPE6042	Advanced Numerical Methods				
		BCHPE6043	Treatment of Industrial effluent				
		BCHPE6044	Sustainability Engineering				
5	OE	B**OE6051	Open Elective – 2	3	0	0	3
		B**OE6052	Open Elective – 2				
		B**OE6053	Open Elective – 2				
		B**OE6051	Open Elective – 2				
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3
		BMSHS5062	Organizational Behaviour				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC6110	Process control Lab	0	0	2	1
8	PC	BCHPC6120	Process Equipment and Design Lab	0	0	2	1
9	PC	BCHPC6130	Fuel &Energy Technology Lab	0	0	2	1
10	PC	BCHPC6140	Advanced Lab-I	0	0	2	1
11	HS	BTPHS6160	#Soft Skill and Employability Skill	0	0	2	1
TOTAL				18	1	10	24

VII SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC7010	Process Modelling and Simulation	3	0	0	3
2	PC	BCHPC7020	Transport Phenomenon	3	0	0	3
3	PE	BCHPE7031	Fertilizer Technology	3	0	0	3
		BCHPE7032	Renewable Energy				
		BCHPE7033	Fluidization Engg				
		BCHPE7034	Interfacial Engineering				
4	PE	BCHPE7041	Petroleum Refinery Engineering	3	0	0	3
		BCHPE7042	Polymer Technology				
		BCHPE7043	Mineral Process Engineering				
		BCHPE7044	Biotechnology				
5	OE	B**OE7051	Open Elective – 3	3	0	0	3
		B**OE7052	Open Elective – 3				
		B**OE7053	Open Elective – 3				
		B**OE7051	Open Elective – 3				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC7140	Advanced Laboratory-II	0	0	4	2
8	PC	BCHPC7150	Mini Project / Projects on Internet of Things	0	0	6	3
9	PE	BCHPE7160	## Massive Open Online Course (MOOC)	0	0	4	2
10	PC	BCHPC7170	^Summer Internship-II	0	0	2	1
		TOTAL:		15	0	16	23

VIII SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PE	BCHPE8011	Modern Separation Technique	3	0	0	3
		BCHPE8012	Integrated Solid Waste Management				
		BCHPE8013	Green Technology				
		BCHPE8014	Pollution and its control				
2	PE	BCHPE8021	Nano Technology	3	0	0	3
		BCHPE8022	Pinch technology				
		BCHPE8023	Optimization Methods				
		BCHPE8024	Fermentation Technology				
3	OE	B**OE8031	Open Elective – 4	3	0	0	3
		B**OE8032	Open Elective – 4				
		B**OE8033	Open Elective – 4				
		B**OE8031	Open Elective – 4				
			PRACTICAL / SESSIONAL				
4	PC	BCHPC8150	Major Project / Industrial Project / Startup Training cum Project	0	0	12	6
5	PC	BCHPC8180	Seminar and Technical Writing	0	0	4	2
6	PC	BCHPC8190	Comprehensive Viva-Voce	0	0	4	2
		TOTAL:		9	0	20	19

Summary

SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER								TOTAL CREDITS	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities, Social & Management Study (HS)	3	3	-	3	-	4	-	-	13	7
2	Basic Sciences (BS)	8	8	7	-	3	-	-	-	26	14
3	Engineering Sciences (ES) / Basic Engineering (BE)	12	12	4	4	-	-	-	-	32	17
4	Professional Core (PC)	-	-	13	17	13	14	8	-	65	35
5	Professional Electives (PE)	-	-	-	-	3	3	8	6	20	11
6	Open Electives (OE)	-	-	-	-	3	3	3	3	12	6
7	Project Work, Seminar and/or Internship in Industry or elsewhere	-	-	-	-	2	-	4	10	16	9
8	Mandatory Courses (MC)	1	1	-	-	-	-	-	-	2	1
	TOTAL	**24**	**24**	**24**	**24**	**24**	**24**	**23**	**19**	**186**	**100**

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS 1010	ENGINEERING MATHEMATICS-I	3	1	0	4	A

Course Educational Objectives

CEO1	To find critical points, and use them to locate maxima and minima
CEO2	To provide the standard methods for solving differential equations
CEO3	To study Fourier series and to express a function in Fourier series
CEO4	To use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	To implement the engineering problems using the concept of Partial differentiation and series and to understand its application.
CO2	To solve the initial value and boundary value problem of ODE related to SHM, Electrical circuit, Growth and Decay problem etc.
CO3	To execute the technique of Fourier series for learning advanced Engineering Mathematics.
CO4	To relate the tools of matrices and linear algebra including ineartrans formations, eigen values, diagonalization and orthogonalization in Engineering.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	2	-	2	-	-	-	-	2		
CO2	3	3	-	-	1	-		-	-	-	-	2		
CO3	2		-	-	2	-	-	-	-	-	-	_		
CO4	2		-	-	2	-	-	-	-	-	-	2		

SYLLABUS

UNIT:1 MULTIVARIABLE CALCULUS **13 Hours**

Partial differentiation, Euler's theorem, Total derivative, Taylor's theorem two variable (without proof), Maxima and Minima, Differentiation under integral sign (Leibtinz rule).

UNIT:2 DIFFERENTIAL EQUATION-I **12 Hours**

Ordinary differential Equation: First order and first degree differential equations and its method of solving, Application to Electrical circuits and conduction heat and their solution.

Differential Equation-II

Linear differential equation of higher order and its different methods of finding solution (operator method). Second order liner differential equation and its solution: Euler Cauchy equation, solution by undermined coefficient method and variation of parameter. Modeling of electrical circuit with solution.

UNIT:3 FOURIER SERIES **10 Hours**

Fourier series, Fourier expansion of functions of any period, Even and odd functions, Half Range Expansion.

UNIT:4 LINEAR ALGEBRA **15 Hours**

Matrices, Types of matrices, Rank of matrix Eigen values and Eigen vectors, Cayley – Hamilton theorem (without proof), system of liner equation, Orthogonal matrices, Complex matrices, Hermitian and skew-Hermitian matrices, Unitary matrices, similarity of matrices. Quadratic forms and Canonical forms.

Teaching Methods: Chalk& Board

Text Books

1. Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, Willey
2. Differential Calculus by Santi Narayan and Mittal, S.Chand Publications

Ref. Books

1. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by B.V.Raman, McGraw Hills Education
3. Advanced Engineer methods by N. P. Daly & Manish Goel.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS1021	**ENGINEERING PHYSICS**	**3**	**0**	**0**	**3**	**A**

Course Educational Objectives

CEO1	To provide the students about the elementary features and the basic concepts of Physics and its applications to different physical systems.
CEO2	Students will be able to communicate these concepts clearly, develop problem solving skills and critical thinking.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Solve engineering problems using the concept of oscillation and wave mechanics and recognize the scientific application of Laser.
CO2	To analysis the structural properties of elemental solids
CO3	Determine gradient of scalar field, divergence and curl of vector fields and solve engineering problems on electromagnetism
CO4	Construct a quantum mechanical model to explain the behavior of a system at microscopic level.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	_	3	2	_	_	_	_	_	_	_	_	_		
CO2	_	_	_	_	3	_	1	_	_	_	_	_		
CO3	_	3	_	_	1	_	_	_	_	_	_	_		
CO4	3		2	_		_	_	_	_	_	_	_		

SYLLABUS

UNIT:1 Interaction of Wave and Matter **(12 Hours)**

Introduction to Harmonic Oscillator, Waves and its Characterstics, Superpositition of Waves, Interference by division of wavefront (Biprism experiment) and division of amplitude
(Newton's Ring experiment). Introduction to Diffraction, types of diffraction.
LASER, spontaneous & stimulated emission, Einstein's relation, Ruby Laser and He-Ne Gas Laser, application of Laser. Optical fiber, Acceptance angle, Numerical aperature, Step index and Graded index fibers, applications of optical fiber.

UNIT:2 Physics of Materials **(12 Hours)**

Crystallography, Crystal structure, crystal direction and plane, Miller indices, Interplanar spacings, Reciprocal Lattice and its characterstics, Reciprocal Lattice of SC, FCC and BCC, Brillouin Zone, Bragg's law.
Energy bands in solids (conduction band, valence band and fermi level), Classification of matter on the basis of band theory.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSBS1022	**ENGINEERING CHEMISTRY**	3			3	A

Course Educational Objectives

CEO1	To impart the knowledge of application of chemical sciences in the field of engineering
CEO2	The course aims at elucidating principles of applied chemistry in industrial systems, Water treatment and engineering materials.
CEO3	To give detailed knowledge about the reactivity of metal with environment and it's Prevention from corrosion.
CEO4	To give an idea about fuel and it's characteristics.
CEO5	To enlighten the students with the applications of advanced materials.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Identify suitable water treatments techniques for domestic and industrial purposes
CO2	Differentiate various types of corrosion, and gain knowledge on control measures associated with corrosion
CO3	Classify the different types of fuel , it's analysis and gain knowledge on fractional distillation of petroleum.
CO4	Understand various types of polymers, their preparation along with applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	_	2	3	_	_	_	_	_		
CO2	3	3	1	2	_	2	3	_	_	_	_	_		
CO3	3	3	2	1	_	2	3	_	_	_	_	_		
CO4	3	3	2	1	_	2	3	_	_	_	_	_		

SYLLABUS

UNIT:1 WATER TREATMENT **(12 Hours)**

Types of water, Impurities in water, Types of Hardness, Determination of Hardness by EDTA method, treatment of water for Domestic use, Water softening processes Lime-soda process, Ion Exchange method, Boiler feed water, Scale and Sludge, Caustic embrittlement, Priming and Foaming ,Removal of dissolved gases, Carbonate and phosphate conditioning, colloidal conditioning, Calgon conditioning, Desallination of brackish water by Reverse osmosis

UNIT:2 CORROSION CHEMISTRY **(12 Hours)**

Introduction, Electrochemical cell, electrode potential E.M.F, Definition of corrosion, Types of corrosion: Dry corrosion and wet corrosion, Galvanic corrosion, Concentration cell corrosion, Factors influencing corrosion, corrosion control: Cathodic protection (Sacrificial anodic protection and Impressed current cathodic protection), Inhibitors, protective coatings: Galvanization and Tinning, Passivation.

UNIT:3 FUEL TECHNOLOGY **(12 Hours)**

Introduction, Classification of Fuels, Calorific Value, Charcteristics of a good fuel, Types and analyses (Proximate and ultimate analysis) of coal, Dulong's Formula, Petroleum, (Extraction, purification and refining),Cracking(thermal cracking, catalytic cracking), Knocking, Antiknocking , Octane numbers, Cetane numbers, Unleaded and synthetic petrol, LPG and CNG, Combustion Numericals.

UNIT:4 CHEMISTRY OF ENGINEERING MATERIALS **(12 Hours)**

Introduction, polymer, Classification of polymers, Types of polymerization and mechanism, Plastics: Thermosetting and thermo plastic, PVC, PE,PS,PMMA, PTFE, Bakelite,Nylon-6,6, Nylon-6, Fiber reinforced plastic.*ADD-ON COURSES: Conducting Polymer (Polyaniline, Polyacetylene),Polycarbonates Bio-Degradable and Non-Bio Degradable polymer, Nano composite.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1 Engineering chemistry by Jain & Jain, Dhanpat Rai publishing company (p) Ltd.

Ref. Books:

1. A Text Book of Engineering Chemistry by S.S.Dara,S Chand Publishers

2. A Text Book of Engineering Chemistry by Sashi Chawla,Dhanpat Rai Publishing house.

3.Text Book of Engineering chemistry, 2nd edition, by R.Gopalan,D.Venkapaya & Sulochana Nagarajan, Vikas Publishing House Pvt.Ltd.

4. B. Tech Chemistry-II by P. K. Kar, S. Dash, B. Mishra kalyani publishers.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1031	BASICS OF MECHANICS	3	0	0	3	A

Course Educational Objectives

CEO1	To apply the established engineering method to complex engineering problem.
CEO2	To understand the vectorial and scalar representation of forces and moments.
CEO3	To evaluate the different forces exhibit in truss member.
CEO4	To obtain the knowledge on kinematics and kinetics of particle to analyze simple and practical problems

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Determine the resultant force and moment for given force system.
CO2	Evaluate the forces in members of trusses, frames and problems related to friction.
CO3	Analyze the properties of surface in relation to centroid and moment of inertia
CO4	Adapt the laws of motion, kinematics of motion and their interrelationship

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	_	_	_	_	_	_	_	_	_	_		
CO2	3	3	_	_	_	_	_	_	_	_	_	_		
CO3	3	3	_	_	_	_	_	_	_	_	_	_		
CO4	3	2	_	_	_	_	_	_	_	_	_	_		

SYLLABUS

UNIT:1 **[16 Hours]**

STATICS OF PARTICLES

Fundamental concepts and principles of engineering mechanics. Resolution of forces Resultant of several concurrent forces Free body diagram. Principles of transmissibility. Moment of a force Varignon's theorem Equivalent system of forces Types of supports and corresponding reactions.

UNIT:2 **[12 Hours]**

ANALYSIS OF TRUSSES AND FRICTION

Introduction to Truss Analysis of Trusses Method of joints, Method of sections.
Laws of Friction Angle of Friction Angle of Repose Ladder and Wedge Friction

UNIT:3 **[12 Hours]**

PROPERTIES OF SURFACES

Determination of first moment area of plane figures by integration – Determination of centroid of composite figures by using standard formula.
Determination of second moment area of plane figures by integration Parallel and perpendicular axis theorems Determination of area moment of inertia of composite figures by using standard formula Polar moment of inertia Radius of gyration.

UNIT:4 **[10 Hours]**

DYNAMICS OF PARTICLES

Rectilinear motion: uniform velocity and uniformly accelerated motion Newton second law D'Alembert's principle and its applications work and energy equation Impulse and Momentum Impact of elastic bodies.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Timoshenko, and Young, "Engineering Mechanics", Tata Mc Graw Hill Book
2. S. S. Bhavikatti, "Engineering Mechanics", New Age International

Ref. Books:

1. Dr. Bansal.R.K, & Sanjay Bansal, "A Text book of Engineering Mechanics", Lakshmi publications.
2. A.K.Tayal, "Engineering Mechanics Statics And Dynamics", Umesh Publications
3. Rajasekaran.S, & Sankarasubramanian.G, "Engineering Mechanics", Vikas Publishing House Pvt Ltd, 2011
4. Engineering Mechanics, (3ed edition) by Statics and Dynamics K.Vijaya Kumar Reddy and J Suresh Kumar, BS Publications.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1032	BASICS OF THERMODYNAMICS	3	0	0	3	A

Course Educational Objectives

CEO1	Learn to classify the fundamentals of thermodynamics like pressure, temperature etc.
CEO2	Apply principle and law of thermodynamics to analysis of different systems
CEO3	Become aware of relevance of environmental and social issues on the analysis process of systems.
CEO4	To understand the basics of properties of pure substance like steam and its conditions and Application of Thermodynamics in engineering practices

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Explain the basic concepts of system, control volume, thermodynamic properties, thermodynamic equilibrium, temperature, work and heat energy.
CO2	Apply the laws of thermodynamics to refrigerators, heat engines, heat pumps compressors and nozzles etc.
CO3	Interpret and apply the concept of entropy to thermodynamic systems
CO4	Evaluate properties of pure substances, gases and their mixtures and to derive and apply to thermodynamic problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2											
CO2	3	3	3											
CO3		2	2											
CO4	3	3	3											

SYLLABUS

UNIT 1 **(15 Hours)**

Basic concepts & definition, scope of thermodynamics. Macroscopic & microscopic approach. Definition of fixed mass (closed) system & control volume (open) system, isolated system. Thermodynamic properties (extensive & intensive), state & its representation on a property diagram, process and its representation, cyclic process Characteristics of properties (point & path function), reversible & irreversible process, Quasistatic Process. Thermodynamic equilibrium. Pressure, Types of pressure, Zeroth law of thermodynamics & temperature scales, calibration of thermometers. Ideal gasses & their P V T relation. Energy transfer; Work transfer(definition & calculation), different modes of work Displacement work for various process, Free expansion work, Heat transfer; modes of heat transfer, basic laws in conduction, convection & radiation.

UNIT 2 **(13 Hours)**

First law of thermodynamics, formal statement (using cyclic process) first law for processes of fixed masses (closed system) Introduction of internal energy, enthalpy as thermodynamic properties Definition of sp.heats (C_p & C_v) and their use in calculation of internal energy & enthalpy with emphasis on ideal gas. Application of first law to control volume (Steady Flow); nozzle, diffuser, compressor, turbine, throttling device.

UNIT 3 **(12 Hours)**

Second law of thermodynamics, Kelvin Planck & Clausius statements, Carnot cycle. Reversible & irreversible engines and their efficiency (Thermal and maximum Efficiency)

Entropy concepts, Clausius inequality, Entropy Principle.

UNIT IV **(10 Hours)**

Properties of pure substance, P v, T s, h s diagram for steam , Steam properties, Introduction to steam table with respect to specific volume, pressure, temperature, enthalpy & entropy, Mollier Diagram. Application of thermodynamics: Steam power plant, Refrigerators and Heat Pump, I C Engines (working principle with schematic diagrams only)

Teaching Methods: Chalk& Board/ PPT

Text Books:

1 Engineering Thermodynamics by P.K.Nag, Publisher: TMH

2 Basic Engineering Thermodynamics by D S Kumar, Publisher: S K Kataria & Sons New Delhi.

Ref. Books:

1. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI

2. Thermodynamics: An Engineering Approach by Yunus A. Cengel, Michael A. Boles Publisher: Mcgraw Hill Education

3. Thermal engineering by R.K.Rajput, Laxmi Publications Pvt. Ltd.

4. Steam Tables in SI Units by K. Ramalingam, Scitech Publications (P) Ltd.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSES1041	BASICS OF ELECTRONICS	3	0	0	3	A

Course Educational Objectives

CEO1	To know the basic concepts of electronics application's
CEO2	To know the characteristics of basic electronics components

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Recognize different components such as transistors, resistors, capacitors and diodes which fit on a small chip with each leg of the chip connecting to a point within the circuit.
CO2	Apply modern modelling software for drafting different electronic circuits.
CO3	Analyze modern electronic circuits and systems.
CO4	Formulate mathematical descriptions and procedures in designing new electronic systems and technically present

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1													
CO2			2											
CO3			2											
CO4	2		2											

SYLLABUS

UNIT-1 **[12 Hours]**

Semiconductor Devices:- Classification of material, Energy band diagram, properties of semiconductors, Types of semiconductors, Semiconductor diode (no bias, forward, reverse),temperature effects, diode equivalent circuit, zener diode, LED , Half wave rectifier, full wave rectifier, clippers ,clampers.

UNIT-2 **[12 Hours]**

Bipolar Junction Transistors (BJTs):- Introduction, transistor operation, Simplified structure and physical operation of n-p-n and p-n-p transistors in the active region, Common–Base configuration, Common–emitter configuration, Common-collector configuration Current-voltage characteristics of BJT, BJT as an amplifier and as a switch.

Field Effect Transistors (FETs):- Introduction, construction and characteristics of JFETs, transfer characteristics, D-MOSFET, E – MOSFET.

UNIT-3 **[12 Hours]**

Communication systems: - Analog and digital signals, block diagram of basic communication system, need for modulation, methods of modulation,AM/FM transmitters & receivers (Block diagram description only)

Electronic Instruments:- Basic principle of Oscilloscope, Function of the sweep generator, Block diagrams of oscilloscope, Measurement of frequency and phase by Lissajous method, Application of oscilloscope for measurement of voltage, period and frequency, Block diagram of standard signal generator, AF sine and square wave generator, and Function generator.

UNIT-4 **[14 Hours]**

Digital systems and binary numbers:-Digital systems, Binary numbers, number system conversion, octal &hexa decimal number, 1's& 2's compliments, signed binary numbers, binary codes, binary logic.

Logic Gates and Boolean Algebra:- The inverter, The AND, OR, NAND NOR, Exclusive-OR and Exclusive-NOR gate, Boolean operations and expressions, Laws and Rules of Boolean algebra, DeMorgan's theorem, Boolean analysis of logic circuits, Standard forms of Boolean expressions, Boolean expression and truth table Combinational Logic and Their Functions: Basic combinational logic circuits, Implementation of combinational logic, The universal properties of NAND and NOR gates, Basic adders

Teaching Methods: Chalk& Board/ PPT

Text Books:

1. *Electronic Devices (Seventh Edition), Thomas L. Floyd, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092 (Selected Portions).*
2. *Digital Fundamentals (Eighth Edition), Thomas L. Floyd and R.P. Jain, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.*
3. *Electronic Instrumentation, H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.*

Reference Books:

1. *Microelectronic Circuits (Fifth Edition), Adel S. Sedra and Kenneth C. Smith, Oxford University Press, YMCA Library Building Jai Singh Road, New Delhi – 110 001.*
2. *Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.*
3. *Electronics Principles (7th Edition), Albert Malvono and David J. Bates, Tata McGraw-Hill Publishing Company Limited, New Delhi.*

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSES1042	BASICS OF ELECTRICAL ENGINEERING	3			3	A

Course Educational Objectives

CEO1	Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
CEO2	This course provides comprehensive idea about DC & AC circuit analysis, magnetic circuit analysis, working principles of machines and common measuring instruments.
CEO3	Emphasize the effects of electric shock and precautionary measures. Improve the ability to function on multi-disciplinary teams.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Understand basics of Electrical Engineering and to solve complex electrical networks mathematically
CO2	Demonstrate basic laws and techniques to develop a working knowledge of the network theorems of analysis used.
CO3	Understand elementary knowledge of electromagnetism
CO4	Differentiate between DC and AC circuits and analyse them

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2												
CO2	1	2												
CO3	2	2												
CO4	1	1												

SYLLABUS

UNIT-1 **[12 Hours]**

DC Circuits:

Introduction to electrical terminology, Ohm's Law, Equivalent Resistance, series-parallel circuits, star-delta transformation, types of elements, ideal and practical voltage & current sources; Kirchhoff's Law, Mesh and Nodal Analysis. Network theorems:Superposition Theorem, Thevenin theorem, Maximum power transfer theorem excited by independent sources, Transients in RL & RC series circuits.

UNIT-II **[14 Hours]**

Single phase & Three phase Ac circuits:

AC Fundamentals: RMS & Average value, form and peak factors, Complex algebra, concepts of reactance, impedance and their representation, AC through pure R, L, C, series RL, series RC, series RLC circuit, Concept of power & power factor; expression of power in complex notation.

Three-phase AC circuits: Comparison between 1-ph & 3-ph AC circuit, Star & Delta connection, relation between line and phase quantities, Measurement of 3-phase power using 2-wattmeter method.

Magnetic circuits: Magnetic flux, Magnetic flux density, Magnetic fields intensity, Relation between B & H, B-H curve, Analogy between Electric and Magnetic circuit, Leakage flux.

UNIT-III **[12 Hours]**

DC Machines:

Introduction, working principle of DC Generator, Construction, Types, EMF equation, working principle of DC Motor Back e.m.f, Application of DC machines.

AC Machines:Introduction, Principle of operation of AC machines, Transformers, Construction, EMF equation, Turn ratio, Ideal transformer on no load with phasor diagram, 3-phase Induction motor principle of operation, Rotating magnetic field, Types of rotors, Synchronous speed and slip, Introduction to 1-phase Induction motor, 1-phase motors types, applications of 3-phase and 1-phase motors, AC generator and motors, Principle of operation, types of rotors, Synchronous motor operating principle.

UNIT-IV **[12 Hours]**

Measuring Instruments:

Introduction, Classification of instruments, construction and working principles of PMMC and moving iron type Instruments.

Introduction to Power System &Domestic Wiring:

General layout of electrical power system and functions of its elements, Generation of electricity (Hydro, Thermal and Nuclear power plant), standard transmission and distribution voltages, Service main, Meter board, Fuse, MCB, Earthing (pipe & plate earthing), House wiring, Electric shock & precautions.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. V. Del Toro, "Principles of Electrical Engineering" Prentice Hall International.
2. P.V. Prasad, S.Sivanagaraju, R.PrasadBasic Electrical and Electronics Engineering; CENGAGE Learning.
3. I.J. Nagarath, " Basic Electrical Engineering" Tata McGraw Hill
4. D.E. Fitzgerald & A. Grabel Higginbotham, " Basic Electrical Engineering Mc- Graw Hill.

Reference Books:

1. Edward Hughes, " Electrical Technology" Longman
2. T.K. Nagsarkar& M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press.
3. H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
4. W.H. Hayt& J.E. Kennely, "Engineering Circuit Analysis" McGraw Hill.
5. Theory and Problems of Basic Electrical Engineering by D.P.Kothari& I.J. Nagrath PHI.
6. Fundamentals of Electrical Engineering and Electronics by B. L. Theraja, S. Chand & Company Ltd, Reprint Edition 2013.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSES1050	PROGRAMMING IN 'C'	3		1	3	A

Course Educational Objectives

CEO1	To develop programming for solving problems using decision structures and loops, applications using arrays, solving scientific problems using functions and to design applications using pointer and structures.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Develop the algorithms, apply them using C by compiling, debug and analyzing programs for solving problems and to understand the basic concepts and decision structures required to design programs.
CO2	Design programs on loops for solving problems and develop applications using array data structure.
CO3	Develop applications using string operations and solve scientific problems using functions.
CO4	Make use of pointers to design applications and projects, dynamic memory allocation for efficient use of memory and design programs in projects involving structure.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2											
CO2	3	3	3	1										
CO3	3	3	3	1										
CO4	3	2	2											

SYLLABUS

UNIT- I **(11 HOURS)**

Introduction to Programming Language, Structured Programming Approach, Basic structure of C program, C compilers, Compilation and Execution Process, Error debugging.

Tokens in C: keywords, identifiers, data types, constants, variables, standard I/O statements, Operators: arithmetic operators, assignment operators, increment and decrement operators, relational operators, logical operators, conditional operator, bit-wise operators, Operator precedence and associativity, Type casting: Implicit and Explicit type casting. Control Flow Statements: Selection Logic: if, if..else, else if ladder, nested if, switch..case

UNIT- II **(11 HOURS)**

Iteration Logic: while, do-while and for loop, break, continue, nested loop, goto statement.

Arrays: Types of Arrays, 1-D Array: declaration, initialization, array operations, 2-D Array: declaration, Initialization, 2-D array operations

UNIT- III **(13 HOURS)**

1-D character array: String handling and string handling library functions. 2–D character array.

Functions: User Defined Function: function prototype, function definition, function call, return statement, types of parameters, Function categories. Recursive functions, function with 1-D and 2-D array, nesting of functions, Storage classes: auto, register, static, extern.

UNIT- IV **(13 HOURS)**

Pointers: Declaration and initialization of pointers, Pointer arithmetic, Pointer and Arrays, Advantages of character pointer , Array of Pointers, Pointers and Functions: call by value and call by address, Function returning pointer, pointer to function, Pointer to Pointer, Dynamic memory allocation.

User Defined Data Types: typedef, enumeration , structures : Declaration and initialization of structures, accessing structure elements , nested structures, structures and arrays, structures and functions, structure and pointers, self- referential structures,

structures with bit fields, Union: Declaration and initialization of Union, accessing union elements, structure with union.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1. C Programming By E. Balagurusamy, Tata McGraw Hill Publications 2. Let us C by Yashavant P. Kanetkar, BPB Publications 3. Programming with C : Schaum's Outline Series by Byron Gottfried and Jitender Chhabra
Ref. Books: 1. Exploring C by Yashavant P. Kanetkar, BPB Publications 2. C: The Complete Reference : By Herbert Schildt

SUBJECT CODE	**NAME OF THE SUBJECT**	**L**	**T**	**P**	**C**	**QP**
BBSHS 1060	**COMMUNICATIVE ENGLISH-I**	**2**	**0**	**0**	**2**	**A**

Course Educational Objectives

CEO1	To develop the communication skills and soft skills of the students
CEO2	To enhance the ability of the students to develop employability and entrepreneurial skills
CEO3	To enable students to develop intrapersonal and interpersonal communication skills
CEO4	To enable students to participate in group discussions without stage dear
CEO5	To make students understand corporate communication

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the importance of effective communication for personal and professional development.
CO2	Use correct vocabulary and grammar for effective communication in English
CO3	Apply ICT for professional communication
CO4	Develop a positive attitude towards people, organization, and life.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	1	-	3	-	-		
CO2	-	-	-	-	-	-	-	-	-	1	-	2		
CO3	-	-	-	-	-	-	-	2	-	-	3	-		
CO4	-	-	-	-	-	-	-	-	3	-	-	1		

SYLLABUS

UNIT -1 Importance of English for Communication in the 21st Century **(10 hours)**

1.1 Role of English in enhancing employability and entrepreneurial skills 1

1.2 The Nature and Scope of Communication 1

1. 3 Objectives of Communication: Information, advice, suggestion, order, motivation, persuasion, warning, negotiation, decision-making, etc. through English Language skills, i.e., LSRW skills 1 + 1

1.4 The process of communication and factors that influence communication: Sender, receiver, channel, code, topic, message, context, feedback, noise, filters and barriers (steps such as Ideation, Encoding, Transmission, Decoding, etc. need to be dealt with); Audience and purpose 1 + 1+ 1.

1.5 Types of Communication: General and Professional Communication; Formal and Informal Communication; Verbal and Non-verbal communication; Intrapersonal and Interpersonal communication; Written communication and Spoken communication. 1 + 1+ 1.

LAB CODE	NAME OF THE LAB	L	T	P	C	Q P
BBSBS1121	**ENGINEERING PHYSICS LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	Students will understand the basic principles of physics and their mathematical description.
CEO2	Students will be able to use the laws of physics and calculus to solve problems
CEO3	Students will be able to work together in collaborative groups to perform experiments, gather data and reach conclusions.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the uses of various Basic Instruments for different Physical measurements.
CO2	Apply the Physical Laws and verify those using standard Experiments.
CO3	Organize experiments to determine different Physical quantities and anlyze those for different application to Physical Systems.
CO4	Evaluate the magnitudes of Physical quantities systematically through experiments and design new experiments with the theoretical knowledge

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	_	2	_	_	_	_	1	2	_		
CO2	3	3	3	_	3	3	1	_	_	2	_	_		
CO3	_	3	2	3	3	_	_	_	_	2	_	_		
CO4	3	3	3	3	3	_	_	_	2	3	3	_		

List of Experiments:

1. Determination of Rigidity modulus of a material of a wire using Barton's apparatus (Static method).
2. Determination of Young's modulus of a material of a wire using Searle's apparatus.
3. Determination of surface tension of water by capillary rise method.
4. Determination of acceleration due to gravity by using Bar/ Kater's pendulum.
5. Verification of laws of transverse vibration by using Sonometer.
6. Determination of Young's modulus of a material by bending of beam method.
7. Study the characteristics of PN junction diode.
8. Study the characteristics of RC circuit.
9. Study the characteristics of BJT / FET.
10. Determination of grating element of a plane diffraction grating.
11. Determination of wavelength of light by Newton's Rings apparatus.
12. Determination of dielectric constant by Leacher wire method.
13. Study of photoemission.
14. Determination of wavelength of laser by Michelson Interferometer.
15. Determination of coefficient of viscosity by Stoke's method.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSBS1122	**ENGINEERING CHEMISTRY LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To train the students about the applications of chemical sciences in the field of engineering and technology

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the basic methods of chemical analysis and instrumentations involved
CO2	Standardize of Chemicals
CO3	Estimate the hardness, ions in salts and compositions in ores.
CO4	Synthesizes the drugs and know about their applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	2	-	2	-	-	2	-	2	-	3	-		
CO2	-	-	-	-	-	-	3	-	3	-	2	-		
CO3	-	2	-	2	-	-	2	-	2	-	2	-		
CO4	-	2	-	2	-	-	2	-	2	-	2	-		

List of Experiments:

1. Determination of total hardness of water by using EDTA.
2. Determination of amount of NaOH and Na_2CO_3 present in mixture of two.
3. Standardization of $KMnO_4$ using sodium oxalate.
4. Determination of ferrous ion in Mohr's salt by standardised $KMnO_4$
5. Determination of % of dissolved oxygen in given water sample.
6. Estimation of available chlorine in bleaching powder solution.
7. Determination of rate constant of acid catalyst Hydrolysis reaction.
8. Preparation of aspirin.
9. Estimation of calcium in limestone.
10. Estimation of Zinc in brass.
11. To determine the strength of HCl and acetic acid from the mixture of acid by strong alkali (NaOH) by Conductrometry.
12. Preparation of nanoparticle.
13. Determination of partition coefficient of iodine in benzene and water.
14. Preparation and determination of pH of buffer solution.
15. To determine the molecular weight of polymer by viscosity measurement.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES1141	**BASICS OF ELECTRONICS LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To know the basic concepts of electronics application's
CEO2	To know the characteristics of basic electronics components

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Test electronic components and devices with multi meter
CO2	Demonstrate the measuring quantities of Oscilloscopes, Signal generators
CO3	Evaluate the characteristics of transistors, MOSFETs etc.,
CO4	Classify various logic gates and Adder circuits

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	1											
CO2		2	2											
CO3		1	1											
CO4		2	2											

SYLLABUS

List of Experiments:

1. Familiarization of electronic components and devices (Testing of semiconductor diodes and transistors using digital multi meter)
2. Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform.
3. V-I characteristics of semiconductor diode
4. Studies on half-wave and full-wave rectifier circuits without and with capacitor filter; recording of the waveforms and measurement of average and rms values of the rectifier output.
5. Studies on clipper circuit.
6. Studies on clamper circuit.
7. V-I characteristic of an n-p-n or p-n-p transistor, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
8. MOSFET I-V characteristics
9. Studies on Logic gates (Truth table verification of various gates).
10. Studies and experiments using ADDER CIRCUITS ICs

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES 1142	BASICS OF ELECTRICAL ENGINEERING LABORATORY	0	0	2	1	

Course Educational Objectives

CEO 1: To know the basic concepts on different types of circuits.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Illustrate the transformers and single phase motors constructional features
CO2	Analyse various electrical quantities with combination of loads
CO3	Examine the characteristics of AC and DC machines
CO4	Distinguish the methods of speed control of DC motors

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	2											
CO2		2	2											
CO3		1	2											
CO4		2	2											

SYLLABUS

List of Experiments:

1. Study of different electrical equipment's(transformer, single phase motors)
2. Power factor improvement using capacitor for fluorescent lamp.
3. Verification of Superposition and Thevenin's theorem
4. Measurement of reactive power by using single watt-meter method
5. 3phase Power measurement by using two wattmeter methods.
6. Calculation of current, voltage and power in series R-L-C circuit excited by single-phase AC supply and calculation of power factor.
7. Determination of open circuit characteristics (OCC) of DC shunt generator
8. Starting and speed control of a dc shunt motor by (a) field flux control method, and (b) armature voltage control method.
9. V-I characteristics of incandescent lamps and time-fusing current characteristics of a fuse.
10. Connection and testing of a single-phase energy meter.

Subject Code	Title of the subject	L	T	P	C	QP
BBSES 1150	**Programming in 'C' Lab**	**0**	**0**	**2**	**1**	-

Pre -Requisite:

Course Educational Objective

CEO1: To provide the ability to understand how analyze a problem and finding logic, to write programs, compiling, tracing errors, executing programs.

CEO2: The students will be able to understand how to write effective codes using the concepts provided in C language.

Course Outcome

CO1	Develop the algorithms and then implement, compile and debug programs in C language for solving problems and to design programs on decision structures.
CO2	Design programs on loops for solving problems and to develop applications using arrays.
CO3	Develop applications using string operations and applying functions to solve scientific problems
CO4	Design applications using pointers, dynamic memory allocation and develop simple projects involving structure.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2												
CO2	3	3	3	1											
CO3	3	3	3												
CO4	3	3	3	1											
Avg.															

Assignment-1:

Introduction to OS: commands, Use of different application software, file and directory management. (use of linux commands/windows operations)

Assignment-2:

Introduction to the C compilers, simple programs writing, Compilation and Execution Process.

2.1	WAP to display name, address, age using a simple program
2.2	WAP to input 2 numbers and display their difference
2.3	WAP to input three numbers and find their average
2.4	WAP to input your name, age and percentage and then display
2.5	WAP to read two numbers and find their product.

Assignment-3:

3.1	WAP to input radius of a circle. Find the area and perimeter of it.
3.2	WAP to input two numbers and swap them without using intermediate variable.
3.3	WAP to input marks for physics, mathematic, chemistry, English by considering each subject have maximum 100 marks. Find and display their percentage.
3.4	Write a program to accept Fahrenheit and calculate its equivalent Celsius.
3.5	Write a program to input a number and check whether it is greater than 0 or not.

Assignment-4: (Operators, type casting, getchar and putchar)

4.1	Write a program to find the area of the triangle using formula sqrt(s*(s-a)*(s-b)*(s-c)) where 's' is the half perimeter and a,b,c are three sides.
4.2	Write a program to input two numbers into variables x,y. Then Find x^y (means x to the power y)
4.3	Write a program to input two integers into x and y. Apply bitwise AND, OR operations on them and display the results.
4.4	Write a program to input an integer value into a variable X. Find and display X/2 in terms of float.
4.5	Write a program to input a float value. Display the integer part and fractional part separately.

Assignment-5: (Operators, type casting, getchar and putchar)

5.1	Write a program to perform x=x*2 without using * operator and also x=x/2 without using / operator.
5.2	Write a program to input three numbers and find the greatest using conditional operator.
5.3	Write a program to input 4 numbers and find the greatest using conditional operator.
5.4	Write a program to input a character using getchar() and display using putchar()
5.5	Write a program to input a string using gets() and display using puts()

Assignment-6: (if..else)

6.1	Write a program to input your age and check whether age>=18 or not using if..else
6.2	Write a program to find greatest among three unequal numbers using else…if ladder.
6.3	Write a program to find the roots of a quadratic equation when three co-efficient values are given.(use if..else)
6.4	Write a program to accept arithmetic operator and two operands. Find the result as per the operator symbol entered using else if ladder.

Assignment -7: (Switch..case)

7.1	Write a program to display weekday as per the digit given within (1 to 7), i.e: 1 – Sunday, 2- Monday, 3-Tuesday etc. Use switch..case
7.2	Write a program to find the greatest among three numbers using switch case.
7.3	Write a program to accept a lower case character and test whether it is vowel or consonant using switch.. case
7.4	Write a program to accept arithmetic operator and two operands. Find the result as per the operator symbol entered using switch..case.

Assignment -8: (Loop)

8.1	Write a program to display all the 256 characters of the C language
8.2	Write a program to find the sum of individual digits of a positive integer.
8.3	Write a program to generate Fibonacci series of N numbers.
8.4	Write a program to find the greatest common divider of two positive numbers given as input

Assignment -9: (Loop)

9.1	Write a program to accept a number test whether it is palindrome or not.
9.2	Write a program to input a number and check whether it is prime or not.
9.3	Write a program to input a number and check whether it is Armstrong or not.
9.4	Write a program to input a positive integer and find its equivalent binary number.

Assignment -10: (Loop)

10.1	Write a C program to display all the natural numbers except the numbers divisible by three within the range 1 to 100
10.2	Write a C program all the prime number between 1 to n where n is the value supplied by the user
10.3	Write a program to find the sine X value of a given number when the X value and the number of terms given input
10.4	Write a program to check a number is magic number or not.

Assignment -11: (Loop)

11.1	Write a program to generate the following pyramid. 1 1 2 3 1 2 3 4 5 1 2 3 4 5 6 7
11.2	Write a program to generate the following pyramid. 1 1 1 1 2 1 1 3 3 1 1 4 6 4 1
11.3	Write a program to generate pyramid: Z Z Y X Z Y X W V Z Y X W V U T

Assignment -12: (1d array)

12.1	Write a program to accept 10 integer in to an array and find largest and smallest integers present in them
12.2	Write a program to input a number and search how many times it is exist in the given list of elements in an array.
12.3	Write a program to accept 10 numbers in to an array and sort it in ascending order

Assignment -13: (2-D Array)

13.1	Write a program to input elements 4x4 matrix. Find the principal diagonal of them.
13.2	Write a program to input values into two matrices P(3x3). Find the sum of individual rows and individual columns or the matrix.
13.3	Write a program to input values into two matrices A(3x4), B(4x3). Perform matrix multiplication and display the resultant matrix C(3X3) matrix.

Assignment -14: (String handling)

14.1	Write a program to input a character and a sentence. Find the frequency of the character in the sentence.
14.2	Write a program to accept a string and test whether it is palindrome or not without using string handling functions
14,3	Write a program to input two strings and check whether they are equal or not using string handling functions.

Assignment -15: (Functions)

15.1	Write a C program to create a user defined function to find the factorial of a given integer.
15.2	Write a C program which contains three UDF's namely add(), subtract() and multiply(). Each function accepts two integers as their arguments and calculate and return the results
15.3	Write a program to create and UDF that tests a number is perfect or not.

Assignment -16: (Functions)

16.1	Write a C program to create an UDF to test a number is strong or not.
16.2	Write a C program to create an UDF which accepts a number and returns the sum of digits of it.
16.3	Write a program to create an UDF which accepts a string and count the vowels present in it.

Assignment -17: (Recursive functions)

17.1	Write a program to find gcd of two integers using recursive function.
17.2	Write a program to input 10 integers, then using recursive function find the largest number.
17.3	Write a program to generate Fibonacci series of N numbers using recursive function.

Assignment -18: (Function with array)

18.1	Write a program to create an UDF which accepts an integer array of 10 elements and returns the count of odd numbers present in it.
18.2	Write a program to create an UDF which accepts a square matrix along with values and displays the transpose of it.
18.3	Write a program to create an UDF which performs addition of two matrices.

Assignment -19: (Pointers)

19.1	Write a program to create user defined function called swap having two integer pointers as its arguments and it has no return value. Call this function for interchanging two values using call-by-address.
19.2	Write a program to input a set of n numbers into an integer array. Create an UDF that accepts the array using pointer and finds number of prime numbers exist in the array.
19.3	Write a program to input two numbers and using call by address concept find LCM and GCD.

Assignment -20: (Pointers & Array)

20.1	Write a program to input a string and then using pointer find how many vowels present in the string.
20.2	Write a program to create an UDF which accepts a number and finds the reverse of it using call by address concept
20.3	Write a program to create an UDF which accepts two strings and then concatenates both strings (use character pointers as parameters in UDF)

Assignment -21: (Pointers & function)

21.1	Write a program to input 10 integers into an array. Create an UDF which accepts the base address of array and finds the sum of even numbers and sum of odd numbers separately.
21.2	Write a program to input 10 integers into an array. Create an UDF which accepts the base address of the array and finds the largest element.
21.3	Write a program to create an UDF which accepts the base address of an integer matrix and it returns the address of largest element present in it.

Assignment -22: (Character pointer)

22.1	Write a program to create an user defined function which accepts a string using a character pointer and returns the length of the string
22.2	Write a program to create an array of character pointers and store a group of strings into it.
22.3	Write a program to accept a string using character pointer and then create an UDF which displays the reverse of the string.

Assignment -23: (Dynamic memory)

23.1	Write a program to store N integers using dynamic memory allocation. Find the mean value of it using a function.
23.2	Write a program to store N float values using DMA and create an UDF which finds the sum of them.
23.3	Write a program to store N numbers in to memory using DMA and then using UDF check how many Armstrong numbers exist in it.

Assignment -24: (Structure)

24.1	Write a program to create a structure called COLLEGE having members: name, location, pincode. Store the details of your college and print again.
24.2	Write a program to create a structure called STUDENT having members: rollno, name, age, branch. Store one student details and display it again.
24.3	Write a program to create a structure called PRODUCT having members: product no, name, manufacturing date. Create another structure called DATE which shall be used for declaring the member manufacturing date. Store a product details and print again.

Assignment -25: (Structure with array)

25.1	Write a program to create a structure CRICKET having members: player name, team name and batting average. Store 10 cricket players details in structure array. Then display only those details where batting average>=50
25.2	Write a program to create a structure BOOKS having members : Book code, book name, author, cost. Store 10 books details using structure array. Find the total cost of all books and the costly book exist.

Assignment -26: (Structure with UDF)

26.1	Write a program to create a structure called complex to represent a complex number. Perform addition of two complex numbers using UDF
26.2	Write a program to create a structure for employee code, name and salary. Store five employee details using structure array and display only employee names whose salary is greater than 25000 using UDF

Assignment -27: (Structure with pointer and array)

27.1	Write a program to create structure called ITEM having members: item code, name, price. Create a structure array of size 10. Store the item details and then using a structure pointer display all the items whose price>=500
27.2	Write a program to create a structure called SUBJECTS having members: rollno, physics, chemistry, maths, total marks. Create a structure array to store 10 students marks. Calculate the total marks of each student. Use a structure pointer to find the topper.

Assignment -28: (Dynamic memory, structure & union)

28.1	Write a program to create a structure for product having members like product code, product name, price and quantity. Create a structure pointer to allocate memory for five products using dynamic memory allocation. Store the product details and display.
28.2	Write a program to create a structure student having members like rollno, name and percentage. Store five student details using structure array. Create an user defined function that accepts the student details using a structure pointer and counts how many first division students present

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSHS 1160	COMMUNICATIVE ENGLISH-I LABORATORY	0	0	2	1	

Course Educational Objectives

CEO1	To develop the vocabulary and usage skills of students by practice
CEO2	To develop the communication skills of the students, especially Listening and Speaking skills.
CEO3	To enable students to participate in group discussions through proper listening and speaking.
CEO4	To enable students eliminate grammatical mistakes in speech and writing.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Memorize and explain a good range of vocabulary and usage .
CO2	Use grammar for effective speaking in GD and other formats of speaking
CO3	Able and defend in conversational and public speaking competencies.
CO4	Develop active listening and speaking skill in different real life situation

CO-PO & PSO Mapping

	PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	-	2	1	-		
CO2	-	-	-	-	-	-	-	-	2	2	-	-		
CO3	-	-	-	-	-	-	-	-	2	2	-	-		
CO4	-	-	-	-	-	-	-	-	-	2	-	1		

SYLLABUS

Phonetics & Listening Skills 16 hours = 8 classes [2 listening tests x 10 marks = 20 marks]

Vowels, diphthongs, consonants, consonant clusters; The International Phonetic Alphabet (IPA); phonemic transcription; Problem sounds; Syllable division and word stress; Sentence rhythm and weak forms; Contrastive stress in sentences to highlight different words; Intonation: falling, rising, and falling-rising tunes; Listening to Newspaper reading/Video, etc. Listening with a focus on pronunciation (ear-training): segmental sounds, stress, weak forms, intonation & Listening for comprehension. Reading of English daily newspapers and self-development books be integrated listening and speaking activities.

Speaking skills 16 hours = 8 classes [4 speaking tests x 10 = 40 marks]

- Topics for 1 minute, 2 minutes, and 5 minutes speaking
- Pictures, Quotations, Attitude-testing Questions may be used.
- Summarizing/responding to handouts, articles, books, magazines and newspapers.

Individual/Group presentations/discussion on given topics

Soft skills development 14 hours = 7 classes [4 assignments x 10 = 40 marks]

Positive thinking (Teachers to engage game/activity-oriented classes)

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text/Reference Books:

1. Business and Corporate Soft skills developed by Rai Tech. University (PDF available)
2. Spoken English (with CD). Sasikumar V and P V Dhamija. New Delhi: Tata McGraw-Hill Education Pvt. Ltd. (2nd Ed.)

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1171	ENGINEERING DRAWING	0	0	2	1	

Course Educational Objectives

CEO1	To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions
CEO2	To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Demonstrate the views of different solid object.
CO2	Construct projection of plane surface and solids.
CO3	Develop Sections of various Solids surface.
CO4	Identify the projection in isometric scale.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			1						1	3			
CO2	1		1	3						2	1			
CO3				1						3				
CO4				1						3				

Unit 1

1. Introduction: Introduction to Standards for Engineering Drawing practice, Line work and Dimensioning. [1 – Sheets]
2. Co ordinate system and reference planes: Definitions of HP, VP, RPP & LPP. Selection of drawing size and scale. Representation of point and line. [1 – Sheets]

Unit 2

3. Orthographic Projections : Introduction, Definitions Planes of projection, reference line, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only),True and apparent lengths, True and apparent inclinations to reference planes. [1 – Sheets]
4. Orthographic Projections of Plane Surfaces (First Angle Projection Only): Introduction, Definitions– projections of plane surfaces–triangle, square, rectangle, hexagon and circle. [1 – Sheets]
5. Projections of Solids (First Angle Projection Only) : Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, cylinders and cones in different positions. [1 sheet]

Unit 3

6. Sections and Development of Lateral Surfaces of Solids : Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. [2 – Sheets]

Unit 4

7. Isometric Projection (Using Isometric Scale Only) : Introduction, Isometric scale, Isometric projection of tetrahedron, cones and spheres. [1 – Sheets]

Teaching Methods: Chalk& Board

TEXT BOOKS

1. Engineering Drawing N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing S. Trymbaka Murthy, I.K. International Publishing House Pvt. Ltd., New Delhi
1. 3. Engineering Drawing by N. S. Parthasarathy and Vela Murali Oxford University Press.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1172	ENGINEERING WORKSHOP	0	0	2	1	

Course Educational Objectives

CEO1	CEO1: To enable students to work on different trades like Fitting, Carpentry, Black smithy etc… which makes the students to learn how various joints are made using wood and other metal pieces
CEO2	CEO2: To familiarize with the basic manufacturing processes and to study the various tools and equipment used, hands on training is given in different sections

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Explain various safety precaution and use of various hand tools
CO2	Demonstrate the process configuration and basic mechanism of different machines like Lathe, Shaper and Milling machine.
CO3	Identify and apply suitable tools for machining processes including turning, thread cutting, facing, knurling and drilling.
CO4	Practice on manufacturing of components using workshop trades including fitting and welding

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

Unit 1

1. Safety Precaution: To study the various Safety precautions in workshop.
2. Fitting :

(i) Study of different hand tools and Machine tools used in fitting.
(ii) Preparation of a male and female fitting job by using different hand tools.

Unit 2

3. Machining:

(i) Study of various components and working principle of lathe machine
(ii) Preparation of a cylindrical job by lathe (turning, Thread cutting, knurling)
(iii) Study on Shaper and Milling Machine

Unit 3

4. Welding Practice :

(i) Hand on practice on Electric Arc Welding to prepare Lap Joint, Butt Joint, T Joint and Corner Joint .
(ii) Study of Oxyacetylene Gas welding and Gas cutting.

Teaching Methods: Chalk & Board, Hands on practice.

Reference Books:

1. Elements of Workshop Technology, Vol. I and II by Hajra choudhary, Khanna Publishers
2. Workshop Technology by WAJ Chapman, Viva Books
3. Workshop Manual by Kannaiah / Narayana, Scitech Publicaitons(P) Ltd.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS 2010	ENGINEERING MATHEMATICS-II	3	1	0	4	A

Course Educational Objectives

CEO1	To apply Laplace Transform methods to solve initial value problems for constant coefficient linear ODEs.
CEO2	To calculate the gradients and directional derivatives of functions of several variables
CEO3	To introduce the concept of Vector differentiation and integration that finds applications in various fields like solid mechanics, fluid flow, heat problems and potential theory

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	To Solve Ordinary differential and partial differential equation by using Laplace transform and its application in Network theory, wave equation etc
CO2	To execute the technique of Fourier Integral and transform for learning in advanced Engineering Mathematics
CO3	To relate gradient, curl and divergence and its application in electromagnetic theory
CO4	To evaluate multiple integrals by using Green's, Stokes' and divergence theorem to give physical interpretation of the curl and divergence of a vector field

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	2	-	1	-	-	-	-	1		
CO2	3	3	-	-	1	-	-	-	-	-	-	-		
CO3	2		-	-	1	-	-	-	-	-	-	-		
CO4	2	-	-	-	2	-	-	-	-	-	-	1		

SYLLABUS

UNIT:1 Laplace Transforms **15 Hours**

Laplace Transforms: Definition, existence of Laplace Transform, Properties of Laplace Transform, Evaluation of integrals by Laplace Transforms, Inverse transforms, convolution theorem, transforms of unit step function, unit impulse function, periodic function.

UNIT:2 **12 Hours**

Introduction of Fourier transform and Fourier Integral, Simple application to ordinary differential equations by Laplace Transform,

UNIT:3 **10 Hours**

Vector differential calculus: vector and scalar functions and fields, Derivatives, Curves, tangents and arc Length, gradient, divergence, curl and their applications.

UNIT:4 **16 Hours**

Definition and evaluation of double integration and triple integration.

Vector integral calculus: Evaluation of line integral, Surface integral and volume integral and their application, Greens theorem, stokes theorem, Gauss theorem (without proof)

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books

1. Advanced Engineering Mathematics by E. Kreyszig, John Willey & Sons Inc. 10th Edition

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS1021	**ENGINEERING PHYSICS**	**3**	**0**	**0**	**3**	**A**

Course Educational Objectives

CEO1	To provide the students about the elementary features and the basic concepts of Physics and its applications to different physical systems.
CEO2	Students will be able to communicate these concepts clearly, develop problem solving skills and critical thinking.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Solve engineering problems using the concept of oscillation and wave mechanics and recognize the scientific application of Laser.
CO2	To analysis the structural properties of elemental solids
CO3	Determine gradient of scalar field, divergence and curl of vector fields and solve engineering problems on electromagnetism
CO4	Construct a quantum mechanical model to explain the behavior of a system at microscopic level.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	_	3	2	_	_	_	_	_	_	_	_	_		
CO2	_	_	_	_	3	_	1	_	_	_	_	_		
CO3	_	3	_	_	1	_	_	_	_	_	_	_		
CO4	3		2	_		_	_	_	_	_	_	_		

SYLLABUS

UNIT:1 Interaction of Wave and Matter (12 Hours)

Introduction to Harmonic Oscillator, Waves and its Characterstics, Superpositition of Waves, Interference by division of wavefront (Biprism experiment) and division of amplitude
(Newton's Ring experiment). Introduction to Diffraction, types of diffraction.
LASER, spontaneous & stimulated emission, Einstein's relation, Ruby Laser and He-Ne Gas Laser, application of Laser. Optical fiber, Acceptance angle, Numerical aperature, Step index and Graded index fibers, applications of optical fiber.

UNIT:2 Physics of Materials (12 Hours)

Crystallography, Crystal structure, crystal direction and plane, Miller indices, Interplanar spacings, Reciprocal Lattice and its characterstics, Reciprocal Lattice of SC, FCC and BCC, Brillouin Zone, Bragg's law.
Energy bands in solids (conduction band, valence band and fermi level), Classification of matter on the basis of band theory.

Ref. Books

1. *Higher Engineering Mathematics by B. V. Ramana , Mc Graw Hill Education.*
2. *Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi.*

Advanced Engineering mathematics by H. K. Das.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSBS1022	ENGINEERING CHEMISTRY	3			3	A

Course Educational Objectives

CEO1	To impart the knowledge of application of chemical sciences in the field of engineering
CEO2	The course aims at elucidating principles of applied chemistry in industrial systems, Water treatment and engineering materials.
CEO3	To give detailed knowledge about the reactivity of metal with environment and it's Prevention from corrosion.
CEO4	To give an idea about fuel and it's characteristics.
CEO5	To enlighten the students with the applications of advanced materials.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Identify suitable water treatments techniques for domestic and industrial purposes
CO2	Differentiate various types of corrosion, and gain knowledge on control measures associated with corrosion
CO3	Classify the different types of fuel , it's analysis and gain knowledge on fractional distillation of petroleum.
CO4	Understand various types of polymers, their preparation along with applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	_	2	3	_	_	_	_	_		
CO2	3	3	1	2	_	2	3	_	_	_	_	_		
CO3	3	3	2	1	_	2	3	_	_	_	_	_		
CO4	3	3	2	1	_	2	3	_	_	_	_	_		

SYLLABUS

UNIT:1 WATER TREATMENT **(12 Hours)**

Types of water, Impurities in water, Types of Hardness, Determination of Hardness by EDTA method, treatment of water for Domestic use, Water softening processes Lime-soda process, Ion Exchange method, Boiler feed water, Scale and Sludge, Caustic embrittlement, Priming and Foaming ,Removal of dissolved gases, Carbonate and phosphate conditioning, colloidal conditioning, Calgon conditioning, Desallination of brackish water by Reverse osmosis

UNIT:2 CORROSION CHEMISTRY **(12 Hours)**

Introduction, Electrochemical cell, electrode potential E.M.F, Definition of corrosion, Types of corrosion: Dry corrosion and wet corrosion, Galvanic corrosion, Concentration cell corrosion, Factors influencing corrosion, corrosion control: Cathodic protection (Sacrificial anodic protection and Impressed current cathodic protection), Inhibitors, protective coatings: Galvanization and Tinning, Passivation.

UNIT:3 FUEL TECHNOLOGY **(12 Hours)**

Introduction, Classification of Fuels, Calorific Value, Charcteristics of a good fuel, Types and analyses (Proximate and ultimate analysis) of coal, Dulong's Formula, Petroleum, (Extraction, purification and refining),Cracking(thermal cracking, catalytic cracking), Knocking, Antiknocking , Octane numbers, Cetane numbers, Unleaded and synthetic petrol, LPG and CNG, Combustion Numericals.

UNIT:4 CHEMISTRY OF ENGINEERING MATERIALS **(12 Hours)**

Introduction, polymer, Classification of polymers, Types of polymerization and mechanism, Plastics: Thermosetting and thermo plastic, PVC, PE,PS,PMMA, PTFE, Bakelite,Nylon-6,6, Nylon-6, Fiber reinforced plastic.*ADD-ON COURSES: Conducting Polymer (Polyaniline, Polyacetylene),Polycarbonates Bio-Degradable and Non-Bio Degradable polymer, Nano composite.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1 Engineering chemistry by Jain & Jain, Dhanpat Rai publishing company (p) Ltd.

Ref. Books:

1. A Text Book of Engineering Chemistry by S.S.Dara,S Chand Publishers

2. A Text Book of Engineering Chemistry by Sashi Chawla,Dhanpat Rai Publishing house.

3.Text Book of Engineering chemistry, 2nd edition, by R.Gopalan,D.Venkapaya & Sulochana Nagarajan, Vikas Publishing House Pvt.Ltd.

4. B. Tech Chemistry-II by P. K. Kar, S. Dash, B. Mishra kalyani publishers.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1031	BASICS OF MECHANICS	3	0	0	3	A

Course Educational Objectives

CEO1	To apply the established engineering method to complex engineering problem.
CEO2	To understand the vectorial and scalar representation of forces and moments.
CEO3	To evaluate the different forces exhibit in truss member.
CEO4	To obtain the knowledge on kinematics and kinetics of particle to analyze simple and practical problems

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Determine the resultant force and moment for given force system.
CO2	Evaluate the forces in members of trusses, frames and problems related to friction.
CO3	Analyze the properties of surface in relation to centroid and moment of inertia
CO4	Adapt the laws of motion, kinematics of motion and their interrelationship

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	_	_	_	_	_	_	_	_	_	_		
CO2	3	3	_	_	_	_	_	_	_	_	_	_		
CO3	3	3	_	_	_	_	_	_	_	_	_	_		
CO4	3	2	_	_	_	_	_	_	_	_	_	_		

SYLLABUS

UNIT:1 **[16 Hours]**

STATICS OF PARTICLES

Fundamental concepts and principles of engineering mechanics. Resolution of forces Resultant of several concurrent forces Free body diagram. Principles of transmissibility. Moment of a force Varignon's theorem Equivalent system of forces Types of supports and corresponding reactions.

UNIT:2 **[12 Hours]**

ANALYSIS OF TRUSSES AND FRICTION

Introduction to Truss Analysis of Trusses Method of joints, Method of sections.

Laws of Friction Angle of Friction Angle of Repose Ladder and Wedge Friction

UNIT:3 **[12 Hours]**

PROPERTIES OF SURFACES

Determination of first moment area of plane figures by integration – Determination of centroid of composite figures by using standard formula.

Determination of second moment area of plane figures by integration Parallel and perpendicular axis theorems Determination of area moment of inertia of composite figures by using standard formula Polar moment of inertia Radius of gyration.

UNIT:4 **[10 Hours]**

DYNAMICS OF PARTICLES

Rectilinear motion: uniform velocity and uniformly accelerated motion Newton second law D'Alembert's principle and its applications work and energy equation Impulse and Momentum Impact of elastic bodies.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Timoshenko, and Young, "Engineering Mechanics", Tata Mc Graw Hill Book
2. S. S. Bhavikatti, "Engineering Mechanics", New Age International

Ref. Books:

1. Dr. Bansal.R.K, & Sanjay Bansal, "A Text book of Engineering Mechanics", Lakshmi publications.
2. A.K.Tayal, "Engineering Mechanics Statics And Dynamics", Umesh Publications
3. Rajasekaran.S, & Sankarasubramanian.G, "Engineering Mechanics", Vikas Publishing House Pvt Ltd, 2011
4. Engineering Mechanics, (3ed edition) by Statics and Dynamics K.Vijaya Kumar Reddy and J Suresh Kumar, BS Publications.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1032	BASICS OF THERMODYNAMICS	3	0	0	3	A

Course Educational Objectives

CEO1	Learn to classify the fundamentals of thermodynamics like pressure, temperature etc.
CEO2	Apply principle and law of thermodynamics to analysis of different systems
CEO3	Become aware of relevance of environmental and social issues on the analysis process of systems.
CEO4	To understand the basics of properties of pure substance like steam and its conditions and Application of Thermodynamics in engineering practices

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Explain the basic concepts of system, control volume, thermodynamic properties, thermodynamic equilibrium, temperature, work and heat energy.
CO2	Apply the laws of thermodynamics to refrigerators, heat engines, heat pumps compressors and nozzles etc.
CO3	Interpret and apply the concept of entropy to thermodynamic systems
CO4	Evaluate properties of pure substances, gases and their mixtures and to derive and apply to thermodynamic problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2											
CO2	3	3	3											
CO3		2	2											
CO4	3	3	3											

SYLLABUS

UNIT 1 **(15 Hours)**

Basic concepts & definition, scope of thermodynamics. Macroscopic & microscopic approach. Definition of fixed mass (closed) system & control volume (open) system, isolated system. Thermodynamic properties (extensive & intensive), state & its representation on a property diagram, process and its representation, cyclic process Characteristics of properties (point & path function), reversible & irreversible process, Quasistatic Process. Thermodynamic equilibrium. Pressure, Types of pressure, Zeroth law of thermodynamics & temperature scales, calibration of thermometers. Ideal gasses & their P V T relation. Energy transfer; Work transfer(definition & calculation), different modes of work Displacement work for various process, Free expansion work, Heat transfer; modes of heat transfer, basic laws in conduction, convection & radiation.

UNIT 2 **(13 Hours)**

First law of thermodynamics, formal statement (using cyclic process) first law for processes of fixed masses (closed system) Introduction of internal energy, enthalpy as thermodynamic properties Definition of sp.heats (C_p & C_v) and their use in calculation of internal energy & enthalpy with emphasis on ideal gas. Application of first law to control volume (Steady Flow); nozzle, diffuser, compressor, turbine, throttling device.

UNIT 3 **(12 Hours)**

Second law of thermodynamics, Kelvin Planck & Clausius statements, Carnot cycle. Reversible & irreversible engines and their efficiency (Thermal and maximum Efficiency)

Entropy concepts, Clausius inequality, Entropy Principle.

UNIT IV **(10 Hours)**

Properties of pure substance, P v, T s, h s diagram for steam , Steam properties, Introduction to steam table with respect to specific volume, pressure, temperature, enthalpy & entropy, Mollier Diagram. Application of thermodynamics: Steam power plant, Refrigerators and Heat Pump, I C Engines (working principle with schematic diagrams only)

Teaching Methods: Chalk& Board/ PPT

Text Books:

1. Engineering Thermodynamics by P.K.Nag, Publisher: TMH
2. Basic Engineering Thermodynamics by D S Kumar, Publisher: S K Kataria & Sons New Delhi.

Ref. Books:

1. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI
2. Thermodynamics: An Engineering Approach by Yunus A. Cengel, Michael A. Boles Publisher: Mcgraw Hill Education
3. Thermal engineering by R.K.Rajput, Laxmi Publications Pvt. Ltd.
4. Steam Tables in SI Units by K. Ramalingam, Scitech Publications (P) Ltd.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSES1041	BASICS OF ELECTRONICS	3	0	0	3	A

Course Educational Objectives

CEO1	To know the basic concepts of electronics application's
CEO2	To know the characteristics of basic electronics components

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Recognize different components such as transistors, resistors, capacitors and diodes which fit on a small chip with each leg of the chip connecting to a point within the circuit.
CO2	Apply modern modelling software for drafting different electronic circuits.
CO3	Analyze modern electronic circuits and systems.
CO4	Formulate mathematical descriptions and procedures in designing new electronic systems and technically present

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1													
CO2			2											
CO3			2											
CO4	2		2											

SYLLABUS

UNIT-1 **[12 Hours]**

Semiconductor Devices:- Classification of material, Energy band diagram, properties of semiconductors, Types of semiconductors, Semiconductor diode (no bias, forward, reverse),temperature effects, diode equivalent circuit, zener diode, LED , Half wave rectifier, full wave rectifier, clippers ,clampers.

UNIT-2 **[12 Hours]**

Bipolar Junction Transistors (BJTs):- Introduction, transistor operation, Simplified structure and physical operation of n-p-n and p-n-p transistors in the active region, Common–Base configuration, Common–emitter configuration, Common-collector configuration Current-voltage characteristics of BJT, BJT as an amplifier and as a switch.

Field Effect Transistors (FETs):- Introduction, construction and characteristics of JFETs, transfer characteristics, D-MOSFET, E –MOSFET.

UNIT-3 **[12 Hours]**

Communication systems: - Analog and digital signals, block diagram of basic communication system, need for modulation, methods of modulation,AM/FM transmitters & receivers (Block diagram description only)

Electronic Instruments:- Basic principle of Oscilloscope, Function of the sweep generator, Block diagrams of oscilloscope, Measurement of frequency and phase by Lissajous method, Application of oscilloscope for measurement of voltage, period and frequency, Block diagram of standard signal generator, AF sine and square wave generator, and Function generator.

UNIT-4 **[14 Hours]**

Digital systems and binary numbers:-Digital systems, Binary numbers, number system conversion, octal &hexa decimal number, 1's& 2's compliments, signed binary numbers, binary codes, binary logic.

Logic Gates and Boolean Algebra:- The inverter, The AND, OR, NAND NOR, Exclusive-OR and Exclusive-NOR gate, Boolean operations and expressions, Laws and Rules of Boolean algebra, DeMorgan's theorem, Boolean analysis of logic circuits, Standard forms of Boolean expressions, Boolean expression and truth table Combinational Logic and Their Functions: Basic combinational logic circuits, Implementation of combinational logic, The universal properties of NAND and NOR gates, Basic adders

Teaching Methods: Chalk& Board/ PPT

Text Books:

1. *Electronic Devices (Seventh Edition), Thomas L. Floyd, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092 (Selected Portions).*
2. *Digital Fundamentals (Eighth Edition), Thomas L. Floyd and R.P. Jain, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.*
3. *Electronic Instrumentation, H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.*

Reference Books:

1. *Microelectronic Circuits (Fifth Edition), Adel S. Sedra and Kenneth C. Smith, Oxford University Press, YMCA Library Building Jai Singh Road, New Delhi – 110 001.*
2. *Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.*
3. *Electronics Principles (7th Edition), Albert Malvono and David J. Bates, Tata McGraw-Hill Publishing Company Limited, New Delhi.*

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSES1042	BASICS OF ELECTRICAL ENGINEERING	3			3	A

Course Educational Objectives

CEO1	Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
CEO2	This course provides comprehensive idea about DC & AC circuit analysis, magnetic circuit analysis, working principles of machines and common measuring instruments.
CEO3	Emphasize the effects of electric shock and precautionary measures. Improve the ability to function on multi-disciplinary teams.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Understand basics of Electrical Engineering and to solve complex electrical networks mathematically
CO2	Demonstrate basic laws and techniques to develop a working knowledge of the network theorems of analysis used.
CO3	Understand elementary knowledge of electromagnetism
CO4	Differentiate between DC and AC circuits and analyse them

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2												
CO2	1	2												
CO3	2	2												
CO4	1	1												

SYLLABUS

UNIT-1 **[12 Hours]**

DC Circuits:

Introduction to electrical terminology, Ohm's Law, Equivalent Resistance, series-parallel circuits, star-delta transformation, types of elements, ideal and practical voltage & current sources; Kirchhoff's Law, Mesh and Nodal Analysis. Network theorems: Superposition Theorem, Thevenin theorem, Maximum power transfer theorem excited by independent sources, Transients in RL & RC series circuits.

UNIT-II **[14 Hours]**

Single phase & Three phase Ac circuits:

AC Fundamentals: RMS & Average value, form and peak factors, Complex algebra, concepts of reactance, impedance and their representation, AC through pure R, L, C, series RL, series RC, series RLC circuit, Concept of power & power factor; expression of power in complex notation. Three-phase AC circuits:

Comparison between 1-ph & 3-ph AC circuit, Star & Delta connection, relation between line and phase quantities, Measurement of 3-phase power using 2-wattmeter method.

Magnetic circuits:

Magnetic flux, Magnetic flux density, Magnetic fields intensity, Relation between B & H, B-H curve, Analogy between Electric and Magnetic circuit, Leakage flux.

UNIT-III **[12 Hours]**

DC Machines:

Introduction, working principle of DC Generator, Construction, Types, EMF equation, working principle of DC Motor Back e.m.f, Application of DC machines.

AC Machines:

Introduction, Principle of operation of AC machines, Transformers, Construction, EMF equation, Turn ratio, Ideal transformer on no load with phasor diagram, 3-phase Induction motor principle of operation, Rotating magnetic field, Types of rotors, Synchronous speed and slip, Introduction to 1-phase Induction motor, 1-phase motors types, applications of 3-phase and 1-phase motors, AC generator and motors, Principle of operation, types of rotors, Synchronous motor operating principle.

UNIT-IV **[12 Hours]**

Measuring Instruments:

Introduction, Classification of instruments, construction and working principles of PMMC and moving iron type Instruments.

Introduction to Power System &Domestic Wiring:

General layout of electrical power system and functions of its elements, Generation of electricity (Hydro, Thermal and Nuclear power plant), standard transmission and distribution voltages, Service main, Meter board, Fuse, MCB, Earthing (pipe & plate earthing), House wiring, Electric shock & precautions.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

5. V. Del Toro, "Principles of Electrical Engineering" Prentice Hall International.
6. P.V. Prasad, S.Sivanagaraju, R.PrasadBasic Electrical and Electronics Engineering; CENGAGE Learning.
7. I.J. Nagarath, " Basic Electrical Engineering" Tata McGraw Hill
8. D.E. Fitzgerald & A. Grabel Higginbotham, " Basic Electrical Engineering Mc- Graw Hill.

Reference Books:

7. Edward Hughes, " Electrical Technology" Longman
8. T.K. Nagsarkar& M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press.
9. H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
10. W.H. Hayt& J.E. Kennely, "Engineering Circuit Analysis" McGraw Hill.
11. Theory and Problems of Basic Electrical Engineering by D.P.Kothari& I.J. Nagrath PHI.
12. Fundamentals of Electrical Engineering and Electronics by B. L. Theraja, S. Chand & Company Ltd, Reprint Edition 2013.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSES2050	DATA STRUCTURE	3			3	A

Course Educational Objectives

CEO1	Develop algorithms for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications. Understand different searching and sorting methods and compare them in terms of performance and applications. Understand and analyze Binary search Tree, AVL Tree, Heap Tree and their applications. Understand the memory representation of graph, its traversal methods and applications. Analyze the Hashing techniques in compare with other sorting techniques.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Develop algorithms for performing different operations on 1D array, matrix, stack, Queue, analyze the difference between them and understand different applications.
CO2	Understand different searching and sorting methods, Linked lists and them compare them in terms of performance and applications.
CO3	Understand the Binary Tree and its memory representation; analyze Binary search Tree and its applications, compare the BST with AVL Tree and examine the advantages.
CO4	Design Heap Tree, observe its applications in sorting. Understand the memory representation of graph; analyze traversal methods and applications of graph. Analyze the Hashing techniques in compare with other sorting techniques.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	11	12	1	
CO1	2	2	2										
CO2	3	2	3	1									
CO3	3	3	3	1									
CO4	3	3	1	1									

SYLLABUS

Unit I **[12 hours]**

Basic concepts: Data abstraction, Algorithm specification, Memory Representation of 1D and 2D Array. Stack: Introduction to stack, basic operations and implementation of stack using arrays Queue: Introduction to linear queue, basic operations and implementation of linear queue using arrays, circular queue, basic circular queue operations & Representation of Double ended Queue Applications on stack – Recursion, infix to postfix conversion, Evaluation of postfix

Unit II [12 hours]
Searching: Linear search and Binary search using linear array Sorting: Bubble sort, Insertion sort, Selection sort, Quick sort, Bucket Sort using linear array. Linked Lists: Basic operations of singly, doubly and circular linked lists, implementation of stack and queue using singly linked list

Unit III [12 hours]
Trees: Introduction, Terminology, Binary Trees, Representation of Binary Trees using arrays and linked lists, Binary tree traversals, Creation of binary tree from in-order & pre-order sequences - Creation of binary tree from in-order & post-order Binary Search Trees: definition, basic operations of BST (Searching, Insertion and deletion) Introduction to AVL trees, Height of an AVL Tree, Balancing AVL tree by rotations after insertions and deletions of a data node.

Unit IV [12 hours]
Heaps: Introduction to binary heaps, definition of a Max-heap, Min-heap, creating Max-Heap, Applications: Heap sort, Priority queue Graphs: Definitions, Graph representation - Adjacency matrix, Incidence Matrix, adjacency lists, Graph Traversals (BFS & DFS), Single source shortest path algorithm (Dijkstra's Algorithm) Topological Sorting Hashing: Hashing Functions, Open hashing (chaining), closed hashing (Open addressing – linear probing, quadratic probing, double hashing), rehashing

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books: 1. Gilberg and Forouzan: "Data Structure- A Pseudo code approach with C" by Thomson publication
2. "Data structure in C" by Tanenbaum, PHI publication / Pearson publication
3. Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms "Tata McGraw Hill.
4. Fundamental of Data Structure" (Schaums Series) Tata-McGraw-Hill.

Reference Books:
1. 'Fundamentals of data structure in C" Horowitz, Sahani & Freed, Computer Science Press.
2. Data Structures, Algorithms And Applications In C++ 2nd Edition (Sartaj Sahni)
3. Data Structure Through C++ Edition-1st (Yashwant Kanitkar)

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSHS 2060	**COMMUNICATIVE ENGLISH-II**	**2**	**0**	**0**	**2**	**A**

Course Educational Objectives

CEO1	To develop the communication skills and soft skills of the students
CEO2	To enhance the ability of the students to develop employability and entrepreneurial skills
CEO3	To enable students to successfully participate in GDs and PIs
CEO4	To make students communicate effectively using technologies and techniques
CEO5	To inculcate a sense of professionalism in students

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the nature and scope of corporate communication and try to be industry ready
CO2	Able to use language skills for professional growth
CO3	Distinguish fact from opinion in reading passages from different text books
CO4	Create professional documents like Resume, Job Application letter for their career needs

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	3	-	-		
CO2	-	-	-	-	-	-	-	-	-	3	2	-		
CO3	-	-	-	-	-	1	-	-	-	3	-	-		
CO4	-	-	-	-	-	-	-	-	-	3	1			

SYLLABUS

UNIT-1 Introduction to Technical Communication **[7 hours]**

1.1 Essence of Technical Communication 1

1.2 Nature and Scope of Technical Communication: 1 +1 +1

Technical Communication -- Interactive and Adaptable; Technical Communication -- Reader Centered; Technical Communication and teamwork; Technical Communication Has Ethical, Legal, and Political Dimensions; Technical Communication – its International and Cross-Cultural nature; Technical communication and use of ICT.

1.3 Need of Technical communication for career development 1

1.4 Computer Assisted Language Learning (CALL) – Self learning through use of technology, Effectiveness of CALL for developing English Language Skills; Use of Internet 1 +1

UNIT - 2 Career Communication **[17 hours]**

2.1. Career making: Setting Goals, SWOT analysis 1
2.3 Preparing a Résumé: Elements of a Résumé; Types of Résumés: Chronological Résumé, Functional Résumé; Use of job portals 1 +1 +1
2.4 Effective Job Application Letter/Cover letter 1 +1
2.5 Group Discussion 1 +1
2.6 Job Interview 1 +1 +1+1 +1
2.7 Effective Oral Presentation 1+1
2.7 Handling a Meeting 1+1

UNIT-3 Technical Approach to Reading **[8 Hours]**

3.1 Know your Reading speed; Advantages of speed reading 1
3.2 SQ4R Techniques of Reading 1+1
3.3. Techniques of Rapid reading: skimming, scanning 1+1
3.4 Understanding coherence and cohesion 1
3.5 Note taking, Mind maps 1+1

UNIT-4 Technical Writing **[14 hours]**

4.1 Writing a technical paper 1+1
4.2 Writing business letters – significance, purpose, structure and elements, layout; types of business letters 1+1+1+1
4.3 Memos 1+1
4.4 Business Reports and Technical proposals 1+1+1+1
4.5 Using the Social media for better communication 1+1

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall.
2. Technical Communication Today by Richard Johnson-Sheehan. Edition 5. Pearson.
3. Communicative English for Engineers and Professionals by Nitin Bhatnagar and Mamta Bhatnagar. Published by DK/Pearson.

Reference Books

1. Basic Communication Skills for Technology by Andre J. Rutherford, Pearson Education Asia, Patparganj, New Delhi.
2. Business Communication by Varinder Kumar and Bodh Raj. Kalyani Publishers.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian
4. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.
5. How to Read better and Faster by Norman Lewis. 4th Edition. Publisher: Crowell.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSBS1121	**ENGINEERING PHYSICS LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	Students will understand the basic principles of physics and their mathematical description.
CEO2	Students will be able to use the laws of physics and calculus to solve problems
CEO3	Students will be able to work together in collaborative groups to perform experiments, gather data and reach conclusions.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the uses of various Basic Instruments for different Physical measurements.
CO2	Apply the Physical Laws and verify those using standard Experiments.
CO3	Organize experiments to determine different Physical quantities and anlyze those for different application to Physical Systems.
CO4	Evaluate the magnitudes of Physical quantities systematically through experiments and design new experiments with the theoretical knowledge

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	_	2	_	_	_	_	1	2	_		
CO2	3	3	3	_	3	3	1	_	_	2	_	_		
CO3	_	3	2	3	3	_	_	_	_	2	_	_		
CO4	3	3	3	3	3	_	_	_	2	3	3	_		

List of Experiments:

16. Determination of Rigidity modulus of a material of a wire using Barton's apparatus (Static method).
17. Determination of Young's modulus of a material of a wire using Searle's apparatus.
18. Determination of surface tension of water by capillary rise method.
19. Determination of acceleration due to gravity by using Bar/ Kater's pendulum.
20. Verification of laws of transverse vibration by using Sonometer.
21. Determination of Young's modulus of a material by bending of beam method.
22. Study the characteristics of PN junction diode.
23. Study the characteristics of RC circuit.
24. Study the characteristics of BJT / FET.
25. Determination of grating element of a plane diffraction grating.
26. Determination of wavelength of light by Newton's Rings apparatus.
27. Determination of dielectric constant by Leacher wire method.
28. Study of photoemission.
29. Determination of wavelength of laser by Michelson Interferometer.
30. Determination of coefficient of viscosity by Stoke's method.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSBS1122	**ENGINEERING CHEMISTRY LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To train the students about the applications of chemical sciences in the field of engineering and technology

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the basic methods of chemical analysis and instrumentations involved
CO2	Standardize of Chemicals
CO3	Estimate the hardness, ions in salts and compositions in ores.
CO4	Synthesizes the drugs and know about their applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	2	-	2	-	-	2	-	2	-	3	-		
CO2	-	-	-	-	-	-	3	-	3	-	2	-		
CO3	-	2	-	2	-	-	2	-	2	-	2	-		
CO4	-	2	-	2	-	-	2	-	2	-	2	-		

List of Experiments:

16. Determination of total hardness of water by using EDTA.
17. Determination of amount of NaOH and Na_2CO_3 present in mixture of two.
18. Standardization of $KMnO_4$ using sodium oxalate.
19. Determination of ferrous ion in Mohr's salt by standardised $KMnO_4$
20. Determination of % of dissolved oxygen in given water sample.
21. Estimation of available chlorine in bleaching powder solution.
22. Determination of rate constant of acid catalyst Hydrolysis reaction.
23. Preparation of aspirin.
24. Estimation of calcium in limestone.
25. Estimation of Zinc in brass.
26. To determine the strength of HCl and acetic acid from the mixture of acid by strong alkali (NaOH) by Conductrometry.
27. Preparation of nanoparticle.
28. Determination of partition coefficient of iodine in benzene and water.
29. Preparation and determination of pH of buffer solution.
30. To determine the molecular weight of polymer by viscosity measurement.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES1141	BASICS OF ELECTRONICS LABORATORY	0	0	2	1	

Course Educational Objectives

CEO1	To know the basic concepts of electronics application's
CEO2	To know the characteristics of basic electronics components

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Test electronic components and devices with multi meter
CO2	Demonstrate the measuring quantities of Oscilloscopes, Signal generators
CO3	Evaluate the characteristics of transistors, MOSFETs etc.,
CO4	Classify various logic gates and Adder circuits

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	1											
CO2		2	2											
CO3		1	1											
CO4		2	2											

SYLLABUS

List of Experiments:

11. Familiarization of electronic components and devices (Testing of semiconductor diodes and transistors using digital multi meter)
12. Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform.
13. V-I characteristics of semiconductor diode
14. Studies on half-wave and full-wave rectifier circuits without and with capacitor filter; recording of the waveforms and measurement of average and rms values of the rectifier output.
15. Studies on clipper circuit.
16. Studies on clamper circuit.
17. V-I characteristic of an n-p-n or p-n-p transistor, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
18. MOSFET I-V characteristics
19. Studies on Logic gates (Truth table verification of various gates).
20. Studies and experiments using ADDER CIRCUITS ICs

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES 1142	BASICS OF ELECTRICAL ENGINEERING LABORATORY	0	0	2	1	

Course Educational Objectives

CEO 1: To know the basic concepts on different types of circuits.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Illustrate the transformers and single phase motors constructional features
CO2	Analyse various electrical quantities with combination of loads
CO3	Examine the characteristics of AC and DC machines
CO4	**Distinguish the methods of speed control of DC motors**

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	2											
CO2		2	2											
CO3		1	2											
CO4		2	2											

SYLLABUS

List of Experiments:

11. Study of different electrical equipment's(transformer, single phase motors)
12. Power factor improvement using capacitor for fluorescent lamp.
13. Verification of Superposition and Thevenin's theorem
14. Measurement of reactive power by using single watt-meter method
15. 3phase Power measurement by using two wattmeter methods.
16. Calculation of current, voltage and power in series R-L-C circuit excited by single-phase AC supply and calculation of power factor.
17. Determination of open circuit characteristics (OCC) of DC shunt generator
18. Starting and speed control of a dc shunt motor by (a) field flux control method, and (b) armature voltage control method.
19. V-I characteristics of incandescent lamps and time-fusing current characteristics of a fuse.
20. Connection and testing of a single-phase energy meter.

Subject Code	**Name of the Subject**	**L**	**T**	**P**	**C**	**QP**
BBSES 2150	**Data Structures using 'C++' Laboratory**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	Develop algorithms for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications.
CEO2	Understand different searching and sorting methods and compare them in terms of performance and applications. Understand and analyze Binary search Tree, AVL Tree, Heap Tree and their applications.
CEO3	Understand the memory representation of graph, its traversal methods and applications. Analyze the Hashing techniques in compare with other sorting techniques.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand and implement the object oriented concepts by in developing the programs for different operations.
CO2	Develop programs for performing different operations on 1D array, matrix, stack, Queue, analyze the difference between them and understand their applications.
CO3	Design code for different searching and sorting methods and analyze their performance.
CO4	Develop the codes for different operations on Linked lists and compare with other data structures.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	3												
CO2	3	2													
CO3	3	3													
CO4	3	3	3												
Avg.															

SYLLABUS

Lab1: introduction to OOPs (C++ features), cin, cout, object, class, Simple programs.

Lab2: Access Specifiers, inline, private, public, arrays of objects, programs on them.

Lab3: Experiment No.1

1) Write a C++ program to create a class called student to store your rollno, name, age. Create an array of object to input 5 students data and then display where age>=20.
2) Write a C++ program to create a class having methods for operations insertion, deletion and display to perform operations on 1D array of elements.

Lab4: Experiment No.2

Write a C++ program to create a class having methods: insertion, multiply and display for performing multiplication on a matrix of elements.

Lab5: Experiment No.3

Write a program using C++ to create a stack using class and perform:
(i) push operation (ii) pop operation (iii) display operation

Lab6: Experiment No.4

Write a C++ program that uses Stack operations to converting an infix expression into equivalent postfix expression.

Lab7: Experiment No.5

Write a C++ program to create a linear queue and perform the following operations: (i) insertion ii) deletion and iii) Traversal

Lab8: Experiment No.6

Write C++ programs that use both recursive and non-recursive functions to perform the linear & binary search operation for a Key value in a given list of integers.

Lab9: Experiment No.7

Write a C++ menu driven program to implement bubble sort, selection sort and insertion sort for a given list of integers in increasing order.

Lab10: Experiment No.8

Write a C++ program to implement quick sort to a given list of integers to sort in ascending order.

Lab11: Experiment No.9

Write a C++ program that uses functions to perform the following operations on linear linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal

Lab12: Experiment No.10

Write a C++ program that uses functions to perform the following operations on Double linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSHS 2160	**COMMUNICATIVE ENGLISH LABORATORY-II**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To enable students to successfully participate in GDs and PIs
CEO2	To make students communicate effectively by classroom practice.
CEO3	To inculcate a sense of professionalism in students

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Memorise and explain a good range of vocabulary and usage
CO2	Use grammer for effective speaking in GD and other formats of speaking
CO3	Able and defend in conversational and public speaking comptencies
CO4	Develop active listening and speaking skill in different real life situation

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	-	2	1	-		
CO2	-	-	-	-	-	-	-	-	2	2	-	-		
CO3	-	-	-	-	-	-	-	-	2	2	-	-		
CO4	-	-	-	-	2	-	-	-	-	2	-	1		

SYLLABUS

1. Writing an Effective Job Application Letter/Cover letter	[4 hours]
2. Writing a winning resume and posting in job portals	[4 hours]
3. Group Discussion	[8 hours]
4. Job Interview	[8 hours]
5. Oral presentation	[6 hours]
6. Organizing a Meeting	[4 hours]
7. Note making and Note taking	[4 hours]
8. Memo writing	[2 hours]
9. Profiling a company	[4 hours]
10. Summarizing books/research paper/news report.	
Teaching Methods: Chalk& Board/ PPT/Video Lectures	

Text Books:

1. Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall.
2. Technical Communication Today by Richard Johnson-Sheehan. Edition 5. Pearson.
3. Communicative English for Engineers and Professionals by Nitin Bhatnagar and Mamta Bhatnagar. Published by DK/Pearson.

Reference Books:

1. Basic Communication Skills for Technology by Andre J. Rutherford, Pearson Education Asia, Patparganj, New Delhi.
2. Business Communication by Varinder Kumar and Bodh Raj. Kalyani Publishers.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian
4. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.
5. How to Read better and Faster by Norman Lewis. 4th Edition. Publisher: Crowell.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1171	ENGINEERING DRAWING	0	0	2	1	

Course Educational Objectives

CEO1	To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions
CEO2	To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Demonstrate the views of different solid object.
CO2	Construct projection of plane surface and solids.
CO3	Develop Sections of various Solids surface.
CO4	Identify the projection in isometric scale.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			1						1	3			
CO2	1		1	3						2	1			
CO3				1						3				
CO4				1						3				

Unit 1

8. Introduction: Introduction to Standards for Engineering Drawing practice, Line work and Dimensioning. [1 – Sheets]

9. Co ordinate system and reference planes: Definitions of HP, VP, RPP & LPP. Selection of drawing size and scale. Representation of point and line. [1 – Sheets]

Unit 2

10. Orthographic Projections : Introduction, Definitions Planes of projection, reference line, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only),True and apparent lengths, True and apparent inclinations to reference planes. [1 – Sheets]

11. Orthographic Projections of Plane Surfaces (First Angle Projection Only): Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, hexagon and circle. [1 – Sheets]

12. Projections of Solids (First Angle Projection Only) : Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, cylinders and cones in different positions. [1 sheet]

Unit 3

13. Sections and Development of Lateral Surfaces of Solids : Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. [2 – Sheets]

Unit 4

14. Isometric Projection (Using Isometric Scale Only) : Introduction, Isometric scale, Isometric projection of tetrahedron, cones and spheres. [1 – Sheets]

Teaching Methods: Chalk& Board

TEXT BOOKS

1. Engineering Drawing N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing S. Trymbaka Murthy, I.K. International Publishing House Pvt. Ltd., New Delhi
2. 3. Engineering Drawing by N. S. Parthasarathy and Vela Murali Oxford University Press.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1172	**ENGINEERING WORKSHOP**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	CEO1: To enable students to work on different trades like Fitting, Carpentry, Black smithy etc… which makes the students to learn how various joints are made using wood and other metal pieces
CEO2	CEO2: To familiarize with the basic manufacturing processes and to study the various tools and equipment used, hands on training is given in different sections
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Explain various safety precaution and use of various hand tools
CO2	Demonstrate the process configuration and basic mechanism of different machines like Lathe, Shaper and Milling machine.
CO3	Identify and apply suitable tools for machining processes including turning, thread cutting, facing, knurling and drilling.
CO4	Practice on manufacturing of components using workshop trades including fitting and welding

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

Unit 1

5. Safety Precaution: To study the various Safety precautions in workshop.
6. Fitting :

(iii) Study of different hand tools and Machine tools used in fitting.
(iv) Preparation of a male and female fitting job by using different hand tools.

Unit 2

7. Machining:

(iv) Study of various components and working principle of lathe machine
(v) Preparation of a cylindrical job by lathe (turning, Thread cutting, knurling)
(vi) Study on Shaper and Milling Machine

Unit 3

8. Welding Practice :

(iii) Hand on practice on Electric Arc Welding to prepare Lap Joint, Butt Joint, T Joint and Corner Joint .
(iv) Study of Oxyacetylene Gas welding and Gas cutting.

Teaching Methods: Chalk & Board, Hands on practice.

Reference Books:

1. Elements of Workshop Technology, Vol. I and II by Hajra choudhary, Khanna Publishers
2. Workshop Technology by WAJ Chapman, Viva Books
3. Workshop Manual by Kannaiah / Narayana, Scitech Publicaitons(P) Ltd.

III SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC3010	Fluid Dynamics	3	0	0	3
2	PC	BCHPC3020	Mechanical Operations	3	1	0	4
3	PC	BCHPC3030	Physical and Analytical Chemistry	3	0	0	3
4	BS	BBSBS3040	Engineering Mathematics-III	3	1	0	4
5	ES	BCSES3051	OOPS through JAVA	3	0	0	3
		BCSES3052	Database Management Systems				
6	BS/ HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC3110	Fluid Dynamics Lab	0	0	2	1
8	PC	BCHPC3120	Mechanical Operations Lab	0	0	2	1
9	PC	BCHPC3130	Physical and Analytical Chemistry Lab	0	0	2	1
10	ES	BCSES3151	JAVA Programming Lab	0	0	2	1
		BCSES3152	Database Management Systems Lab				
TOTAL				**18**	**2**	**8**	**24**

Subject code	Course Title	L	T	P	C	QP
BCHPC3010	**Fluid Dynamics**	3	0	0	3	

Pre-Requisites (If any)-Mathematics, Mechanics

Course Educational Objective

CEO1:To impart to the student knowledge on fluid properties, fluid statics, dynamic characteristics through pipes and porous medium, flow measurement and fluid machineries

Course Outcome

CO1	Rephrase the basic principles of fluid mechanics
CO2	Analyze fluid flow problems with the application of the momentum and energy equations
CO3	Explain the pipe flows, mixing processes & fluid machinery
CO4	Compare and distinguish fluid particle systems and equipment, solid-solid separation method and conveying system

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	
CO3	2	3	-	-	-	-	-	-	-	-	-	-	1	
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	

Unit:1 **12hrs**

Methods of analysis and description - fluid as a continuum, Classification of fluid, Fluid statics – basic equation - equilibrium of fluid element – Hydrostatic Pressure, Pressure measuring Devices. Flow in boundary layers. Its formation & growth in tubes & plates. Basic equations of fluid flow continuity, momentum & Bernoulli's equation. Flow measuring devices; Venturi, Orifice, Pitot tube & Rotameter

Unit:2 **13hrs**

Flow of incompressible fluid in pipes, Relation between skin friction & wall shear. Laminar flow in pipes, Hagen-Poiuilles equation, Friction factor, Friction from changes in velocity or direction, Flow of compressible fluids, Basic equations. Flow past immersed bodies, Drag Co-efficient. Motion of particles through fluids. Its mechanics, terminal Velocity. Dimensional analysis

Unit:3 **10hrs**

Friction inflows through beds of solids, Fluidization, Mechanism of fluidization, pressure drop in fluidization, Application of fluidization.

Unit:4 **10hrs**

Transportation of fluids, Flow measurement - Constant and variable head meters; Velocity measurement techniques; Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps, compressors and fans. Concept of slip

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:. Unit operations of Chemical Engg. by Mc Cabe & Smith

2: Fluid Mechanics for Chemical Engg. by Noel Drevers

Ref. Books 1: A Text book of Fluid Mechanics & Hydralic Machines by R.K.Bansal

2: Transport processes and unit operations by Christie J. Geankopolis, PHI

Subject Code	Course Title	L	T	P	C	QP
BCHPC3020	MECHANICAL OPERATION	3	1	0	4	

Pre-Requisites (If any)-Fluid Dynamics, Mathematics

Course Educational Objective

CEO:In this course, the students will learn characterization of solids, size reduction, techniques of solid – fluid separation and mixing

Course Outcome

CO1	Understand and apply the basic methods of characterization of particles and bulk solids.
CO2	Analyze and evaluate the technology of mechanical processing of solid material in order to achieve defined characteristics.
CO3	Describe the operation, as well as constriction and exploitation characteristics of machines for mechanical operations.
CO4	Illustrate the usage of wide specter and sources of information as well as individual and team work.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	-	-	-	-	-	-		
CO2	3	2	-	-	-	-	-	-	-	-	-	-		
CO3	3	2	-	-	-	-	-	-	1	-	-	-		
CO4	3	2	-	-	-	-	-	-		-	-	-		

Unit:1 **10hrs**

Particle size, shape, Specific surface area, etc. Storage and Transportation of solids Size Reduction: Laws of grinding, Jaw, roll and gyratory crushers, revolving mills, Ball mill, attrition mill, fluid energy mill, open Circuit & closed Circuit grinding.

Unit:2 **10hrs**

Size Separation, screening, screening equipments, Trammels, Capacity & effectiveness of screens, Magnetic and Electrostatic Separators.

Unit:3 **10hrs**

Motion of particles through fluid, drag Coefficient, Free and hindered setting, Thickeners, Cyclones, Classifications: Sink & float method, Jigging, Tabling.

Unit:4 **10hrs**

Fillration, Theory, plats & frame filter Press, Leaf fietr, Rotary filter,
Mixing & Agitation, Power consumption of Mixer, Liquid Mixing, Solid Mixing, Mixing equipment. Forth flotation

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Mc Cabe & Smith ,Unit operations of Chemical engineering, Mc Graw lim
2: Coulson & Richabol Vol-2 Chemical Engineering pergammmic Press.

Ref. Books 1: Mechanical Operation for chemical engineers,Narayan and Bhattacharjee
2:Mechanical Operation by Swain. Publisher, Tata McGraw-Hill Education, 2011.

Subject code	Course Title	L	T	P	C	QP
BCHPC3030	**PHYSICAL AND ANALYTICAL CHEMISTRY**	**3**	**0**	**0**	**3**	

Pre-Requisites (If any)-Organic Chemistry, Inorganic Chemistry

Course Educational Objective

CEO1: To enable the students to acquire knowledge in the field of electrochemistry, solubility behaviour, photochemical reactions and colloidal chemistry, adsorption towards different applications

CEO2 : To enable the students to acquire knowledge in the field of chromatography, spectroscopy for analytic purposes

Course Outcome

CO1	Explain the behavior of and interactions between, matter and energy at the atomic and molecular levels
CO2	Apply quantitative reasoning skills to determine quantities of matter and energy involved in physical and chemical changes.
CO3	Analyze the atomic structure, chemical bonding and molecular geometry based model
CO4	Adopt the workings environment to work with various instruments

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	0	0	-	-	-	-	-	-	-	-	3	
CO2	3	3	0	0	-	-	-	-	-	-	-	-	2	
CO3	2	2	2	1	-	-	-	-	-	-	-	-	1	
CO4	1	0	0	0	-	-	-	-	-	-	-	-	2	

Unit:1 **11hrs**

Colloidal system-Introduction and properties of colloidal systems, (preparation details not required), electrical properties, electro kinetic properties: electrophoresis and electro-Osmosis, gels and emulsions Simple mixtures: Partial molar quantities, Theory of mixing; Solution of non-volatile solutes; Colligative properties; Mixture of volatile liquids; Phase rule and phase equilibrium.

Unit:2 **12hrs**

Electro-kinetic phenomena: Ion Transport, Conductivity and Ionic Interactions; Conduct metric titration; Processes at electrode (Electrical double layer, Rate of charge transfer, Over potential and other related aspects); Electrochemical processes; Power generation and storage (Fuel cells, Storage batteries); Corrosion and electrolysis (Elementary idea only).

Unit:3 **10hrs**

Adsorption at surfaces: Growth and structure of solid surfaces; Physical adsorption, and chemical adsorption; applications of adsorption, adsorption of gases by solids Extent of adsorption and adsorption isotherms; Freundlich adsorption isotherm; B.E.T. theory of multilayer adsorption.

Unit:4 **13hrs**

Chromatography and chromatographic methods of analysis. Atomic and molecular spectra: Spectra of simple and complex atoms; General features of spectroscopy; Rotation and vibration of molecules; Electron Spin and Nuclear Magnetic Resonance, Atomic absorption spectroscopy; UV and Visible spectro-photometry; IR absorption spectroscopy; Fluorescence spectroscopy; Mass spectroscopy; Emission spectroscopy; Introduction to NMR spectroscopy; Raman spectroscopy; Moss Bauer spectroscopy.

Teaching Mentod (s):Chalk & Board/PPT

Text Books

1: Puri. B.R., Sharma. L.R.and Madan. S. Pathania, "Principles of Physical Chemistry", 44th Edn., Vishal Publishing Co, Jallandhar, 2010

2: Samuel. H, Maron and Carl.F, Prutton, Principles of Physical Chemistry, 4th Edn., Amerind Publishing Co., 1972.

Ref. Books

1: Seamus P.J. Higson: Analytical Chemistry.

2: Douglas A. Skoog and Donald M..West: Fundamentals of Analytical Chemistry.

Subject code	Course Title	L	T	P	C	QP
BBSBS3050	**ENGINEERING MATHEMATICS-III**					

Course Outcomes

Pre-Requisites (If any) –

CO1	To execute the technique of series for solving ordinary differential equation.
CO2	To Evaluate a contour integral using Cauchy's integral formula and to Compute singularities and also the residues.
CO3	To apply numerical methods in Engineering Mathematical Problems.

Unit:1 SPECIAL FUNCTIONS : **(12 hours)**

Beta and Gamma functions, relation between Beta and Gamma functions, Error function, Series solution of differential equations (up to second order), Legendre equation, Legendre polynomials and their properties, Bessel's function.

Unit:2 Complex Analysis: **(12 hours)**

Analytic function, Cauchy-Riemann equations, Laplace equation, Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions

Unit:3 (12 hours)

Taylor's series, Laurent's series, Singularities and zeros, Residue integration, evaluation of real integrals.

Unit:4 Numerical methods: (14 Hours)

Approximation and round of errors, Roots of equation: fixed point iteration, the Newton-Raphson method. Interpolation: Lagrange Interpolation, Newton divided difference interpolation, Newton's forward and backward interpolation. Numerical Differentiation, Numerical integration: The trapezoidal rule, The Simpson's rules, Ordinary differential equation: Euler's method, modified Euler's method.

Teaching Method(s): Chalk & Board/ PPT/Video Lectures/ MOOC/ Internship/Industry Guest Lecture/ Invited Guest lecture/ Demonstration. etc.

Text Books

E. Kreyszig," Advanced Engineering Mathematics:, Eighth Edition, Wiley India
Numerical method for Engineers by M. K. Jain and Iyenger.

Reference Books

Higher Engineering Mathematics by B S Grewal : Khanna Publishers, New Delhi.
Numerical Analysis by Dutta and Jena

Subject Code	Course Title	L	T	P	C	QP
BCSES3051	**OBJECT ORIENTED PROGRAMMING SYSTEMS**	**3**	**0**		**3**	

Pre -Requisite:

Course Educational Objective

CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
CEO4	How to test, document and prepare a professional looking package for each business project using javadoc.

Course Outcome

CO1	Students will be able to map real world problems into the Programming language with oopfeatures and Implement object oriented principles for reusability.
CO2	Students will be able to write programs using basic data types and strings, using loops, Array.
CO3	Student will be able to Assign priorities and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Students will be able to Interpret Events handling techniques for interaction of the user with GUI and Develop client/server applications using socket programming

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	8	9	10	11	12	1	2
CO1	2			2		1			1		1		
CO2	2			1					1		1		
CO3	1			1		1			1		1		
CO4	2			2					1		1		

UNIT:1 **(10 Hours)**

An introduction Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program?, Architecture of JVM. Understanding, Java Tokens, Datatypes, Operators, Control Structures and Arrays, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

UNIT:2 **(12 Hours)**

Introduction to Classes and Objects. Constructors, static Keyword , this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance ,Types of Inheritance and Java supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. String Manipulations. Wrapper classes, Auto boxing and unboxing. Abstract classes, Interfaces, Multiple Inheritance Using Interfaces, Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details ,User defined exception classes.

UNIT:3 **(12 Hours)**

Multithreading , Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class. IO Streams (java.io package) , Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Util Package interfaces, List, Set, Map

UNIT:4 **(10 Hours)**

Applet Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Programming in Java. Second Edition. Oxford higher education. (Sachin Malhotra/ Saurav Choudhary)
2. Core Java for beginners. (Rashmi Kanta Das), Vikas Publication

Ref. Books

1. JAVA Complete Reference (9th Edition) Herbalt Schelidt

Graphs: Definitions, Graph representation - Adjacency matrix, Incidence Matrix, adjacency lists, Graph Traversals (BFS & DFS), Single source shortest path algorithm (Dijkstra's Algorithm) Topological Sorting

Hashing: Hashing Functions, Open hashing (chaining), closed hashing (Open addressing – linear probing, quadratic probing, double hashing), rehashing

Subject Code	Name of the Subject	L	T	P	C	QP
BCSES3052	**DATABASE MANAGEMENT SYSTEM**	**3**	**0**	**0**	**3**	**A**

Course Educational Objectives

Pre -Requisite:

CEO 1	Gain a good understanding of the architecture and functioning of Database Management Systems as well as associated tools and techniques.
CEO 2	Understand and apply the principles of data modeling using Entity Relationship and develop a good database design.
CEO3	Understand the use of Structured Query Language (SQL) and its syntax
CEO4	Apply Normalization techniques to normalize a database.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	***Identify*** and ***Classify*** the concepts of Database Management system, Data models and architecture of database, ER to Relational mapping concepts.
CO2	***Applying*** the constraints in database using different query languages like:- relational algebra and calculus, SQL and QBE for the ***implementing*** the Data definition and data manipulate languages in Database.
CO3	***Compare*** the different normal forms to ***Apply*** normalization process to construct the consistent Database.
CO4	***Design and Develop*** the Database by inspecting concurrency control and recovery strategies to make complete Database without confliction and anomalies in concurrent access environment.

CO-PO & PSO Mapping:

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1												
CO2	3	2	1												
CO3	2	1	1												
CO4	2	1	2												
Avg.															

SYLLABUS

UNIT:1 **(15 Hours)**

Introduction to database Systems, advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models.

UNIT:2 **(13 Hours)**

Entity relationship model, Components of ER model, Mapping E-R model to Relational schema, Relational Algebra, Tuple & Domain Relational Calculus, Relational Query Languages: SQL and QBE. Database Design:-Database development life cycle (DDLC), Automated design tools, Functional dependency and Decomposition, Join strategies, Dependency Preservation & lossless Design, Normalization, Normal forms:1NF, 2NF,3NF, and BCNF, Multi-valued Dependencies, 4NF & 5NF. Query processing and optimization: Evaluation of Relational Algebra Expressions, Query optimization, Query cost estimation.

UNIT:3 **(10 Hours)**

Network and Object Oriented Data models, Storage Strategies: Detailed Storage Architecture, Storing Data, Magnetic Disk, RAID, Other Disks, Magnetic Tape, Storage Access, File & Record Organization, File Organizations & Indexes, Order Indices, B+ Tree Index Files, Hashing Data Dictionary.

UNIT:4 **(12 Hours)**

Transaction processing and concurrency control: Transaction concepts, properties of transaction, concurrency control, locking and Timestamp methods for concurrency control schemes. Database Recovery System, Types of Data Base failure & Types of Database Recovery, Recovery techniques, fundamental concepts on Object-Oriented Database, Object relational database, distributed database, Parallel Database, introduction to Data warehousing & Data Mining.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *Sudarshan, Korth: Database System Concepts, 6th edition, McGraw-Hill Education*
2. *Elmasari &Navathe: Fundamentals of Database System, Pearson Education.*

Reference Books:

1. *Elmasari &Navathe: Fundamentals of Database System, Pearson Education.*
2. *Ramakrishnan: Database Management Systems, McGraw-Hill Education.*
3. *Andrew S. Tanenbaum: Modern Operating Systems, 3rd Edition, Pearson Education.*
4. *Terry Dawson, Olaf Kirch: Linux Network Administrator's Guide, 3rd Edition O'Reilly*

Subject code	Course Title	L	T	P	C	QP
BMGHS3061	**ENVIRONMENTAL ENGINEERING & SAFETY**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1:The course introduces the students to the environmental consequences of industries

CEO2: To provide minimization of their impacts through technology and legal systems.

Course Outcome

CO1	Students will understand the ecological system of environment.
CO2	They will learn about treatment of water/waste water
CO3	Students should know about cause and remedies of environment pollution and technological approaches
CO4	They will understand the importance of environmental safety.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

UNIT:1 **(10 Hours)**

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

UNIT:2 **(12 Hours)**

Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobicdigestion,Reactor configurations and methane production. Air Pollution: Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, Air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOxremoval,Fugitive emissions.

UNIT:3 **(10 Hours)**

Solid waste, Hazardous waste management, Solid Waste Management, Source classificationand composition of MSW: Separation, storage and transportation, Reuse and recycling, WasteMinimization Techniques. Hazardous Waste Management, Hazardous waste and theirgeneration, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A.,Environmental auditing.

UNIT:4 **(10 Hours)**

Occuptional Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention -Detection, Extinguishing Fire, Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Hydro Carbons Wastes. Personal Protective Equipments.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely,

.Environmental Engineering by Prof B.K. Mohapatra, Seven Seas Publication,
Cuttack

3. Environmental Engineering and Safety ,Raut&Sen Scientific Publishers.

Ref. Books 1. Environmental Engineering by Arcadio P. Sincero&Gergoria A. Sincero PHI Publication

2 Environmental Science, Curringham&Saigo, TMH

Subject code	Course Title	L	T	P	C	QP
BMSHS3062	**ENGINEERING ECONOMICS & COSTING**	3	0	0	3	-

Pre -Requisite:

Course Educational Objective

CEO1: to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost

CEO2: to help students to grasp various economics concepts and theories towards making economic decision.

Course Outcome

CO1	Understanding the fundamentals of economic theory in general- concept of demand & supply, theories of production-Laws of returns
CO2	Overview of cost and revenue concepts: Understood the nature and behavior of cost, cost sheet, Break-even analysis- linear approach and understanding of depreciation with its measurement.
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time-value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indian financial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

UNIT:1 **(12 Hours)**

Engineering Economics –

Meaning, Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.

Demand and Supply Analysis -

Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved)

Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Theory of Production -Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2 **(10 Hours)**

Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved),

Break Even Analysis -

Linear approach (Simple numerical problems to be solved). Depreciation-Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation (Straight line

UNIT:3 **(12 Hours)**

Time value of money -

Interest Analysis - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.

Evaluation of engineering projects-

Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Sensitivity Analysis, Replacement Analysis- Determination of economic life of an asset, Replacement of existing asset with a new asset.

UNIT:4 **(10 Hours)**
Overview of Indian financial system. Commercial bank, Functions of commercial bank, Credit creation, Central bank, Functions of Central Bank. Inflation- Meaning of inflation, types, causes, measures to control inflation. National Income - Definition, Concepts of national income, Method of measuring national income
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1, Vengedasalam, Deviga. Madhavan, Karunagaran, Principles of Economics, Oxford University Press. 2. R. Paneer Seelvan, " Engineering Economics ", PHI 3. Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd 4. Riggs,J.L., Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India 5.Paul, R.R., Money, Banking and International Trade, Kalyni Publishers.
Ref. Books 1.Park, Chan.S, "Fundamental of Engineering Economics", Pearson. 2. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson 3. Thuesen, G.J.,Fabrycky,. Engineering Economy, PHI. 4.Jhingan,M.L., "Macro Economic Theory", Vrinda Publications Ltd

Subject code	course title	L	T	P	C	QP
BCHPC3130	Mechanical Operations Lab					

Pre -Requisite:

Course Educational Objective

CEO1:To enable the students to develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators

Course Outcome: At the end of the course, the students will be able to

CO1	Describe the operation, as well as constriction and exploitation characteris0.tics of machines for mechanical operations.
CO2	Analyze and evaluate the technology of mechanical processing of solid material in order to achieve defined characteristics
CO3	Make use of knowledge in real time.
CO4	Illustrate the usage of wide specter and sources of information as well as individual and team work.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	1	
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	

List of experiment

1. To find out the average size of particles in a sample (Volume-surface mean dia).
2. To determine the critical speed and time of grinding in a ball mill for producing a product with 80% passing a given screen.
3. To separate a mixture of coal into two fractions using sink and float
4. Determination of the effectiveness of a vibrating screen.
5. To verify the Rittinger's and Kick's law using crushing rolls and to find out the Work Index of the coal.
6. To study the characteristics of batch sedimentation using coal sample.
7. To determine the specific cake resistance and filter medium resistance of slurry in Plate and frame filter press.
8. To separate a mixture of sand and iron powder by means of tabling.
9. To find out the reduction ratio in Jaw Crusher and Hammer Mill.
10. To study the separation characteristics of sample of mixture by Jigging and Tabling

Subject code	course title	L	T	P	C	QP
BCHPC3130	**Physical and Analytical Chemistry lab**					

Pre -Requisite: CHEMISTRY

Course Educational Objective

CEO1: To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis

CEO2: To make the student to acquire instrumental methods for quantitative estimation of distribution coefficient, cement analysis. Critical solution temperature.

Course Outcome: At the end of the course, the students will be able to

CO1	Explain the behavior of, and interactions between, matter and energy at the atomic and molecular levels.
CO2	Apply quantitative reasoning skills to determine quantities of matter and energy involved in physical and chemical changes.
CO3	Analyze the atomic structure, chemical bonding and molecular geometry based model
CO4	Adopt the workings environment to work with various instruments

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	0	0	3	-	-	-	-	-	-	-	1	
CO2	3	3	0	0	3	-	-	-	-	-	-	-	2	
CO3	2	2	2	1	2	-	-	-	-	-	-	-	1	
CO4	1	0	0	0	1	-	-	-	-	-	-	-	2	

List of experiment

1. Determination of concentration of arsenic in contaminated ground water.
2. Determination of concentration of iron in ground water.
3. Analysis of fluoride in ground water and potable Water
4. Estimation of dissolved Cl_2 or residual chlorine content present in the supplied water sample by Iodometry.
5. Determination of surface tension of a liquid by drop weight method/stalagmometer.
6. Determination of rate constant for the hydrolysis of ethyl acetate using HCl as catalyst.
7. Determination of percentage of MnO_2 in Pyrolusite.
8. Determination of distribution coefficient between water and carbon tetrachloride.
9. Determination of P^H value of the given slurry.
10. Determination of CaO in Cement.
11. Determination of concentration of sugar solution by Refractometer.
12. Determination of critical solution temperature (CST).

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3151	**JAVA PROGRAMMING LAB**			**2**	**1**	

Pre -Requisite: None

Course Educational Objectives

CEO1	To introduce the pure object-oriented concepts through Java programming.
CEO2	To enable a detailed insight into the Java programming concepts such as creating classes, Methods, Interfaces, Packages, Multithreaded Environment, String handling, Enumerations, Creating small Swing application.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Apply the object-oriented concepts through Java language.
CO2	Demonstrate the concepts of polymorphism and inheritance.
CO3	Write Java programs to implement error handling techniques using exception handling
CO4	Develop solution for a real problem using Java programming.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1											
CO2	3	3			2		1		1					
CO3	3	2			2							1		
CO4	3	3	3	2		1								
Avg														

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

Subject Code	Name of the Laboratory	L	T	P	C	QP
BCSES3152	**DATABASE MANAGEMENT SYSTEM LAB.**	**0**	**0**	**2**	**1**	

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	***Implement*** the concept of Entity-Relationship (E-R) model from specified information and to transform into to relational model.
CO2	***Apply*** the different types of Constraints in relational database and defines the database.
CO3	***Compares*** the different types of manipulation and access methods of data from database.
CO4	***Analyze*** and simple database application that demonstrates understanding of all the above, working as a team.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1												
CO2	3	2	1												
CO3	2	1	1												
CO4	2	1	2												
Avg.															

List of Experiments

1. Use of SQL syntax: insertion, deletion, join, updation using SQL.
2. Programs on join statements and SQL queries including where clause.
3. Programs on procedures and functions.
4. Programs on database triggers.
5. Programs on packages.
6. Programs on data recovery using check point technique.
7. Concurrency control problem using lock operations.
8. Programs on ODBC using either VC++.
9. Programs on JDBC.
10. Programs on embedded SQL using C / C++ as host language.

Additional Assignments

1. Use of NoSQL database like MongoDB.
2. Programs on connectivity to MongoDB using MEAN.
3. Programs on connectivity to Mongo-DB using Python.
4. Programs on connectivity to MongoDB using PHP.

IV SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC4010	Chemical Process Technology	3	0	0	4
2	PC	BCHPC4020	Mass Transfer-I	3	1	0	4
3	PC	BCHPC4030	Heat Transfer	3	0	0	3
4	PC	BCHPC4040	Chemical Process Calculation	3	1	0	4
5	ES	BCSES3051	Object Oriented Programming through JAVA	3	0	0	3
		BCSES3052	Database Management Systems				
6	BS/ HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC4110	Chemical Technology Lab	0	0	2	1
8	PC	BCHPC4120	Mass Transfer-I Lab	0	0	2	1
9	PC	BCHPC4130	Heat Transfer Lab	0	0	2	1
10	ES	BCSES3151	JAVA Programming Lab	0	0	2	1
		BCSES3152	Database Management Systems Lab				
TOTAL				**18**	**2**	**8**	**24**

Subject code	Course Title	L	T	P	C	QP
BCHPC4010	**CHEMICAL PROCESS TECHNOLOGY**	3	0	0	3	

Pre-Requisites (If any)-CHEMISTRY,FLUID DYNAMICS

Course Educational Objective

CEO1:To gain knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory

Course Outcome

CO1	Relate the manufacturing of various inorganic and organic chemicals
CO2	Interpret the process flow diagram and various process parameters
CO3	Analyze the various solve engineering problems during production
CO4	Elaborate the modified process to be adopted in the process industry.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	0	0	-	-	-	-	-	-	1			2
CO2	2	2	1	0			3	-	-	-	-	-		1
CO3	2	2	1	1	-	-	-	-	-	-	-	-		2
CO4	1	0	0	0	-	-	-	-	-	-	-	-		1

Unit:1 **10hrs**

Unit operations and unit processes, functions of chemical engineer, new emerging areas, Indian chemical industry - An overview, Manufacture of Heavy Chemicals: Caustic Soda & Chlorine, HCL, Soda Ash, Sulphuric acid.

Unit:2 **10hrs**

Natural Products:-Edible and essential oils, Extraction and Refining of Oil, hydrogenation of Oil, soaps and detergents, glycerin, pulp and paper industry, manufacture of sugar, starch and its derivatives, Industrial & absolute alcohol, paints and varnishes, Natural dyes.

Unit:3 **12hrs**

Ceramic materials: Cement: Chemical composition of Portland cement, raw materials, dry and wet process for manufacturing cement clinker, setting and hardening of cement. Glass: Composition of glass, raw materials, manufacturing method of glass- pot furnace and tank furnace, annealing of glass. Ceramic: Basic raw materials, white-wares, manufacturing process of porcelain and their forming operations.

Unit:4 **13hrs**

Polymerization industry: Fundamentals, polymerization technology, Production of thermoplastic and thermo-setting resins: polyethylene, PVC, polypropylene, Polystyrene, ABS resins, Phenol formaldehyde, Urea formaldehyde, Epoxy resins, Poly vinyl acetate, Polylactic acid , natural and synthetic rubber(SBR, Butyl rubber) and natural and synthetic fibers(Viscose Rayon, polyamides, polyesters, Terelyne)

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Shreve's Chemical Process Industries, 5th ed. by G T Austin, McGraw-Hill.

2: Dryden's Outlines of Chemical Technology, M. Gopala Rao, Marshall Sittig, East West Press, 1997

Ref. Books 1: Faith, W.L., Keyes, D.B. and Clark, R.L., Industrial Chemicals, 4th Edition, John Wiley.

2: "Textbook of chemical Technology" Vol-1 & Vol-2 by G N Pandey, Vikas Publishing

Subject code	Course Title	L	T	P	C	QP
BCHPC4020	MASS TRANSFER-I	3	1	0	4	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: Students will learn to determine mass transfer rates under laminar and turbulent conditions

CEO2:To provide introduction to physical and thermodynamic principles of mass transfer with an emphasis on how these principles affect the design of equipment and result in specific requirements for quality and capacity

Course Outcome

CO1	To demonstrate about the diffusion process
CO2	Familiar with special distillation techniques such as steam distillation and azeotropic distillation
CO3	Distinguish the mechanism of absorption, distillation and humidification
CO4	Design the distillation column, absorption tower

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0								2			1
CO2	2	2	1	1			3							1
CO3	2	2	1	-	-	-	-	-	-	-	-	-		2
CO4	1	0	0	-	-	-	-	-	-	-	-	-		1

Unit:1 **12hrs** Diffusion: Introduction to Mass transfer operations, molecular diffusion in fluids, binary solutions, Fick's law, equation of continuity, steady state equimolal counter current diffusion, Stefan-Maxwell equation, diffusivity of gases and liquids, application of molecular diffusion, mass transfer coefficients, in laminar and turbulent flow, Interphase mass transfer, Film theory, Penetration theory, surface-renewal theories, analogy between mass, heat and momentum transfer.

Unit:2 **10hrs** Absorption : Solubility of gases in liquids, two components system, multi component system, ideal and non -ideal solutions, choice of solvent for absorption, single component absorption material balance, counter current multistage operations, dilute gas mixtures, non -isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU,NTU concepts for single component absorption.

Unit:3 **10hrs** Distillation: Principle of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation steam distillation, azeotropic and extractive distillation. Continuous distillation: Mc Cabe -Thiele method, Ponchon -Savarit method, Tray efficiencies, introduction to multi component distillation.

Unit:4 **13hrs** Humidification operations: Definition of fundamental terms, Psychometric charts, theory of adiabatic saturation and wet bulb temperature, Lewis relation, Gas liquid contact, Dehumidification, Adiabatic Humidification. Equipments: Natural Circulation, Natural draft, Mechanical draft, Spray tower, Spray chamber, Spray pond. Humidity Measurement: Direct chemical method, Hygrometer method, Sling psychrometer, Dew point method, Mirror method.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures /MOOC/ Internship/Industry Guest Lecture

Text Books 1: Mass Transfer Operations by R E Treybal, McGraw Hill.
2:Unit Operations of Chemical Engineering, 7th ed. by W L McCabe, J C Smith, and P Harriott, McGraw-Hill.

Ref. Books 1: Principles of Mass Transfer and Separation Processes by B K Dutta, PHI.
2: Mass Transfer Operations by A Suryanarayana, New Age International.

Subject code	course title	L	T	P	C	QP
BCHPC4030	**Heat Transfer**	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1:To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

Course Outcome

CO1	Explain the basic concepts and laws of the three modes of heat transfer
CO2	Apply analytical techniques to the solution of conduction heat-transfer problems
CO3	Make use of empirical equations to solve forced and natural convection heat-transfer problems
CO4	Solve simple radiation heat transfer problems

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0	-	-	-	-	-	-	-	2		1	
CO2	2	2	1	1			3						2	
CO3	2	2	1	-	-	-	-	-	-	-	-	-	1	
CO4	1	0	0	-	-	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

Modes of heat transfer, Basic laws of heat transfer, Conduction: Steady-state one, two and three dimensional heat conduction, Heat transfer from extended surfaces, Unsteady state heat conduction in finite and semi-infinite solids, Critical insulation thickness.

Unit:2 **10hrs**

Convection : The convective heat transfer coefficient, introduction to thermal boundary layer, Dimensionless numbers in heat transfer and their significance. Dimensional analysis: Forced Convection, Analogy between heat and momentum transfer: Reynolds's Pradtl and Colburn analogies. Natural Convection: Grashoff number, Natural convection from vertical and horizontal surfaces. Heat Transfer with phase change: Heat transfer from condensing vapors: film and drop-wise condensation. Nusselt equation. Effect of non-condensable gases. Heat transfer to boiling liquids.

Unit:3 **10hrs**

Heat Exchanges : Types of heat exchangers, LMTD. Energy balances, Overall heat transfer Coefficients, Heat Exchanger effectiveness. Fouling factors, Design and description of heat transfer equipment. Types of evaporators, capacity and economy, Boiling point elevation and Duhring's rule, Methods of feeding.

Unit:4 **10hrs**

Heat transfer by radiation : Thermal radiation, Black body radiation, Kirchhoff's law, emissivity, grey body, laws of black body radiation, geometric factor, Radiation in enclosures with black surfaces and grey surfaces. Large parallel plates, concetric, cylindrical, spheres. Combined heat transfer by conduction, convection and radiation

Teaching Method (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Mc Cabe W. L. & Smith J. C. & Harriot P, Unit Operations of Chemical Engineering (5th Edition),Mc Graw Hill, New York

2: Mc Adams, W. H., Heat Transmission

Ref. Books 1: Kern D. Q., Process Heat Transfer

2: R.K Rajput Heat and mass transfer, S. Chand publication

Subject code	course title	L	T	P	C	QP
BCHPC4040	**Chemical Process Calculations**	3	1	0	4	

Pre-Requisites (If any)-Mathematics,Chemistry,Thermodynamics

Course Educational Objective

CEO1:To teach fundamentals of calculation and its application to solution of mass and energy balance equations for single and network of units

Course Outcome

CO1	Demonstrate material balances on unit operations and processes.
CO2	To follow the material balance calculations involving with and without chemical reactions
CO3	Evaluate the degrees of freedom to analyze the system.
CO4	Make use of the concept of humidity and usage of psychometric chart

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	0	0	-	-	-	-	-	-	-	-	2	
CO2	3	3	1	0	-	-	-	-	-	-	-	-	1	
CO3	2	2	2	1	-	-	-	-	-	-	-	-	1	
CO4	1	0	0	0	-	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

Units, dimensions and conversions, Fundamental concept of stoichiometry- mole concept, density, specific gravity and its scale, composition of solids, liquids and gases- weight fraction, mole fraction, ppm, molarity, normality, molality, Ideal gas laws, equation of state

Unit:2 **12hrs**

Solution: Ideal solution, Raoult's law, Non-ideal solution, Henry's law; Vapor pressure, Clausius-Clapeyron equation, Antoine equation, vapors pressure plots, humidity- dry bulb temperature, wet bulb temperature, dew point, saturation, adiabatic saturation temperature, humidity, relative humidity & percent humidity, saturated humidity, humid heat, humid volume, use of humidity chart.

Unit:3 **11hrs**

Material balances &unit operation- Drying, Evaporation, Dissolution and crystallization, Mixing. Solving material balance with Chemical reaction: The chemical equation & stoichiometry, concept of limiting & excess reactants, conversion, degree of conversion, yield etc. recycle, bypass & purge calculations. Combustion processes.

Unit:4 **10hrs**

Energy balance concepts & units, Heat capacity, Calculation of enthalpy changes without change of phase, Energy balance with Chemical reaction, Standard heat of reaction at constant pressure & constant volume, effect of temperature on heat of reaction, Adiabatic reaction of temperature ,heat of solution & heat of mixing.

Teaching Mentod (s):Chalk & Board/PPT

Text Books 1: Stoichiometry & process Calculations by-K.V. Narayanan & B-lakshmikatty
2: Basic principles and calculation in chemical engineering by Himmelblau D.H. 5th Edition. PHI, 2001.

Ref. Books 1: Chemical process principles- Hoejen, Watson, John Wiley & Asia pub.
2: Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata Mc Graw Hill publishing company Ltd.New Delhi (1996)

Subject Code	Course Title	L	T	P	C	QP
BCSES3051	**OBJECT ORIENTED PROGRAMMING SYSTEMS**	**3**	**0**		**3**	

Pre -Requisite:

Course Educational Objective

CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
CEO4	How to test, document and prepare a professional looking package for each business project using javadoc.

Course Outcome

CO1	Students will be able to map real world problems into the Programming language with oop features and Implement object oriented principles for reusability.
CO2	Students will be able to write programs using basic data types and strings, using loops, Array.
CO3	Student will be able to Assign priorities and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Students will be able to Interpret Events handling techniques for interaction of the user with GUI and Develop client/server applications using socket programming

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	8	9	10	11	12	1	2
CO1	2			2		1			1		1		
CO2	2			1					1		1		
CO3	1			1		1			1		1		
CO4	2			2					1		1		

UNIT:1 **(10 Hours)**

An introduction Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program?, Architecture of JVM. Understanding, Java Tokens, Datatypes, Operators, Control Structures and Arrays, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

UNIT:2 **(12 Hours)**

Introduction to Classes and Objects. Constructors, static Keyword , this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance ,Types of Inheritance and Java supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. String Manipulations. Wrapper classes, Auto boxing and unboxing. Abstract classes, Interfaces, Multiple Inheritance Using Interfaces, Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details ,User defined exception classes.

UNIT:3 **(12 Hours)**

Multithreading , Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class. IO Streams (java.io package) , Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Util Package interfaces, List, Set, Map

UNIT:4 **(10 Hours)**

Applet Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Programming in Java. Second Edition. Oxford higher education. (Sachin Malhotra/ Saurav Choudhary)
2. Core Java for beginners. (Rashmi Kanta Das), Vikas Publication

Ref. Books

1. JAVA Complete Reference (9th Edition) Herbalt Schelidt

Graphs: Definitions, Graph representation - Adjacency matrix, Incidence Matrix, adjacency lists, Graph Traversals (BFS & DFS), Single source shortest path algorithm (Dijkstra's Algorithm) Topological Sorting
Hashing: Hashing Functions, Open hashing (chaining), closed hashing (Open addressing – linear probing, quadratic probing, double hashing), rehashing

Subject code	Course Title	L	T	P	C	QP
BCSES4040	**Database Management System**					

Pre -Requisite:

Course Educational Objective

CEO1: To understand the different issues involved in the design and implementation of a database system

CEO2: To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.

CEO3: To understand and use data manipulation language to query, update, and manage a database

CEO4: To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server(Database Server), Data Warehousing.

CEO5: To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

CO1	Interpreting the Database Management concepts, different Data models and architectures with ER to Relational mapping.
CO2	Applying and executing the SQL, relational algebra and calculus commands to create and manipulate Database.
CO3	Differentiate normal forms for normalization process to construct the consistent Database.
CO4	Design the Database by inspecting concurrency and recovery strategies to make complete DB without confliction and consistent DB in concurrent environment.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

UNIT:1 **(15 Hours)**

Introduction to database Systems, advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models.

UNIT:2 **(13 Hours)**

Entity relationship model, Components of ER model, Mapping E-R model to Relational schema, Relational Algebra, Tuple & Domain Relational Calculus, Relational Query Languages: SQL and QBE. Database Design :-Database development life cycle (DDLC), Automated design tools, Functional dependency and Decomposition, Join strategies, Dependency Preservation & lossless Design, Normalization, Normal forms:1NF, 2NF,3NF, and BCNF, Multi-valued Dependencies, 4NF & 5NF. Query processing and optimization: Evaluation of Relational Algebra Expressions, Query optimization, Query cost estimation.

UNIT:3 **(10 Hours)**

Network and Object Oriented Data models, Storage Strategies: Detailed Storage Architecture, Storing Data, Magnetic Disk, RAID, Other Disks, Magnetic Tape, Storage Access, File & Record Organization, File Organizations & Indexes, Order Indices, B+ Tree Index Files, Hashing Data Dictionary.

UNIT:4 **(12 Hours)**

Transaction processing and concurrency control: Transaction concepts, properties of transaction, concurrency control, locking and Timestamp methods for concurrency control schemes. Database Recovery System, Types of Data Base failure & Types of Database Recovery, Recovery techniques. fundamental concepts on Object-Oriented Database, Object relational database, distributed database, Parallel Database, introduction to Data warehousing & Data Mining.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Sudarshan, Korth: **Database System Concepts**, 6th edition, McGraw-Hill Education

References Books:

1. Elmasari &Navathe: **Fundamentals of Database System**, Pearson Education.

2. Ramakrishnan: **Database Management Systems**, McGraw-Hill Education.

Subject code	Course Title	L	T	P	C	QP
BMGHS3061	**ENVIRONMENTAL ENGINEERING & SAFETY**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1:The course introduces the students to the environmental consequences of industries

CEO2: To provide minimization of their impacts through technology and legal systems.

Course Outcome

CO1	Students will understand the ecological system of environment.
CO2	They will learn about treatment of water/waste water
CO3	Students should know about cause and remedies of environment pollution and technological approaches
CO4	They will understand the importance of environmental safety.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

UNIT:1 **(10 Hours)**

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

UNIT:2 **(12 Hours)**

Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobicdigestion,Reactor configurations and methane production. Air Pollution: Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, Air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOxremoval,Fugitive emissions.

UNIT:3 **(10 Hours)**

Solid waste, Hazardous waste management, Solid Waste Management, Source classificationand composition of MSW: Separation, storage and transportation, Reuse and recycling, WasteMinimization Techniques. Hazardous Waste Management, Hazardous waste and theirgeneration, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A.,Environmental auditing.

UNIT:4 **(10 Hours)**

Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention -Detection, Extinguishing Fire, Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Hydro Carbons Wastes. Personal Protective Equipments.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely,

.Environmental Engineering by Prof B.K. Mohapatra, Seven Seas Publication, Cuttack

3. Environmental Engineering and Safety ,Raut&Sen Scientific Publishers.

Ref. Books 1. Environmental Engineering by Arcadio P. Sincero&Gergoria A. Sincero PHI Publication

2 Environmental Science, Curringham&Saigo, TMH

Subject code	course title	L	T	P	C	QP
BMSHS3062	Engineering Economics & Costing	3	0	0	3	-

Pre -Requisite:

Course Educational Objective

CEO1: to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost

CEO2: to help students to grasp various economics concepts and theories towards making economic decision.

Course Outcome

CO1	Understanding the fundamentals of economic theory in general- concept of demand & supply, theories of production-Laws of returns
CO2	Overview of cost and revenue concepts: Understood the nature and behavior of cost, cost sheet, Break-even analysis- linear approach and understanding of depreciation with its measurement.
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time-value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indian financial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

UNIT:1 **(12 Hours)**

Engineering Economics –

Meaning, Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.

Demand and Supply Analysis - Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved)

Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved). Theory of Production -Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2 **(10 Hours)**

Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved),

Break Even Analysis -

Linear approach (Simple numerical problems to be solved). Depreciation-Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation (Straight line

UNIT:3 **(12 Hours)**

Time value of money -

Interest Analysis - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.

Evaluation of engineering projects-

Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Sensitivity Analysis, Replacement Analysis- Determination of economic life of an asset, Replacement of existing asset with a new asset.

UNIT:4 **(10 Hours)**

Overview of Indian financial system. Commercial bank, Functions of commercial bank, Credit creation, Central bank, Functions of Central Bank. Inflation-

Meaning of inflation, types, causes, measures to control inflation.

National Income - Definition, Concepts of national income, Method of measuring national income

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1, Vengedasalam, Deviga. Madhavan, Karunagaran, Principles of Economics, Oxford University Press.
2. R. Paneer Seelvan, " Engineering Economics", PHI
3. Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd
4. Riggs,J.L., Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India
5.Paul, R.R., Money, Banking and International Trade, Kalyni Publishers.

Ref. Books

1.Park, Chan.S, "Fundamental of Engineering Economics", Pearson.
2. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
3. Thuesen, G.J.,Fabrycky,. Engineering Economy, PHI.
4.Jhingan,M.L., "Macro Economic Theory", Vrinda Publications Ltd

Subject code	course title	L	T	P	C	QP
BCHPC4110	**Chemical Technology Lab**			**2**	**1**	

Course Educational Objective

CEO:To learn basic principles involved in analysis and synthesis of different organic derivatives

Course Outcome

CO1	Relate the manufacturing of various inorganic and organic chemicals
CO2	Interpret the process flow diagram and various process parameters
CO3	Analyze the various solve engineering problems during production
CO4	Design a plant layout.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	0	0	-	-	-	-	-	-	1			2
CO2	2	2	1	0			3	-	-	-	-	-		2
CO3	2	2	1	1	-	-	-	-	-	-	-	-		2
CO4	1	0	0	0	-	-	-	-	-	-	-	-		1

LIST OF EXPERIMENTS:

1. 1 Manufacture of soap from vegetable oil.
2. Determination of saponification value of the given oil sample.
3. Determination of acid value of the given oil sample.
4. Estimation of iodine value of oil
5. Estimation of nitrogen in nitrogenous fertilizer.
6. Preparation of phenol formaldehyde resin.
7. Preparation of aspirin.
8. Preparation of jam/jelly from red apple.
9. Preparation of coloured pigments and dyes.
10. Preparation of a fertilizer and its estimation of anion.
11. Preparation of manganese dioxide nano particles or alumina-particles.

Subject code	course title	L	T	P	C	QP
BCHPC4120	**Mass Transfer-I Lab**			**2**	**1**	

Pre -Requisite:

Course Educational Objective

CEO:To train the students to develop sound working knowledge on different types of mass transfer equipments

Course Outcome: At the end of the course, the students will be able to

CO1	Explain about the diffusion process
CO2	Describe the operation of cooling tower
CO3	Distinguish the mechanism of absorption, distillation and humidification
CO4	Design the distillation column

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0								2		2	
CO2	2	2	1	1			3						2	
CO3	2	2	1	-	-	-	-	-	-	-	-	-	1	
CO4	1	0	0	-	-	-	-	-	-	-	-	-	2	

LIST OF EXPERIMENTS:

1. Determination of diffusion coefficient for carbon tetrachloride -air system by using vapour-air diffusion apparatus.

2. Study of vapour –liquid equilibrium curve for methanol-water system.

3. Verification of Rayleigh's equation through simple distillation for binary mixture of water and ethanol.

4. Determination of vaporization and thermal efficiencies in steam distillation of the given organic liquid i.e. nitrobenzene or aniline.

5. Study of lab scale bubble cap distillation column at different reflux ratios.

6. Calculation of height equivalent to a theoretical plate (HETP) of packed bed distillation column at total reflux for a binary system of methanol and water using Fenske's equation.

7. Determination of number of plates of packed bed distillation column at varying reflux ratios for a binary mixture of methanol and water using Mc Cabe Thiele diagram.

8. Study of the phenomenon of surface evaporation and determine the Humus equation constant.

Subject code	Course Title	L	T	P	C	QP
BCHPC4130	Heat Transfer Lab			2	1	

Pre -Requisite:

Course Educational Objective

CEO1:To enable the students to develop a sound working knowledge on different types of heat transfer equipments

Course Educational Objective	
CO1	Explain the basic concepts and laws of the three modes of heat transfer
CO2	Apply analytical techniques to the solution of conduction heat-transfer problems
CO3	Make use of empirical equations to solve forced and natural convection heat-transfer problems
CO4	Solve simple radiation heat transfer problems

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	0	1								2		1	
CO2	2	1	2	1			3						2	
CO3	2	1	2		-	-	-	-	-	-	-	-	1	
CO4	1	0	0		-	-	-	-	-	-	-	-	2	

LIST OF EXPERIMENTS:

1 Study of parallel flow and counter flow heat exchanger

2. Study of Calendria type evaporator

3. Study of Shell and Tube heat exchanger

4. Study of Vertical and Horizontal condenser

5. Study of Composite Wall

6. Study of Bare and Fin Tube heat exchanger

7. Study of Film wise and Drop wise condensation apparatus

8. Study of Jacketed Vessel

9. Determination of Thermal Conductivity of Liquid

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3151	JAVA PROGRAMMING LAB			2	1	

Pre -Requisite: None

Course Educational Objectives

CEO1	To introduce the pure object-oriented concepts through Java programming.
CEO2	To enable a detailed insight into the Java programming concepts such as creating classes, Methods, Interfaces, Packages, Multithreaded Environment, String handling, Enumerations, Creating small Swing application.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Apply the object-oriented concepts through Java language.
CO2	Demonstrate the concepts of polymorphism and inheritance.
CO3	Write Java programs to implement error handling techniques using exception handling
CO4	Develop solution for a real problem using Java programming.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1											
CO2	3	3			2		1		1					
CO3	3	2			2							1		
CO4	3	3	3	2		1								
Avg														

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

Subject code	course title	L	T	P	C	QP
BCSES3152	Database Management System Lab			2	1	

Pre -Requisite:

Course Educational Objective

Course Outcome: At the end of the course, the students will be able to

CO1	***Implement*** the concept of Entity-Relationship (E-R) model from specified information and to transform into to relational model.
CO2	***Apply*** the different types of Constraints in relational database and defines the database.
CO3	***Compares*** the different types of manipulation and access methods of data from database.
CO4	***Analyze*** and simple database application that demonstrates understanding of all the above, working as a team.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

List of experiment

1. . Use of SQL syntax: insertion, deletion, join, updation using SQL.
2. Programs on join statements and SQL queries including where clause.
3. Programs on procedures and functions.
4. Programs on database triggers.
5. Programs on packages.
6. Programs on data recovery using check point technique.
7. Concurrency control problem using lock operations.
8. Programs on ODBC using either VC++.
9. Programs on JDBC.
10. Programs on embedded SQL using C / C++ as host language.

Additional Assignments

1. Use of NoSQL database like MongoDB.
2. Programs on connectivity to MongoDB using MEAN.
3. Programs on connectivity to Mongo-DB using Python.
4. Programs on connectivity to MongoDB using PHP.

V SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC5010	Mass Transfer-II	3	0	0	3
2	PC	BCHPC5020	Chemical Reaction Engineering	3	1	0	4
3	PC	BCHPC5030	Chemical Engineering Thermodynamics	3	0	0	3
4	PE	BCHPE5041	Bio-chemical Engg	3	0	0	3
		BCHPE5042	Process utility &Industrial Safety				
		BCHPE5043	Corrosion Engineering				
		BCHPE5044	Battery Technology				
5	OE	B**OE5051	Open Elective 1	3	0	0	3
		B**OE5052	Open Elective 1				
		B**OE5053	Open Elective 1				
		B**OE5051	Open Elective 1				
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3
		BMSHS5062	Organizational Behaviour				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC5110	Mass Transfer-II Lab	0	0	2	1
8	PC	BCHPC5120	Chemical Reaction Engineering Lab	0	0	2	1
9	PC	BCHPC5130	Biotechnology Lab	0	0	2	1
10	PC	BCHPC5150	*Skill Development Project and Hands on Training	0	0	2	1
11	PC	BCHPC5170	^Summer Internship-I	0	0	2	1
		TOTAL:		**18**	**1**	**10**	**24**

Subject code	course title	L	T	P	C	QP
BCHPC5010	**MASS TRANSFER – II**	3	0	0	3	

Pre-Requisites (If any)-Mass Transfer-I, Heat Transfer, Chemical Process Calculations

Course Educational Objective

CEO1: To teach the students different separation techniques.

CEO2:At the end of the study students will come to know the design of a adsorber and calculations involved in liquid-liquid extraction and solid liquid extraction

Course Outcome

CO1	Understanding fundamentals of some major Mass transfer operations like adsorption, drying
CO2	Analyse the situations where liquid–liquid extraction might be preferred to distillation leaching
CO3	Development of design processes for cooling tower, fixed-bed adsorption.
CO4	Building foundation for process intensification and innovations for novel systems of mass transfer

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	0								2		2	1	
CO2	2	1	1			3						2	2	
CO3	2	1	-	-	-	-	-	-	-	-	-	2	1	
CO4	0	0	-	-	-	-	-	-	-	-	-	1	2	

Unit:1 **10hrs**

Liquid - liquid Operations : Extraction : Introduction, liquid - liquid equilibrium, analytical and graphical solutions for single and multistage operations, continuous, counter current operation without and with reflux, equipments for liquid liquid extraction.

Unit:2 **10hrs**

Leaching: Operation of solid, steady and unsteady state operation, analytical methods for single and multistage operations, Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments.

Unit:3 **13hrs**

Adsorption: Theory of adsorption, Industrial adsorbents, adsorption equilibrium, Adsorption isotherms, single and multistage operations, Ion – Exchange: Principle of Ion exchange, techniques and applications. Introduction to crystallization, Mier's super saturation theory, crystallization equipment: continuous vacuum crystallizer, Draft tube-baffle crystallizer Swenson-walker crystallizer. Material and energy balance calculations in batch crystallizers.

Unit:4 **10hrs**

Drying: Equilibria, Drying rate curve, Batch and continuous drying. Time of drying and calculations, mechanism of batch drying, equipments for batch and continuous drying operations. Design of dryers.

Teaching Mentod (s): Chalk & Board/PPT/Video Lectures

Text Books 1: Treybal R. E., Mass Trasnfer Operation, Mc Graw Hill.
2:Mc Cabe & Smith. Unit Operation in Chemical Engineering, Mc Graw Hill & Kogakusha.

Ref. Books 1: C.J. Geankoplis, Transport Processes and Unit Operations, 3rd Edition,Prentice Hall, India, 1993.
2: Mass Transfer Operations by A Suryanarayana, New Age International.

Subject code	Course Title	L	T	P	C	QP
BCHPC5020	Chemical Reaction Engineering	3	1	0	4	

Pre-Requisites (If any)-

Course Educational Objective

CEO1:To learn about reaction kinetics for single, multiple, isothermal, non-isothermal reactions and reactor design procedures.

Course Outcome

CO1	Develop rate laws for homogeneous reactions.
CO2	Design of ideal reactors for single and complex reactions
CO3	Explain non-isothermal reactors and the heat exchange.
CO4	Distinguish between various RTD curves and predict the conversion from a Non-ideal reactor using tracer information.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	0	0	-	-	-	-	-	-	-	-	2	
CO2	1	3	2	0	-	-	-	-	-	-	-	-	2	
CO3	2	1	3	0	-	-	-	-	-	-	-	-	1	
CO4	0	1	0	3	-	-	-	-	-	-	-	-	2	

Unit:1 **12hrs**

Introduction and overview of the subject, kinetics of homogeneous reactions, elementary and non-elementary reactions, Concentration and temperature dependent term of a rate equation, Collision theory, Transition - state theory and Arrhenius theory. Interpretation of batch reactor data for both reversible and irreversible reactions. Various methods of analysis of batch reactor data (including variable volume and variable pressure (data).

Unit:2 **12hrs**

Homogeneous flow reactors: Design equations for steady state plug flow reactor (PFR) and steady state continuous stirred tank reactor (CSTR), data analysis in flow reactors, mean residence time, space time, space velocity. Combined reactors, reactors in parallel and in series, size comparison of single reactors, recycle reactors.

Unit:3 **10hrs**

Design for parallel reactions, product distributions, contacting patterns for reactions in parallel, quantitative treatment of product distribution, selectivity, multiple reactions, qualitative treatment of batch, PFR and mixed reactors.

Unit:4 **10hrs**

Basics of non-ideal flow, RTD, Age distribution of fluid, Pulse experiment, Relationship between F and E curve only. non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Ievenspiel O. Chemical Reaction Engineering, Wiley International
2:Fogler H. S., Chemical Kinetics and Reactor Calculation.

Ref. Books 1: Smith J. M., Chemical Engineering Kinetics, Mc Graw Hill.
2: Wales J. M., Kinetics for Chemical Engineering, Mc Graw Hill.

Subject code	Course Title	L	T	P	C	QP
BCHPC5030	CHEMICAL ENGINEERING THERMODYNAMICS	3	0	0	0	A

Pre-Requisites (If any)-

Course Educational Objective

CEO1:To introduce the principles of chemical engineering thermodynamics and illustrate their applications in the design of chemical process plants.

Course Outcome

CO1	Apply fundamental concepts of thermodynamics to engineering applications Determine thermodynamic efficiency of various energy related processes
CO2	Estimate thermodynamic properties of substances in gas and liquid states
CO3	Explain the vapor-liquid equilibrium for a system
CO4	Explain the chemical reaction equilibrium for a system

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	0	0	-	-	-	-	-	-	-	-	2	
CO2	3	3	1	0	-	-	-	-	-	-	-	-	2	
CO3	2	2	2	1		-	-	-	-	-	-	-	1	
CO4	1	0	0	0		-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

The first law of Thermodynamics, the thermodynamic state and state function, Constant volume constant pressure process, Properties of pure fluids; PVT behavior of pure substances, Virial equations of state, The ideal gas, Applications of Virial equations, Cubic equation of state, Theorem of corresponding states. Second Law: Entropy, work function, Introduction to third law.

Unit:2 **13hrs**

VLE at low to moderate pressure, the nature of equilibrium, the phase rule, VLE qualitative behavior, Dew point and Bubble point calculations using Raoult's law and Modified Result's law. VLE from K-value correlation, flash calculations, Dew point & bubble point calculations and Flash calculations for non-ideal solutions. Thermodynamic properties and VLE from equations of state: properties of fluids from the virial equations of state, VLE from Vander Waals equations of state.

Unit:3 **10hrs**

Fundamental property relation, Maxwel relationship, 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, Ideal solutions, excess properties.

Unit:4 **10hrs**

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

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books:

1.Introduction to Chemical Engg. Thermodynamics by Smith and H.C. Vannes and M. Abbot (7th editation) Tata McGraw Hill, 2009

2:S.Sandler, "Chemical, Biochemical and Engineering Thermodynamics", 4th edition,Wiley,India.

Ref. Books

1: Chemical Engg. Thermodynamics by Y.V.C. Rao – University Press

2:Chemical Engg. Thermodynamics by K.V.Narayan, PHI, 2000

Subject code	course title	L	T	P	C	QP
BCHPE5041	BIOCHEMICAL ENGINEERING	3	0	0	3	A

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To introduce the engineering principles of bioprocesses including characteristics of different microbial cells, enzymes, microbial kinetics, and design considerations.

CEO2: To enhance skills in the areas of biochemical processes, to provide the fundamental background of biological systems, bio-chemical engineering, environmental engineering, advanced bioprocess engineering, biologically mediated processes and waste treatment.

Course Outcome

CO1	Categorize the different cells and their use in biochemical processes
CO2	Assess the role of enzymes in kinetic analysis of biochemical reaction
CO3	Utilize the basic concepts of thermodynamics, mass and energy balances, reaction kinetics and reactor design for biochemical processes
CO4	Analyze bioreactors, upstream and downstream processes in production of bio-products

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	0	0	-	-	-	-	-	-	-	-	2	
CO2	1	3	2	0	-	-	-	-	-	-	-	-	2	
CO3	2	1	3	0	-	-	-	-	-	-	-	-	1	
CO4	0	1	0	3	-	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

Introduction to microbiology and biochemistry; Classification and characteristics of microorganism; Essential chemicals of life- lipids, sugars and polysaccharides, RNA and DNA, amino acids and proteins;

Unit:2 **10hrs**

Enzymes and their classification; Enzyme kinetics; Immobilization of enzymes and whole cells; Immobilized enzyme kinetics Cell metabolism; Regulation; Stoichiometry; End products. Cell growth kinetics; Product formation kinetics

Unit:3 **10hrs**

Transport phenomena in cellular systems; Oxygen transfer rates; Mass transfer coefficient and interfacial area; Mechanical agitation and power requirement. Thermal death kinetics; Media and air sterilization.

Unit:4 **10hrs**

Bioreactors: Type, design, operation and scale-up; Instrumentation and control. Down-stream processing, Industrial production of ethanol, anti-biotics, single cell protein. Bioleaching. Effluent treatment by biological method.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:. Bailey, J.E. and Ollis, D.F., “Biochemical Engineering Fundamentals”, McGraw-Hill.
2:Aiba, S., Humphery, A.E. and Milli, N.R.,“Biochemical Engineering ”, Academic Press.

Ref. Books 1:Biochemical Engineering and Biotechnology - 1st Edition. Print Book & E-Book. ISBN9780444528452,
2:Biochemical Engineering and Biotechnology by Ghasem Najafpour

Subject code	Course Title	L	T	P	C	QP
BCHPE5042	PROCESS UTILITY AND INDUSTRILA SAFETY	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: This course will provide effective use of chemical industries utilities.

CEO2: Emphasis on the knowledge of loss prevention, personal safety, industrial safety, hazard analysis, toxicology and personal proactive equipments.

Course Outcome

CO1	Explain the different types of safety precaution to be taken in working environment.
CO2	Describe the various safety rules and regulation
CO3	To develop optimization techniques to optimize various parameters in chemical industries.
CO4	Study the different hazardous effect of accident inside the plant.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	-	-	-	-	2	3	-	-	-	-	-	2	
CO2	2	-	-	-	-	3	2	-	-	-	-	-	2	
CO3	2	-	-	-	-	2	2	-	-	-	-	-	1	
CO4	0	-	-	-	-	1	0	-	-	-	-	-	2	

Unit:1 **10hrs**

Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

Unit:2 **10hrs**

Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

Unit:3 **13hrs**

Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

Unit:4 **12hrs**

History of Safety movement–Evolution of modern safety concept-general concepts of management–planning for safety for optimization of productivity-productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on, safety

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Eckenfelder, W. W, Jr. "Industrial Water Pollution Control" McGraw-Hill: New York, 1966.
2: P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi, 1986.

Ref. Books 1: P. N. Ananthanarayan, "Basic Refrigeration & Air conditioning", Tata McGraw Hill, New Delhi, 2007
2:Perry R. H. Green D. W. "Perry's chemical Engineer's Handbook", McGraw Hill, New York, 2007.

Subject code	Title of the subject	L	T	P	C	QP
BCHPE5043	**CORROSION ENGINEERING**	**3**	**0**	**0**	**3**	**A**

Course Educational Objective

CEO1:To provide an understanding of the corrosion principles and engineering methods used to minimize and prevent the corrosion.

CEO2: TO solve problems involving various types of corrosion, corrosion resistant materials for a given application.

Pre-Requisites (If any)-Mathematics,Chemistry,Material Science

Course Outcome: Upon successful completion of this course, students should be able to

CO1	Explain about Types of corrosion available in details.
CO2	Describe the various corrosion controlled processes.
CO3	Illustrate the idea about prevention strategies process.
CO4	Develop a microbial influenced corrosion in terms of case studies.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		0		-	-	0	-	-	-	3			1
CO2	1		2	2	-	-	2	-	-	-	-	-		2
CO3	2		1		-	-	1	-	-	-	-	-		2
CO4	1		0		-	-	0	-	-	-	-	-		1

Unit:1 **11hrs**

Corrosion – introduction, definitions and types,Electrochemical cells-definitions and Principles,Potential measurements – galvanic cells, concentration cells.,EMF and Galvanic series – bimetallic couples., Eh-pH diagrams – fundamental aspects.,Construction of Eh – pH diagrams. Fe- H2O-O2 diagram.,Copper, Aluminium and general corrosion diagrams

Unit:2 **10hrs**

Electrode – solution interface –definition and types of polarization.Exchange current density – polarization relationships.,Polarization techniques – corrosion rate determination.,Mixed potentials – concepts and Basics.,Mixed potential theory – bimetallic couples,Mixed potential theory – activation and diffusion controlled processes

Unit:3 **12hrs**

Prevention strategies – design and coatings, Prevention strategies – inhibitors and surface engineering. Cathodic protection – principles and classification.,Cathodic protection – influencing factors and monitoring., Design aspects for cathodic protection. Stray current corrosion.,Passivity – definitions and influencing parameters,Passivity – application of mixed potential theory,Passivity – design of corrosion resistant alloys. Anodic protection

Unit:4 **13hrs**

Microbially influenced corrosion (MIC– definitions, environments and microbiology,MIC - Electrochemical aspects and general mechanisms., MIC – Bacterial transport, attachment and affected materials. MIC - Role of aerobic and an aerobic microorganisms Mechanisms and models for SRB corrosion. MIC and Biofilms. MIC – case studies and mechanisms

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures /MOOC/ Internship)

Text Books 1:Denny A Jones, Principles and Prevention of Corrosion (second edition), Prentice-Hall, N. J. (1996).
2.M. G. Fontana, Corrosion Engineering (Third Edition) McGraw-Hill Book Company (NY) (1987).

Ref. Books 1:H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley (NY) (1985).
2:M.Pourbaix, Atlas of Electrochemical Equilibria in aqueous solutions, NACE, Houston(1974).

Subject code	Title of the subject	L	T	P	C	QP
BCHPE5044	BATTERY TECHNOLOGY	3	0	0	3	A

Course Educational Objective

CEO1:Define electrochemistry and identify and explain various aspects of battery cells, battery systems, and battery manufacturing.

CEO2:Explain how a battery works, describe the basic principles of battery chemistry, and analyze oxidation, reduction, and various losses.

Pre-Requisites (If any)-Chemistry, Material Science

Course Outcome :Upon successful completion of this course, students should be able to:

CO1	Explain about Types of battery available in details.
CO2	Describe the various battery manufacturing processes.
CO3	Illustrate the idea about fuel cell.
CO4	Apply the knowledge for recycle and reuse of battery.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0		-	-	-	-	-	-	3			2
CO2	1	1	2	2	-	-	2	-	-	-	-	-		1
CO3	2	2	1		-	-	-	-	-	-	-	-		2
CO4	1	0	0		-	-	-	-	-	-	-	-		1

Unit:1 **10hrs**

General Background on alternative energy sources and sustainability, Introduction to electric-based transportation, Introduction to battery, Dry Cell, Alkaline Battery, Li-ion batteries (main focus) ,Principle of operation ,Battery components and design ,Electrode, cell and battery fabrications ,Building block cells, battery modules and packs ,Li, polymer, batteries and applications ,All solid state batteries and future developments ,Li-S battery, future battery ,Li-Air battery, frontier battery.

Unit:2 **10hrs**

Sodium-battery ,Magnesium battery ,Aluminum battery ,Silicon battery, Nickel Metal Hydride Battery :Advance Ni-MH batteries for transportation ,Future prospects of Ni-MH batteries vs. lithium ion batteries, Lead-acid battery Advance lead-acid batteries Horizontal plate Pb-Acid batteries for transportation Cylindrical Pb-Acid battery vs. flat plate system,High temperature batteries for back-up applications Zebra cell Li-iron sulfide cells Li-S cells Flow batteries for load leveling and large scale grid application Vanadium and iron based batteries Semi-fluid flow batteries Ni-Hydrogen batteries for space and marine applications Ni-H2 cells for space applications

Unit:3 **10hrs**

Introduction to fuel cells PEM and alkaline fuel cells for transportation Solid oxide fuel cells Hydrogen storage systems Solid state hydrogen storage tanks Gas phase hydrogen storage tanks Cryogenic hydrogen storage tanks Liquid phase hydrogen storage tanks Fuel reformers Advanced fuel reformers

Unit:4 **10hrs**

Technology and economic aspects of battery recycling ,Battery Applications for Stationary and Secondary Use, Regulations and Safety Aspects of High Voltage Batteries ,Code and Standards Safe handling of Lithium Batteries ,Safety of high voltage devices

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1: G-A. Nazri and G. Pistoa, Lithium Batteries, Science and Technology, Kluwer Academic Publisher, 2003.
2:H. A. Kiehne, "Battery Technology Handbook," Marcel Dekker, NYC, 2003.

Ref. Books 1:. James Larminie and John Lowry, "Electric Vehicle Technology Explained," John Wiley, 2003.
2:.D. Linden and T. S. Reddy, "Handbook of Batteries," 3rd Edition, McGraw-Hill, 2002.

Subject code	Course Title	L	T	P	C	QP
BBSHS5061	**Optimization In Engineering**	**3**	**0**		**3**	

Pre -Requisite:

CEO1:To introduce the students how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science

CEO2:To provide students with opportunity using various software package for solving liner programming and integer programming models

CEO3:To introduce the students to use of basic methodology for solution of linear programs and integer programs

CEO4:To introduce the students to advance methods for large scale transportation and assignment problems

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

CO1	**Analyze,** formulate and solve linear programming problems using appropriate techniques.
CO2	**Conduct** and **interpret** post-optimal and sensitivity analysis and explain the primal-dual relationship
CO3	**Develop** mathematical skills related to transportation and assignment problem can analyze and solve integer programming problem arising from a wide range of applications.
CO4	**Communicate** ideas, explain procedures and interpret results and solutions related to nonlinear programming problem

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

UNIT:1 **[14 Hours]**

Introduction

Historical overview of operations research, fundamentals of OR Modeling Approach. Linear Programming: Basic assumptions, formulation, graphical method, simplex method, Big-M method, duality theory, primal-dual relationships, sensitivity analysis.

UNIT:2 **[14 Hours]**

Transportation and Assignment Problems

Specific features of transportation problem, streamlined simplex method for solving transportation problems, special features of assignment problems, Hungarian method for solving assignment problems. Integer programming: Special features, binary integer programming models-branch-and-bound technique.

UNIT:3 **[10 Hours]**

Dynamic Programming

Characteristics, principle of optimality, solution procedure, deterministic problems. Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process.

UNIT:4 **[10 Hours]**

Non-linear programming

Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming Introduction to Genetic Algorithm.

Teaching Methods: Chalk& Board/PPT

Text Books:

1. Taha H.A., Operations Research 9th Edition, Prentice Hall of India, New Delhi, 2010Book
2.KantiSwarup., Man Mohan., and Gupta, P.K., Introduction to Operations Research 7thEdition, Sultan chand& Sons, New Delhi, 2005

Ref. Books:

5. P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd
6. Hillier, F.S., and Lieberman G.J., Introduction to Operations Research, 7thEdition, TMH, 2009.

Subject code	Course Title	L	T	P	C	QP
BMGHS5062	**Organizational Behavior**					
	Course Educational Objectives	3	0	0	3	A
CEO1	To develop an understanding of the behaviour of individuals and groups inside organizations					
CEO2	To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.					
CEO3	To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.					

Course Outcomes

CO1	Define, explain and illustrate a range of organizational behaviour theories.
CO2	Analyse the behaviour of individuals and groups in organizations in terms of organizational behaviour theories, models and concepts.
CO3	To explain group dynamics and demonstrate skills required for working in groups (team building)
CO4	Communicate effectively in oral and written forms about organizational behaviour theories and their application using appropriate concepts, logic and rhetorical conventions.
CO5	To explain organizational culture and describe its dimensions and to examine various organizational designs

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

Unit –1 **[14Hrs]**

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behaviouristic and social cognitive), Limitations of OB.

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behaviour and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.

Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.

Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).

Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Unit-2 **[12Hrs]**

Foundations of Group Behaviour: The Meaning of Group & Group behaviour & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.

Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.

Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

Unit – 3 **[14 Hrs.]**

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Unit – 4 **[8 Hrs.]**

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change.

Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change &Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for

Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books/Reference books:

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa,HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.

Organizational Behaviour, Hitt, Miller, Colella, Wiley

Subject code	Course Title	L	T	P	C	QP
BCHPC5110	Mass Transfer-II Lab					

Pre -Requisite:

Course Educational Objective

CEO1:To learn analytical experimental methods using sophisticated instruments and interpretation of Experimental data.

Course Outcome: At the end of the course, the students will be able to

CO1	Explain the Separation by adsorption
CO2	Describe separation by liquid-liquid Extraction & leaching
CO3	Design the equipments for separation of feed solution
CO4	Develop a equipment for separation

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0		-	-	-	-	-	-	3		2	
CO2	1	1	2	2	-	-	2	-	-	-	-	-	1	
CO3	2	2	1		-	-	-	-	-	-	-	-	1	
CO4	1	0	0		-	-	-	-	-	-	-	-	2	

1. . Extraction of oil from a sample of mustard cake.

2. Study of drying characteristics of wet solids in a tray dryer under forced draft condition.

3. Drying of solids in a rotary dryer.

4. Adsorption isotherm & efficiency determination.

5. To study the performance of a Swenson-Walker crystallizer and to determine the crystal yield and the efficiency of crystallizer.

6. To determine that mass transfer coefficients for the given system using the experimental setup.

Subject code	course title	L	T	P	C	QP
BCHPC5120	Chemical Reaction Engineering Lab					

Pre -Requisite:

Course Educational Objective

Course Outcome: At the end of the course, the students will be able to

CO1	Develop rate laws for homogeneous reactions
CO2	Design of ideal reactors for single and complex reactions
CO3	Explain non-isothermal reactors and the heat exchange.
CO4	Distinguish between various RTD curves and predict the conversion from a Non-ideal reactor using tracer information

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	0	0	-	-	-	-	-	-	-	-	2	
CO2	1	2	3	0	-	-	-	-	-	-	-	-	1	
CO3	1	2	3	0	-	-	-	-	-	-	-	-	1	
CO4	0	3	0	1	-	-	-	-	-	-	-	-	2	

LIST OF EXPERIMENTS:

1. To determine the order and value of the rate constant for the liquid reaction of caustic soda and ethyl acetate in a batch reactor.
2. To determine the rate constant for a reaction of ethyl acetate with sodium hydroxide in a PFR.
3. To determine the residence time distribution in the given configuration for pulse and step inputs.
4. To evaluate the performance of a series of mixed reactors for the given system of NaOH and CH3COOC2H5.
5. To perform the kinetic studies to establish the rate constant using CSTR.
6. To study the performance of an isothermal batch reactor.
7. To study the reaction kinetics in a fluidized/packed bed reactor

Subject code	course title	L	T	P	C	QP
BCHPC5130	Biotechnology Lab		2	1		

Pre -Requisite:

Course Outcome: At the end of the course, the students will be able to

CO1	Categorize the different cells and their use in biochemical processes
CO2	Assess the role of enzymes in kinetic analysis of biochemical reaction
CO3	Utilize the basic concepts of thermodynamics, mass and energy balances, and reactor design for biochemical processes
CO4	Analyze bioreactors, upstream and downstream processes in production of bio-products

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	0		0	-	-	1	1	-	-	-	-	-		1
CO2	3		0	-	-	2	2	-	-	-	-	-		2
CO3	3		0	-	-	2	2	-	-	-	-	-		2
CO4	0		1	-	-	3	3	-	-	-	-	-		1

LIST OF EXPERIMENTS:

1. Different sterilization and inoculation techniques.
2. Preparation of various types of media.
3. Effect of pH, substrate concentration, and temperature on cell growth.
4. Determination of volumetric mass transfer co-efficient.
5. Determination of mixing time and size and density of the microbial cells.
6. Determination of thermal death rate constant.
7. Preparation of immobilized whole cell system.
8. Substrate degradation, cell growth, and product formation kinetics using free cells and whole cell immobilization.
9. Treatment of sample waste water in a bioreactor.
10. Production of acetic acid using fermentor

VI SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC6010	Process control and Instrumentation	3	1	0	4
2	PC	BCHPC6020	Process Equipment and Design	3	0	0	3
3	PC	BCHPC6030	Fuel &Energy Technology	3	0	0	3
4	PE	BCHPE6041	Computational Fluid Dynamics	3	0	0	3
		BCHPE6042	Advanced Numerical Methods				
		BCHPE6043	Treatment of Industrial effluent				
		BCHPE6044	Sustainability Engineering				
5	OE	B**OE6051	Open Elective – 2	3	0	0	3
		B**OE6052	Open Elective – 2				
		B**OE6053	Open Elective – 2				
		B**OE6051	Open Elective – 2				
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3
		BMSHS5062	Organizational Behaviour				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC6110	Process control Lab	0	0	2	1
8	PC	BCHPC6120	Process Equipment and Design Lab	0	0	2	1
9	PC	BCHPC6130	Fuel &Energy Technology Lab	0	0	2	1
10	PC	BCHPC6140	Advanced Lab-I	0	0	2	1
11	HS	BTPHS6160	#Soft Skill and Employability Skill	0	0	2	1
TOTAL				18	1	10	24

Subject code	Course Title	L	T	P	C	QP
BCHPC6010	PROCESS CONTROL AND INSTRUMENTATION	3	1	0	4	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To gain the knowledge of different process instruments, , To design various control schemes and to apply the control system in various processes.

CEO2:To understand dynamic modeling of a physical process using first principles and to convert the model to a form amenable to solution and analysis

Course Outcome

CO1	Describe the stages involved in the development of a process model.
CO2	Create a chemical engineering problem as a mathematical model from basic engineering principles.
CO3	Explain the appropriate numerical solutions to be used in solving the models
CO4	Classify various simulation tools for solving the chemical engineering models developed.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	0	-	2	-	-	-	-	-	-	-	2	
CO2	1	1	1	-	2	-	-	-	-	-	-	-	2	
CO3	2	2	1	-	2	-	-	-	-	-	-	-	1	
CO4	1	0	0	-	0	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

Unit:2 **10hrs**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, Block diagram of a Chemical Reactor Control system, principles of pneumatic and electronic controllers, Closed loop transfer functions, transient response of simple control systems, Stability, Root locus.

Unit:3 **10hrs**

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, Advanced control strategies- Cascade control, feed forward control, ratio control, Dead time compensation, internal model control, controller tuning and process identification, control valves.

Unit:4 **10hrs**

Introduction to sampled data controllers-sampling and Z-transforms, sampled data control of a first order process with transportation lag, Design of sampled data controllers. Control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:Process Systems Analysis and Control, 3rd ed. by D R Coughanowr and S E LeBlanc, McGraw-Hill.
2: Chemical Process Control: An Introduction to Theory and Practice by G Stephanopoulos, PHI.

Ref. Books 1: Process Dynamics & Control by J M Douglas, PHI.
2: Computer Aided Process Control by S K Singh, PHI

Subject code	course title	L	T	P	C	QP
BCHPC6020	**Process Equipment Design**	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To learn about the design procedures of process equipment used in chemical process plants.

CEO2:To acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments

Course Outcome

CO1	Identify equipment and process involved in process flow diagrams.
CO2	Develop a model from process utilizing flow diagrams.
CO3	Explain the different control strategies employed in the process from the instrumentation diagrams
CO4	Design and draw fabrication diagrams by scaling

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0	1	-	-	-	-	-	-	2		2	
CO2	1	2	1	1	-	-	3	-	-	-	-	-	2	
CO3	1	2	1	2	-	-	-	-	-	-	-	-	1	
CO4	1	0	0	-	-	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, ptimization in process design

Unit:2 **10hrs**

Distillation columns (Tray tower) – for binary mixtures along with tray hydraulics,
Absorbers (Packed Tower) – for counter current binary systems without reactions,

Unit:3 **10hrs**

Heat exchangers – concentric tube, shell and tube types, Condenser. Evaporators – single and multi effects,

Unit:4 **10hrs**

Design of pressure vessels and storage tanks, Isothermal reactors

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:. R. E. Treybal, Mass Transfer Operations.
2:. D. Q. Kern, Process Heat Transfer.

Ref. Books 1: J. H. Perry, Chemical Engineers Handbook.
2: Mc Cabe W. L. & Smith J. C. & Harriot P, Unit Operations of Chemical Engineering (5th Edition), Mc Graw Hill, New York

Subject code	Course Title	L	T	P	C	QP
BCHPC6030	FUEL AND ENERGY TECHNOLOGY					

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To study various types of conventional and non-conventional energy resources including solid, liquid and gaseous fuels. Also, to understand and practice various characterization techniques for fuels.

Course Outcome

CO1	Differentiate solid, liquid and gaseous fuels
CO2	Apply the knowledge of characterization techniques for fuels
CO3	Develop the alternate energy sources
CO4	Explain the modern energy conversion technologies

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		1	-	-	1	-	-	-	-	-	-		2
CO2	2		2	-	-	3	-	-	-	-	-	-		1
CO3	1		1	-	-	2	2	-	-	-	-	-		2
CO4	1		2	-	-	0		-	-	-	-	-		1

Unit:1 **10hrs**

Fuels: Solid Fuels : Coal - Origin, Chemical composition, calorific value, Classifications,
Characteristics & distribution of Indian coals, Storage and spontaneous combustion of coal, Coal washing and blending, Pertrographic constituents of coal, Carbonization of coal, manufacture and properties of metallurgical coke, recovery of by-products.

Unit:2 **10hrs**

Liquid Fuels : Origin and composition of crude oil, crude oil distillation and its products with special reference to gasoline, Kerosene and diesel oil, cracking and reforming, Coaltar distillation Products, Shale oil.

Unit:3 **10hrs**

Gaseous Fuels: Natural gas, coal gas. Coke oven and blast furnace gas, Manufacture of Water gas and producer gas, Carburetted water gas. Synthetic Fuels : Hydrogenation of coal, fischer – Tropsch synthesis

Unit:4 **10hrs**

Nuclear fuels and nuclear reactors, moderators and structural materials.
Combustion : Combustion of solids fuels, Pulverized coal. Calculation of volumes and weights of air necessary for combustion of fuels, gas analysis.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:.Solid, Liquid and gaseous fuel - Brame and King.
2:.Elements of Fuels, Furnaces and Refractories, O. P. Gupta.

Ref. Books 1: Fuels and Combustion - S. Sarkar
2: Elements of Fuel Technology - Himus

Subject code	Course Title	L	T	P	C	QP
BCHPE6041	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1:To learn various computational techniques for analyzing and solving chemical engineering problems.

Course Outcome

CO1	Explain the basic principles of mathematics and numerical concepts of fluid dynamics.
CO2	Develop governing equations for a given fluid flow system.
CO3	Adapt finite difference techniques for fluid flow models.
CO4	Solve computational fluid flow problems using finite volume techniques.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1			-	-	-	-	-	-	-	2	
CO2	2	1	2		1	-	-	-	-	-	-	-	2	
CO3	1	1	2		2	-	-	-	-	-	-	-	1	
CO4	1	1	0		1	-	-	-	-	-	-	-	2	

Unit:1 **11hrs**

Introduction to CFD, Conservation laws of fluid motion-Governing equations of fluid flow and heat transfer, Equation of state, Navier Stokes equations for a Newtonian fluid – Governing equations of the flow of compressible Newtonian fluid, Differential and integral forms of the general transport equations, Turbulence and its modeling-effect of turbulence on time-averaged Navier-stoke equations, characteristics of turbulent flow, turbulent models, inviscid flow, boundary layer approximation.

Unit:2 **12hrs**

Basic Computational techniques, Finite volume method for diffusion problems-One-dimensional, two dimensional and three dimensional steady state diffusion problems, The finite volume method for convective-diffusion problems- Steady one-dimensional convection and diffusion , Assessment of the central differencing scheme for convective diffusion problems, The upwind differencing scheme, The hybrid differencing scheme , Higher order differencing schemes for convective diffusion, Finite volume method for unsteady flow-one dimensional unsteady heat conduction, Discretisation of transient convection-diffusion equation.

Unit:3 **12hrs**

Solution algorithms for pressure-velocity coupling in Steady flows-Introduction, The staggered grid , The momentum equations , The SIMPLE algorithm, The SIMPLER algorithm, The SIMPLEC algorithm, The PISO algorithm, Transient SIMPLE algorithm. Solution of discretised equations-introduction, the tri-diagonal matrix algorithm, Application of TDMA to two dimensional problems, Application of the TDMA method to three-dimensional problems.

Unit:4 **10hrs**

Advanced topics and Application-combustion modeling, body fitted coordinate system, advanced applications, aerospace applications, automobile applications, biomedical applications.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1: 1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd ed. by H Versteeg and W Malalasekra, Pearson.

Ref. Books 1: Computational Fluid Dynamics: The Basics with Applications, J D Anderson, McGraw-Hill.
2: Fundamentals of Computational Fluid Dynamics, T K Sengupta, University Press.

Subject code	Course Title	L	T	P	C	QP
BCHPE6042	ADVANCED NUMERICAL METHODS	3	0	0	3	

Course Outcome

CO1	Solve a linear system of equations and non-linear algebraic or transcendental equation using an appropriate numerical method
CO2	Illustrate a function using an appropriate numerical method
CO3	Evaluate a definite integral and a derivative at a value using an appropriate numerical method
CO4	Explain partial differential equations using an appropriate numerical method

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	-		-	-	-	-	-	-	-	2	
CO2	2	2	-	1		-	-	-	-	-	-	-	2	
CO3	2	1	1	-		-	-	-	-	-	-	-	1	
CO4	1	2	-	2	-	-	-	-	-	-			2	

Unit:1 **10hrs**

Interpolation: Piecewise Linear Interpolation, Piecewise Quadratic Interpolation, Piecewise Cubic Hermite Interpolation, Piecewise Spline Interpolation. Numerical Differentiation: First Derivative, Higher Derivatives, Partial Derivative, Richardson's Extrapolation. Romberg algorithm for numerical integration. Chemical engineering problems where the above mentioned numerical schemes will be illustrated in details.

Unit:2 **10hrs**

Eigen values and Eigen Vectors: Basic power method, Rayleigh Quotient, Shifted power method, Accelerating convergence, Inverse power method, Basic QR method, Better QR method, Finding eigen vectors, Accelerating convergence. Fourier methods: Discrete Fourier Transforms, Fast Fourier Transforms, Matrix form of FFT, Algebraic form of FFT, Mixed-Radix FFT.

Unit:3 **10hrs**

Ordinary Differential Equations: Adams-Bashforth Methods, Adams-Moulton Methods, Adams Predictor-Corrector methods, Other Predictor-Corrector methods (Simpson's method and Milne's method). Application in chemical and bio-chemical reaction.

Unit:4 **10hrs**

Parabolic Partial Differential Equation: Explicit Method, Implicit method, Crank-Nicolson method. Hyperbolic Partial Differential Equation: Explicit Method, Implicit method. Elliptic Partial Differential Equation: Finite-difference method. Convergence and stability criteria of these methods. Application in unsteady-state heat transfer through a slab and unsteady-state tubular reaction problem.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:Applied Numerical Analysis Using MATLAB, 2nd ed. by L V Fausett, Pearson.

Ref. Books 1: Atkinson, K.E., "An Introduction to Numerical Analysis", John Wiley & Sons, 1978.
2: Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012. Press,

Subject code	Title of the Subject	L	T	P	C	QP
BCHPE6043	TREATMENT OF INDUSTRIAL EFFULUENT	3	0	0	3	A

Course Educational Objective

CEO1: Emphasize on this course is on the fundamentals of pollution control aspects and characterization of effluent streams.

CEO2: Know the primary, secondary and advanced wastewater treatment process.

CEO3: Learn about different air pollutants sampling and analysis methods and air pollution control equipments.

Pre-Requisites (If any)-Chemistry, Chemical process Technology

Course Outcome: Upon successful completion of this course, students should be able to:

CO1	Explain about the various disposal and biological treatment process.
CO2	Describe various air and water treatment methods.
CO3	Apply the knowledge in developing new digester for treatment process.
CO4	Make use of various chemical and biological processes for effluent treatment.

co	**PROGRAM OUT COMES**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	**2**	-	-	**2**	**1**	-	-	-	-	-
CO2	-	-	**1**	-	-	**3**	**2**	-	-	-	-	-
CO3	-	-	**1**	-	-	**2**	**2**	-	-	-	-	-
CO4	-	-	**1**	-	-	**1**	**1**	-	-	-	-	-

Unit:1 **10hrs**

General Characteristics of Industrial effluents, effects on Environment –ISI tolerance limits for discharging industrial effluents into surface water, into public sewers and on to land for Irrigation.

Unit:2 **10hrs**

Hazardous Waste Fundamentals, Definition, Classification, Generation, Regulatory process, Current Management Practices, Treatment and Disposal Methods, Physicochemical processes, Biological processes.

Unit:3 **10hrs** Necessity of treatment –Segregation – Process changes – Salvaging –By Product Recovery –Ion Exchange, Electro dialysis, Solvent Extraction,Floatation – Removal of Nitrogen and Phosphorus – Boiler water treatment methods and cooling water treatment methods.

Unit:4 **10hrs**

Sources, characteristics and treatment of Sugar, Dairy, Distilleries,treatment of power plants, oil refineries,cement and steel.,Paper and pulp, tanneries, textiles, fertilizers and pharmaceuticals

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:Rao, M.N. & Dutta, A.K. “Waste Water Treatment”, 3rd Edition, IBH Publishers, 1982

2. Metcalf and Eddy. “Waste water Engineering – Collection, Treatment, Disposal and Reuse”, Mc Graw Hill Pub. Co., 1995.

Ref. Books 1:Numersorn. N.L., “Liquid Waste from industry – theories, Practice and Treatment”.

2: Bhide, A.D. & Sunderesan, B.B. “Solid Waste Management”, INSDOC, NEERI, Nagpur 1994

Subject Code	Course Title	L	T	P	C	QP
BCHPE6044	SUSTAINABILITY ENGINEERING	3	0	0	3	A

Pre -Requisite:

Course Educational Objectives

CEO1: To develop an increased awareness among students on issues in areas of sustainability

CEO2: To make students understand the role of engineering and technology within sustainable development;

CEO3: To know the methods, tools, and incentives for sustainable product-service system development

CEO4: To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

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

CO1	have knowledge about the concept and importance of sustainability
CO2	understand different types of pollution and waste generation, their causes, effects and control
CO3	understand environmental management standards and environmental impact assessment
CO4	understand the concepts of biomimicking, green engineering, green building, sustainable habitat, sustainable urbanization

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		2		2			1							1
CO2		2		1			1							1
CO3		1		1			1							1
CO4		2		2			1							1

UNIT:1 **(10 Hours)**

Sustainability - Introduction, Need and concept of sustainability, Social- environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.

UNIT:2 **(10 Hours)**

Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concepts, 3 R concept. Global environmental issues- Resource degradation, Climate change, Global warming, Ozone layer depletion, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print.
Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) - Procedures of EIA in India.

UNIT:3 **(10 Hours)**

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings. Sustainable cities, Sustainable transport.
Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy.

UNIT:4 **(10 Hours)**

Green Engineering, Sustainable Urbanisation, industrialisation and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books:

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.

Reference Books:

1. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
2. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
3. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
4. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
5. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.

.

Subject code	Course Title	L	T	P	C	QP
BBSHS5061	**Optimization In Engineering**	**3**	**0**		**3**	

Pre -Requisite:

CEO1:To introduce the students how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science

CEO2:To provide students with opportunity using various software package for solving liner programming and integer programming models

CEO3:To introduce the students to use of basic methodology for solution of linear programs and integer programs

CEO4:To introduce the students to advance methods for large scale transportation and assignment problems

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

CO1	**Analyze,** formulate and solve linear programming problems using appropriate techniques.
CO2	**Conduct** and **interpret** post-optimal and sensitivity analysis and explain the primal-dual relationship
CO3	**Develop** mathematical skills related to transportation and assignment problem can analyze and solve integer programming problem arising from a wide range of applications.
CO4	**Communicate** ideas, explain procedures and interpret results and solutions related to nonlinear programming problem

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

UNIT:1 **[14 Hours]**

Introduction

Historical overview of operations research, fundamentals of OR Modeling Approach. Linear Programming: Basic assumptions, formulation, graphical method, simplex method, Big-M method, duality theory, primal-dual relationships, sensitivity analysis.

UNIT:2 **[14 Hours]**

Transportation and Assignment Problems

Specific features of transportation problem, streamlined simplex method for solving transportation problems, special features of assignment problems, Hungarian method for solving assignment problems. Integer programming: Special features, binary integer programming models-branch-and-bound technique.

UNIT:3 **[10 Hours]**

Dynamic Programming

Characteristics, principle of optimality, solution procedure, deterministic problems. Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process.

UNIT:4 **[10 Hours]**

Non-linear programming

Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming Introduction to Genetic Algorithm.

Teaching Methods: Chalk& Board/PPT

Text Books:

1. Taha H.A., Operations Research 9th Edition, Prentice Hall of India, New Delhi, 2010Book
2.KantiSwarup., Man Mohan., and Gupta, P.K., Introduction to Operations Research 7thEdition, Sultan chand& Sons, New Delhi, 2005

Ref. Books:

1. P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd
2. Hillier, F.S., and Lieberman G.J., Introduction to Operations Research, 7thEdition, TMH, 2009.

Subject code	Course Title	L	T	P	C	QP
BMSHS5062	**Organizational Behavior**					
	Course Educational Objectives	3	0	0	3	A
CEO1	To develop an understanding of the behavior of individuals and groups inside organizations					
CEO2	To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.					
CEO3	To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.					
Course Outcomes						
CO1	Define, explain and illustrate a range of organizational behaviour theories.					
CO2	Analyse the behaviour of individuals and groups in organizations in terms of organizational behaviour theories, models and concepts.					
CO3	To explain group dynamics and demonstrate skills required for working in groups (team building)					
CO4	Communicate effectively in oral and written forms about organizational behaviour theories and their application using appropriate concepts, logic and rhetorical conventions.					
CO5	To explain organizational culture and describe its dimensions and to examine various organizational designs					

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2		1	1			1		1		
CO2	2			1						1		1		
CO3	1			1		1				1		1		
CO4	2			2						1		1		

Unit –1 **[14Hrs]**

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behaviouristic and social cognitive), Limitations of OB.

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behaviour and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.

Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.

Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).

Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Unit-2 **[12Hrs]**

Foundations of Group Behaviour: The Meaning of Group & Group behaviour & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.

Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.

Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

Unit – 3 **[14 Hrs.]**

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Unit – 4 **[8 Hrs.]**

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change.

Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change &Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books/Reference books:

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa,HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.

Organizational Behaviour, Hitt, Miller, Colella, Wiley

Subject code	Course Title	L	T	P	C	QP
BCHPC6110	Process control Lab					

Pre -Requisite:

Course Educational Objective

To learn about dynamic behaviour of nonlinear, distributed and other complex systems, and design their control schemes.

Course Outcome: At the end of the course, the students will be able to

CO1	Describe the stages involved in the development of a process model.
CO2	Create a chemical engineering problem as a mathematical model from basic engineering principles.
CO3	Explain the appropriate numerical solutions to be used in solving the models
CO4	Classify various simulation tools for solving the chemical engineering models developed.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	0	-	2	-	-	-	-	-	-	-	2	
CO2	1	1	1	-	2	-	-	-	-	-	-	-	2	
CO3	2	2	1	-	2	-	-	-	-	-	-	-	1	
CO4	1	0	0	-	0	-	-	-	-	-	-	-	2	

1. To study the response of a single tank with step change in inlet flow and to find out time constant graphically.
2. To study the transient response of two interacting tanks with step change in inlet flow rate and to find out the time constant graphically.
3. To study the transient response of two non-interacting tanks with step change in inlet flow rate and to find out the time constant graphically.
4. To study the open loop response and the operation of ON-off electronic temperature controller and determination of its performance to control the temperature of a system having capacity to store thermal energy.
5. To study the open loop response and the operation of ON-OFF electronic pressure controller and determination of its performance to control the pressure of a pressure vessel.
6. To study of effect of PD, PI and PID controller on a temperature control trainer.
7. To study of effect of PD, PI and PID controller on a pressure control trainer.
8. To study the stability of a temperature control trainer.
9. To study the stability of a pressure control trainer.
10. To study Tuning of controller (Open loop method) of a temperature controller trainer.
11. To study Tuning of controller (Open loop method) of a pressure controller trainer.

Subject code	Course Title	L	T	P	C	QP
BCHPC6120	**Process Equipment and Design Lab**	**3**	**0**		**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To learn about the design procedures of process equipment used in chemical process plants.

Course Outcome: At the end of the course, the students will be able to

CO1	Analyze the method to be adopted to calculate equipment cost, and profitability for process.
CO2	Classify internal pressure vessels and external pressure vessels
CO3	Design of shell & tube heat exchanger
CO4	Solve critical problems associated with sieve tray distillation column

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0	1				-	-	-	1		2	
CO2	1	2	1	1			3	-	-	-			2	
CO3	1	2	1	2	-	-	-	-	-	-	-	-	1	
CO4	1	0	0		-	-	-	-	-	-	-	-	2	

1. Design of Double pipe heat exchanger
2. Design of 1-2 shell and tube Heat Exchanger
3. Design of Single effect horizontal tube evaporator.
4. Design of Single effect vertical tube evaporator.
5. Design of Absorption Column (Packed tower).
6. Design of Continuous Distillation Column (Plate tower).
7. Design of Storage tank (fixed roof).

Subject code	Course Title	L	T	P	C	QP
BCHPC6130	Fuel &Energy Technology Lab					

Pre -Requisite:

Course Educational Objective

CEO1:To learn about types of fuels and their characteristics, and combustion systems with emphasis on engineering applications

Course Outcome: At the end of the course, the students will be able to

CO1	Differentiate solid, liquid and gaseous fuels
CO2	Apply the knowledge of characterization techniques for fuels
CO3	Develop the alternate energy sources
CO4	Explain the modern energy conversion technologies

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		1			1	-	-	-	-	-	-		2
CO2	2		2			3	-	-	-	-	-	-		1
CO3	1		1			2	2	-	-	-	-	-		2
CO4	1		2			0		-	-	-	-	-		1

1. Determination of moisture content, volatile matter, carbon, and ash by Proximate Analysis method.
2. Determination of Cloud & Pour Point of an oil sample.
3. Determination of Flash &Fire Point of an oil sample.
4. Determination of Moisture Content of an oil sample by Dean & Stark Apparatus.
5. Determination of Carbon Residue of an oil sample by Conradson's Apparatus.
6. Determination of Aniline Point of an oil sample.
7. Determination of Viscosity of an oil sample by open cup apparatus.
8. Determination of Viscosity of an oil sample by closed cup apparatus.
9. Determination of Calorific Value of a fuel sample by Bomb Calorimeter.
10. Determination of washability characteristics of the supplied sample of Coal using Float and Sink test.

Subject code	Course Title	L	T	P	C	QP
BCHPC6140	**Advanced lab – I**	**3**	**0**		**3**	

Course Educational Objective

CEO1:To learn chemical engineering principles and their practical applications in the areas of mass transfer ,reaction engineering and particle mechanics

Course Outcome: At the end of the course, the students will be able to

CO1	Explain the d8ifferent types of pollution and apply knowledge for the protection and improvement of the environment
CO2	Make use of suitable wastewater treatment technique
CO3	Identify suitable sampling, analysis and equipment for air pollutants.
CO4	Apply their knowledge in controlling the pollution in process industries

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	0		0	-	-	1	1	-	-	-	-	-	2	
CO2	3		0	-	-	2	2	-	-	-	-	-	2	
CO3	3		0	-	-	2	2	-	-	-	-	-	1	
CO4	0		1	-	-	3	3	-	-	-	-	-	2	

1. Hydrodynamic studies of inverse fluidized bed.
2. Hydrodynamic study of single stage and multistage fluidized bed.
3. Determination of chemical oxygen demand (COD) of the waste water sample.
4. Determination of Biochemical oxygen demand (BOD) of the waste water sample.
5. Determination of viscosity of slurry using Brook-field viscometer & to study its principle of operation.
6. Determination of Viscosity co-efficient of a given liquid using Ostwald's Viscometer.
7. Conductometric estimation of an Acid mixture using standard NaOH solution.
8. Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.
9. Flame Photometric estimation of Sodium and Potassium in the given sample of Water.
10. Colorimetric estimation of Copper in a given solution.
12. Study and operation of a magnetic separator and thereby finding its efficiency of separation.

VII SEMESTER							
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
			THEORY				
1	PC	BCHPC7010	Process Modeling and Simulation	3	0	0	3
2	PC	BCHPC7020	Transport Phenomenon	3	0	0	3
3	PE	BCHPE7031	Fertilizer Technology	3	0	0	3
		BCHPE7032	Renewable Energy				
		BCHPE7033	Fluidization Engg				
		BCHPE7034	Interfacial Engineering				
4	PE	BCHPE7041	Petroleum Refinery Engineering	3	0	0	3
		BCHPE7042	Polymer Technology				
		BCHPE7043	Mineral Process Engineering				
		BCHPE7044	Biotechnology				
5	OE	B**OE7051	Open Elective – 3	3	0	0	3
		B**OE7052	Open Elective – 3				
		B**OE7053	Open Elective – 3				
		B**OE7051	Open Elective – 3				
			PRACTICAL / SESSIONAL				
7	PC	BCHPC7140	Advanced Laboratory-II	0	0	4	2
8	PC	BCHPC7150	Mini Project / Projects on Internet of Things	0	0	6	3
9	PE	BCHPE7160	## Massive Open Online Course (MOOC)	0	0	4	2
10	PC	BCHPC7170	^Summer Internship-II	0	0	2	1
		TOTAL:		15	0	16	23

Subject code	Course Title	L	T	P	C	QP
BCHPC7010	PROCESS MODELLING AND SIMULATION	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: Learn to develop mathematical models of phenomena involved in various chemical engineering processes and solutions for these models.

CEO2:To provide training to solve the model equations using numerical techniques

Course Outcome

CO1	Describe the stages involved in the development of a process model.
CO2	Create a chemical engineering problem as a mathematical model from basic engineering principles.
CO3	Explain the appropriate numerical solutions to be used in solving the models
CO4	Classify various simulation tools for solving the chemical engineering models developed.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0	-	-	-	-	-	-	-	-	-	2	
CO2	2	2		-	-	-	-	-	-	-	-	-	2	
CO3	1	2	3	-	-	-	-	-	-	-	-	-	1	
CO4	2	1	2	2	-	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

Modeling: Fundamentals of mathematical models and formulation – Continuity equation, Equation of motion, Transport equations, Energy equation, Equations of state, Equilibrium, Chemical kinetics and their applications; Population balance models and applications; Empirical models; Model parameters estimation. Lumped and distributed parameter models.

Unit:2 **10hrs**

Fluid systems, C.S.T.R. (single, series, isothermal, constant hold up, variable hold up, gas phase pressurized and non-isothermal), Single component vaporizer, Multi-component flash drum, Batch reactor, Reactor with mass transfer, Ideal binary distillation column, Batch distillation, Heat exchanger, etc.

Unit:3 **10hrs**

Optimization: Single variable optimization (analytical, dichotomous search, Fibonacci, golden section, regulafalsi), Multivariable optimization (analytical, geometric programming, linear programming), Convergence methods (Newton's methods, direct substitution, Wegstein's method).

Unit:4 **12hrs**

Simulation: Techniques of digital simulation – Information flow, from process to information flow diagram, From information flow diagram to numerical form, Recycles, Calculation of a recycle set, etc. Dynamic simulation - Batch reactor, Gravity flow tank, Three CSTR in series, Non-isothermal CSTR; Binary distillation column, Multi-component distillation column, Variable pressure distillation column, Ternary batch distillation with holdup.

Teaching Method (s): Chalk & Board/PPT/Video Lectures /MOOC/ Internship/Industry Guest Lecture/Invited Guest Lecture Demonstration.

Text Books 1:.Process Modeling, Simulation, and Control for Chemical Engineers, 2nd ed. by W L Luyben, McGraw-Hill.
2:.Process Plant Simulation, B V Babu, Oxford University Press

Ref. Books 1: Engineering Optimization: Theory and Practice by S S Rao, New Age.
2: . Process Control: Modeling, Design and Simulation, 1st ed. by B W Bequette, PHI.

Subject code	Course Title	L	T	P	C	QP
BCHPC7020	**TRANSPORT PHENOMENA**	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To Understand the fundamental connections between the conservation laws in heat, mass, and momentum.

CEO2: To develop sound physical understanding of flows.

CEO3: To familiarize various aspects of velocity, temperature and concentration distribution in laminar and turbulent flow.

Course Outcome

CO1	Analyze advanced transport problems in heat, mass, and momentum, both macroscopic and microscopic.
CO2	Create energy and mass balances equations in chemical processes.
CO3	Solve simple linear partial differential equations arising in transport problems.
CO4	Classify initial-value versus boundary-value problems and how to solve them either analytically or numerically

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0		-	-	-	-	-	-	-	-	2	
CO2	2	3			-	-	-	-	-	-	-	-	2	
CO3	2	2	3	-	-	-	1	-	-	-	-	-	1	
CO4	1	2	-	-	1	-	-	-	-	-	-	-	2	

Unit:1 **11hrs**

Momentum Transport: Viscosity and the mechanism of momentum transport, Shell momentum balances and pressure and velocity distributions in falling film, circular tube, annulus, slit, Flow of Two Adjacent Immiscible Fluids- Creeping Flow around a Sphere.. Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems,

Unit:2 **12hrs**

Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits. Energy equations, special forms, use of equations of change,

Unit:3 **11hrs**

Diffusivity, temperature and pressure effect, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow : stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change,

Unit:4 **10hrs**

Dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions, Inter phase transport in isothermal systems. temperature distribution for turbulent flow in tubes, jets, empirical expressions for turbulent mass flux.

Teaching Mentod (s):Chalk & Board/PPT/Video Lectures

Text Books 1:Transport Phenomena, 2nd ed. by R B Bird, W E Stewart, and E N Lightfoot, John Wiley & Sons.

2:.2. Analysis of Transport Phenomena, William M. Deen, Oxford University Press

Ref. Books 1:Introduction to Transport Phenomena: Momentum, Heat, and Mass by B Raj, PHI.

2:Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1999.

Subject code	Course Title	L	T	P	C	QP
BCHPE7031	FERTILIZER TECHNOLOGY					

Pre-Requisites (If any)-

Course Educational Objective

CEO1: Able to improve knowledge over a varied range of fertilizer production techniques, exposure to Nitrogenous and Complex fertilizer production technologies.

CEO2: Able to understand the best available technology options with cost effective, minimal energy consumption along with the best approaches to safety and environmental management.

Course Outcome

CO1	Describe the utility of different fertilizers .
CO2	Apply the knowledge of for production of new types of micro fetilizes for crop production
CO3	Explain about the various types of fertilizers
CO4	Develop the new process of storage technique.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	0	0	-	-	-	-	-	-	1			2
CO2	2	2	1	0			3	-	-	-	-	-		1
CO3	2	2	1	1	-	-	-	-	-	-	-	-		2
CO4	1	0	0	0	-	-	-	-	-	-	-	-		1

Unit:1 **10hrs**

Fertilizers: Chemical Fertilizers and Organic manures, Types of Chemical Fertilizers, Fertilizer applications and agronomic details Other Fertilizers: Secondary nutrients, micronutrients, Fluid fertilizers, controlled release fertilizers.

Unit:2 **10hrs**

Nitrogenous Fertilizers : Feedstock for production of Ammonia Gas, Associated Gas, Coke Oven Gas, Naphtha, Fuel Oil, Petroleum Heavy Stock, Coal, Lignite, Coke, Water. Methods of production, characteristics, specification and storage of Ammonium sulphate, ammonium nitrate, urea, calcium ammonium nitrate and ammonium chloride.

Unit:3 **10hrs**

Phosphatic Fertilizers: Raw materials - phosphate rock, sulphur, pyrites. Methods of production, characteristics, specification and storage of single super phosphate, triple super phosphate.

Potassic Fertilizers : Methods of production, characteristics, specification and storage of potassium chloride, potassium sulphate and potassium nitrate.

Unit:4 **10hrs**

Complex and NPK Fertilizers: Methods of production, characteristics specification and storage of ammonium phosphate sulphate, di-ammonium phosphate, nitro phosphates, urea ammonium phosphate, mono ammonium phosphate and various grades of NPK fertilizers.

Teaching Method (s):Chalk & Board/PPT/Video Lectures /MOOC/ Internship/Industry Guest Lecture/Invited Guest Lecture Demonstration.

Text Books 1:Handbook of fertilizer technology, Fertilizer Association of India, New Delhi
2: Fertilizer Industry - An Introductory survey, M. G. Menon, Higginbothams (P) Ltd.

Ref. Books 1: Shreve's Chemical Process Industries, 5th ed. by G T Austin, McGraw-Hill.
2: Unit process in organic systhesis : P.H. Groggins,MGH

Subject code	Course Title	L	T	P	C	QP
BCHPE7032	**RENEWABLE ENERGY**	**3**	**0**	**0**	**3**	

Pre-Requisites (If any)-Fuel technology

Course Outcome

CO1	To develop fundamental understanding about Solar Thermal and Solar Photovoltaic systems.
CO2	To provide knowledge about development of Wind Power plant and various operational as well as performance parameter/characteristics.
CO3	To explain the contribution of Biomass Energy System in power generation.
CO4	To teach different Storage systems, Integration and Economics of Renewable Energy

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	0	-	-	2	3	-	-	-	-	-		2
CO2	-	-	0	-	-	3	2	-	-	-	-	-		2
CO3	-	-	1	-	-	3	2	-	-	-	-	-		1
CO4	-	-	0	-	-	3	1	-	-	-	-	-		1

Unit:1 **10hrs**

Solar energy: Solar radiation at the earth's surface, solar radiation measurements, estimation of average solar radiation, solar thermal flat plate collectors, concentrating collectors, solar thermal applications, heating, cooling, desalination, drying, cooking, etc, solar thermal electric power plant, principle of photovoltaic conversion of solar energy, types of solar cells, Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc, solar PV power plant, Net metering concept.

Unit:2 **10hrs**

Wind energy: Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, wind resource assessment, Betz limit, site selection, wind energy conversion devices, classification, characteristics, applications, offshore wind energy, Hybrid systems, safety and environmental aspects, wind energy potential and installation in India, Repowering concept.

Unit:3 **10hrs**

Bio-energy: Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications - alcohol production from biomass – bio diesel production, Urban waste to energy conversion, Biomass energy programme in India

Unit:4 **10hrs**

Other types of energy: Ocean energy resources, principle of ocean thermal energy conversion (OTEC), ocean thermal power plants, ocean wave energy conversion, tidal energy conversion, small hydro-geothermal energy, geothermal power plants, hydrogen production and storage, Fuel cell – principle of working, various types, construction and applications.
, mono ammonium phosphate and various grades of NPK fertilizers.

Teaching Method (s):Chalk & Board/PPT/Video Lectures /MOOC/ Internship/Industry Guest Lecture/Invited Guest Lecture Demonstration.
(can be chosen one or many)

Text Books

1.Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984.
2.Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.

Ref. Books

1.Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
2.Peter Gevorkian, Sustainable Energy Systems Engineering, McGraw Hill,2007
3.Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.

Subject code	Course Title	L	T	P	C	QP
BCHPE7033	FLUIDISATOION ENGINEERING					

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To be Acquainted with the fundamentals of fluidization engineering, different regimes, classification of particles.

CEO2: To enable the students to learn the design aspects of fluidized beds.

Course Outcome

CO1	Explain the basic of fluidization.
CO2	Describe the various industrial application of fluidization.
CO3	Explain the various fluidization regimes, Classification of particles.
CO4	Describe the staging of fluidized bed reactor.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	3	-	-	-	-	-	-	-	-	-	2	
CO2	2	1	2	-	-	-	-	-	-	-	-	-	2	
CO3	1	2	2	-	-	-	-	-	-	-	-	-	1	
CO4	1	3	0	-	-	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

The Phenomenon of Fluidization, Liquidlike Behavior of a Fludized Bed, Advantages and Disadvatages of Fluidized Beds for Industrial Operations, Fluidization Quality, Industrial Applications of Fluidized Beds: Coal Gasification, Gasoline from Other Petroleum Fractions, Gasoline from Natural and Synthesis Gases, Synthesis Reactions, Metallurgical and Other Processes .

Unit:2 **12hrs**

Cracking of Hydrocarbons: (FCC), Fluid Coking and Flexi-Coking, Thermal Cracking
Combustion and Incineration: Fluidized Combustion of Coal, Incineration of solid Waste
Carbonization and Gasification: Gasification of Coal and Coke, Activation of Carbon, Gasification of Solid Waste, Reactions Involving Solids: Roasting Sulfide Ores, Silicon for the Semiconductor and Solar Cell Industries, Chlorination and Fluorination of Metal Oxides, Reduction of Iron Oxide, Biofluidization

Unit:3 **13hrs**

Fixed Beds of Particles: Characterization of Particles, Fixed Beds-One Size of Particles, Fixed Beds-Solids with a Distribution of sizes, Fluidization withour Carryover of Particles: Minimum Fluidizing Velocity, pressure Drop-versus-Velocity Diagram, Effect of Pressure and Temperature on Fluidized Behaviour, Sintering and Agglomeration of Particles at High Temperature, The Geldart Classification of Particles

Unit:4 **10hrs**

Distributor Types: Ideal Distributors, Perforated or Multiorifice Plates, Tuyeres and Caps, Pipe Grids and Spargers ,Pressure Drop Requirements across Distributors Estimation of Bed Properties: Gas Flow in the Emulsion phase, Bubble Gas flow, Bubble Size and Bubbles Growth, Bubble Rise Velocity, Beds with Internals.

Teaching Method (s):Chalk & Board/PPT/Video Lectures

Text Books 1:Fluidization Engineering: Daizo Kunii and Octave Levenspiel
2: Introduction to Chemical Engg. Thermodynamics by Smith and H.C. Vannes and M. Abbot (7th editation) Tata McGraw Hill, 2009

Ref. Books 1: Shreve's Chemical Process Industries, 5th ed. by G T Austin, McGraw-Hill.
2: Unit process in organic systhesis : P.H. Groggins,MGH

Subject Code	Course Title	L	T	P	C	QP
BCHPE7034	INTERFACIAL ENGINEERING	3	0	0	3	A

Pre -Requisite: Knowledge of chemical engineering, particularly thermodynamics, fluid mechanics, mass transfer and reaction engineering

Course Educational Objectives

CEO1: To Develop an understanding of the role that interfaces play in determining the properties of materials.

CEO2: To Identify the intermolecular and surface forces acting in various colloidal suspensions and nanoscale systems and be able to develop quantitative estimates of the strength and magnitude of these forces

CEO3: To understand the phenomena occur in the colloids and the importance of colloids and role of interfacial engineering and study near the interface processes.

CEO4: Role of colloids in industry is also covered like drug delivery, paints and textile etc

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

CO1	Study Cause of formation of self-assembled structures such as micelles of various sizes and shapes, bilayers and vesicles, and link it to 2 and 3 component surfactant phase diagrams.
CO2	Understand the origin of van der Waals attraction between molecules, and the factors that make it strong/weak
CO3	Analyze the Balance of repulsion between charged surfaces due to osmotic pressure buildup and van der Waals attraction between bodies decides kinetic stability of dispersed phase systems using DLVO theory
CO4	identify how interparticle and surface forces could be playing a role in a new system, isolate them by reasoning and additional experiments, and make progress towards engineering desired control on it.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	-	1	-	-	-	-	-	-	-	2	
CO2	1	1	2	-	2	-	-	-	-	-	-	-	2	
CO3	1	2	2	-	1	-	-	-	-	-	-	-	1	
CO4	1	1	0	-	1	-	-	-	-	-	-	-	2	

UNIT:1 **(10 Hours)**

Introduction to colloidal material, surface properties, origin of charge on colloidal particles, preparation & characterization of colloidal particles.

Surfactants type (Anionic, cationic, Zwitterionic, Gemini and non-ionic). Theory of surfactants. CMC. Kraft temperature. Phase behavior of cone surfactant systems, surfactant geometry, bilayers, vesicles and liquid crystals, and packing. Emulsions, Microemulsions & Gels

UNIT:2 **(10 Hours)**

Intermolecular Forces, Van-der-waals forces (Kessom, Debye, and London Interactions). Potential energy curve, Brownian motion and Brownian Flocculation.

Surface and interfacial Tension. Surface free energy, Surface tension for curved interfaces, Surface excess and Gibbs adsorption isotherm. Measurement of Surface tension, Interfacial Tension, Contact angle. Wetting Young-Laplace equation, and Dynamic properties of interfaces. Surface viscosity, Kelvin equation.

UNIT:3 **(10 Hours)**

Electrical phenomena at interfaces (Electronic kinetic phenomena, Electric double layer, short range forces). DLVO theory, capillary hydrostatics. Zeta potential, Electro osmosis phenomena, Streaming potential, Electro viscous flows.

UNIT:4 **(10 Hours)**

Thermodynamics of interfaces, thermodynamics of micelle and mixed micellar formation. Applications in detergents, personal-care products, pharmaceuticals, nanotechnology and food, textile, paint and petroleum industries.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books:

1. Adamson, A. W. and Gast, A. P., Physical Chemistry of Surfaces, John Wiley, New York, 1997.
2. Ghosh, P., Colloid and Interface Science, PHI Learning Pvt. Ltd., New Delhi, 2009.
3. Hiemenz, P. C. and Rajagopalan, R., Principles of Colloid and Surface Chemistry, Marcel Dekker, New York, 1997.
4. Stokes, R. J. and Evans, D. F., Fundamentals of Interfacial Engineering, Wiley-VCH, New York, 1997.

Reference Books:

1. Baszkin, A. and Norde, W., Physical Chemistry of Biological Interfaces, Marcel Dekker, New York, 2000.
2. Edwards, D. A., Brenner, H. and Wasan, D. T., Interfacial Transport Processes and Rheology, Butterworth-Heinemann, Boston, 1990.
3. Hunter, R. J., Foundations of Colloid Science, Oxford University Press, New York, 2005.
4. Israelachvili, J., Intermolecular and Surface Forces, Academic Press, London, 1992.
5. Slattery, J. C., Interfacial Transport Phenomena, Springer-Verlag, New York, 1990.

Subject code	Course Title	L	T	P	C	QP
BCHPE7041	**PETROLEUM REFINERY ENGINEERING**	**3**	**0**	**0**	**3**	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To learn the testing of petroleum products, crude processing and treatment techniques

CEO2: To familiarize students with the application of chemical engineering principles to petroleum refining.

Course Outcome

CO1	Describe the petroleum industry scenario worldwide.
CO2	Explain the different refining processes.
CO3	Develop knowledge of safety and pollution control in the refining industries.
CO4	Illustrate the suitable refining technology for maximizing the gasoline yield.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		1	-	-	1		-	-	-	-	-	2	
CO2	2		2	-	-	3		-	-	-	-	-	1	
CO3	1		1	-	-	2	2	-	-	-	-	-	1	
CO4	1		2	-	-	0		-	-	-	-	-	2	

Unit:1 **10hrs**

Origin and formation of petroleum, Reserves and deposits of the world. Indian petroleum Industry, composition of petroleum. ,Evaluation of Petroleum, Thermal properties of petroleum fraction, Important products-Properties and Test methods

Unit:2 **10hrs**

Crude pretreatment, dehydration and desalting, Pipe still heater, atmospheric and vacuum distillation of crude oil. Important products – properties and test methods: natural gas, Associated gas, Dissolved gas, Refinery off gas, LPG, Reid vapour pressure, ASTM distillation, Octane number and Cetane number.

Unit:3 **10hrs**

Treatment of products, additives, blending of gasoline. Treatment of gasoline, kerosene, lubes and lubricating oils, waxes.

Unit:4 **10hrs**

Thermal and catalytic cracking, Hydro cracking and hydro treating. Coking, Visbreaking, Alkylation, Isomerization, Asphalt and air blown asphalt.

Teaching Method (s):Chalk & Board/PPT/Video Lectures /MOOC/ Internship.

Text Books 1:Nelson, Petroleum Refinery Engineering, Mc Graw Hill Book.
2:. Rao, B. K. B., Modern Petroleum Refining Processes, Oxford and IBH.

Ref. Books 1: Cox, P.A., "The Elements on Earth", Oxford University Press, Oxford 1995

Subject code	Course Title	L	T	P	C	QP
BCHPE7042	POLYMER TECHNOLOGY	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To equip students with basic knowledge of polymer synthesis that will help them to develop new materials.

CEO2: To study various processing methods of polymers and elastomers.

Course Outcome

CO1	Describe the polymer rheology and properties
CO2	Explain the structure and molecular weight of Polymers
CO3	Apply knowlegde to develop new polymers
CO4	Understand the various process of polymerization

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	0	0	-	-		-	-	-	1			2
CO2	2	2	1	0	-	-	3	-	-	-				1
CO3	2	2	1	1	-	-	-	-	-	-	-	-		2
CO4	1	0	0	0	-	-	-	-	-	-	-	-		1

Unit:1 **10hrs**

Polymers - History of polymers, nomenclature of polymers, functionality, types of polymerization, Chemistry of polymerization, Classification of polymers, Mechanism of addition polymerization, kinetics of polymerization, polymerization techniques- bulk, dispersion, solution, suspension and emulsion polymerizations.

Unit:2 **12hrs**

Elementary idea on polymer rheology & properties of polymers – physical, chemical, mechanical, electrical properties and optical properties of polymers-Crystallinity and glass transition temperature(Tg), macro molecular structure. Molecular weight of polymers and its determination by viscometry, light-scattering and osmotic pressure methods, polydispersity, Polymer degradation.

Unit:3 **13hrs**

Manufacture and uses of important polymers: Thermoplastic Polymers – polyolefins – vinyl polymers – poly vinyl chloride, polyvinyl alcohol, polyvinyl acetate, polyethylene, polypropylene, polystyrene, PMMA, SAN, PAN, Teflon, polyamides, polycarbonates. Thermosetting Polymers – Phenolic resins-UF, MF, polyesters, epoxies, bisphenol-A, polyurethanes, silicone resins. Elastomers: Natural rubber – Isoprene rubber, Synthetic rubbers - Butadiene rubber- Butyl rubber- Styrene Butadiene Rubber- Chloroprene rubber- Nitrile rubber—EPDM rubber and Silicone rubber and their applications.

Unit:4 **10hrs**

Polymer additives, Plastic materials and elastomers as materials of construction in chemical equipments, Introduction to reactor design for polymerization, Polymer processing, Processing of thermoplastics and thermosetting plastics, compounding, processing aids – injection moulding – extrusion moulding – blow moulding. Processing of natural and synthetic rubbers – vulcanisation, mastication, calendaring– reaction injection moulding – sintering - solution casting – SMC and DMC–fibre spinning and drawing. Application of Polymers –Engineering plastics, Electrical and electronics- conducting polymers, high temperature applications- Polymer blends, alloys and liquid crystals- lithography and water treatment-biomedical, automotives.

Teaching Method (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Billmeyer F.W., "Text book of Polymer Science," 3rd edn., Wiley, Singapore, 1984.
2: Polymer Science & Technology, P.Ghosh, TMC

Ref. Books 1: polymer science by joel fried

Subject code	Course Title	L	T	P	C	QP
BCHPE7043	**MINERAL PROCESS ENGINEERING**	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To introduce the theoretical aspects of common mineral processing techniques and the associated equipment utilized now-a-days in mining and extractive metallurgy practices.

CEO2: To introduce students to the principles of ore comminution, liberation and particle size analysis.

Course Outcome

CO1	Apply the knowledge of various thermal methods of mineral processing.
CO2	Classify the different mineral processing methods.
CO3	Make use of knowledge in real time practice.
CO4	Assess the separation method in hydrometallurgy

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	-	-	-	-	-	-		2
CO2	3	2	-	-	-	-	-	-	-	-	-	-		1
CO3	3	2	-	-	-	-	-	-	-	-	-	-		2
CO4	3	2	-	-	-	-	-	-	-	-	-	-		1

Unit:1 **10hrs**

Introduction of ores and minerals; characterization of particulate materials, estimation of particle size by different methods, representation of size analysis, size reduction equipment, work index determination, mineral separation including gravity separation, jigging, spiralling, shaking table concentration etc., electrical and magnetic methods of separation, froth flotation chemistry, froth flotation unit operation, flotation equipment and flotation technology; fine particles processing, separation efficiency versus fine particles fine particles processing techniques

Unit:2 **10hrs**

Thermal methods in processing of Ores, Roasting, Sintering, Calcination, Pelletisation and briquetting. Chemical and electrochemical methods in mineral processing, Leaching, leaching process variables, Dump and heap leaching, Acid Leaching, Bacteria leaching.

Unit:3 **10hrs**

Solid-liquid separation in hydrometallurgy, solution purification, Amalgamation and cyanidation. Uranium processing

Unit:4 **10hrs**

Tailings treatment and effluent processing, tailings pond management and environmental concerns; case studies including sulphide minerals flotation.

Teaching Method (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Mineral Beneficiation: A Concise Basic Course, D.V. Subba Rao, Pub.: CRC Press, 2011
2:Introduction to Mineral Processing, E.G. Kelly and D.J. Spottiswood, Pub.: Wiley, 1982.

Ref. Books 1: Coulson & Richabol Vol-2 Chemical Engineering pergammmic Press.

Subject code	Course Title	L	T	P	C	QP
BCHPE7044	**BioTechnology**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To introduce the basic knowledge of biotechnology and its application

CEO2: To understand the principles of genetic engineering, plant biotechnology and food biotechnology

Course Outcome

CO1	obtain knowledge on application of biotechnology for societal development.
CO2	understand the structure and reproduction of bacteria
CO3	have an idea about plant biotechnology and its application
CO4	know about single cell protein and its production.

COs	PROGRAMME OUTCOMES												PSOs	

UNIT:1 **(10 Hours)**

Introduction and application of microbiology, Structure and functioning of bacterial cell, Classification and Identification criteria for bacteria. Nutritional requirements and nutritional types of bacteria.

UNIT:2 **(10 Hours)**

Isolation of micro-organisms, pure culture techniques and cultural characteristics. Bacterial growth, measurements and reproduction.

UNIT:3 **(10 Hours)**

Fundamentals of microbiology ecology and ecosystems, microbial associations and interactions. Applications of microbiology.

UNIT:4 **(10 Hours)**

Types of bacteria in water, sanitary examination of water, water purification, average disposal and sewage purification.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Microbiology, 4th ed. by MJPelczar, RDReid, and ECSChan, McGraw-Hill.

2. *Microbial Ecology: Fundamentals and Applications, 4th ed. by R M Atlas and R Bartha, Benjamin Cummings*.

Ref. Books 1Bioprocess Engineering by Bjorn K. Lydersen, et. al ,Wiley India Edition

2 2 Bioprocess Engineering by M.L. Shuler and F.Kargei Person

Subject Code	Course Title	L	T	P	C	QP
BCHPC7140	**Advanced lab – II**	**3**	**0**		**3**	

Course Educational Objective

Course Outcome: At the end of the course, the students will be able to

CO1	Study the properties of liquid.
CO2	Calculate turbidity of given sample
CO3	Make use of ASPEN PLUS in optimizing the distillation column
CO4	Understand the fluid flow using FLUENT.

1. Finding out matrix addition, multiplication, inversion, rank, Eigen values using MATLAB simulator.
2. Plotting set of data using MATLAB.
3. Parameter estimation using least-square technique using MATLAB.
4. Writing "m." files in MATLAB platform to solve coupled linear algebraic equations using Gauss elimination method.
5. Writing "m." files in MATLAB platform to solve non-linear algebraic equations using Newton Raphson Technique.
6. Design of a shell & tube heat exchanger by using AUTOCAD.
7. Design of a distillation column by using AUTOCAD.
8. Design of a single effect evaporator by using AUTOCAD.
9. Design of an absorption tower by using AUTOCAD.
10. Design of a storage vessel by using AUTOCAD.
11. Generation of VLE data and plot T-x-y and P-x-y plots of binary systems using ASPEN PLUS.
12. Determination of the composition of the liquid mixture using high performance liquid chromatography.
13. Determination of concentration of dyes using spectrophotometric analysis.
14. Determination of velocity of ultrasonic wave in a medium of liquid using ultrasonic interferometer.
15. Study the operation and characteristics of Potentiostat.

VIII SEMESTER

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
			THEORY				
1	PE	BCHPE8011	Modern Separation Technique	3	0	0	3
		BCHPE8012	Integrated Solid Waste Management				
		BCHPE8013	Green Technology				
		BCHPE8014	Pollution and its control				
2	PE	BCHPE8021	Nano Technology	3	0	0	3
		BCHPE8022	Pinch technology				
		BCHPE8023	Optimization Methods				
		BCHPE8024	Fermentation Technology				
3	OE	B**OE8031	Open Elective – 4	3	0	0	3
		B**OE8032	Open Elective – 4				
		B**OE8033	Open Elective – 4				
		B**OE8031	Open Elective – 4				
			PRACTICAL / SESSIONAL				
4	PC	BCHPC8150	Major Project / Industrial Project / Startup Training cum Project	0	0	12	6
5	PC	BCHPC8180	Seminar and Technical Writing	0	0	4	2
6	PC	BCHPC8190	Comprehensive Viva-Voce	0	0	4	2
		TOTAL:		9	0	20	19

Subject code	Course Title	L	T	P	C	QP
BCHPE8011	**MODERN SEPARATION TECHNIQUES**	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To acquire in-depth knowledge in the area of membrane separation mechanisms, transport models, membrane permeability computations, membrane types and modules, membrane reactors, etc.

CEO2: to understand the preparation and characterization of membranes for different applications.

Course Outcome

CO1	Explain about Types of membrane available in details.
CO2	Describe the various filtration processes.
CO3	Illustrate the idea about electric field separation process
CO4	Develop a separation technique in terms of modeling.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0					-	-	-	3		2	
CO2	1	1	2	2			2	-	-	-	-	-	1	
CO3	2	2	1	-	-			-	-	-	-	-	1	
CO4	1	0	0	-	-			-	-	-	-	-	2	

Unit:1 **10hrs**

Membrane, Classification, characterization and preparation of membrane, Membrane modules, Classification of membrane separation processes, Materials of membrane construction, Advantages of membrane processes, Major areas of application, preparation and characteristics of membranes.

Unit:2 **10hrs**

Principles of membrane separation processes: Reverse osmosis, nano-filtration, ultra-filtration, micro-filtration, osmotic controlled filtration, gel layer controlled filtration. Basic principles and modeling of dialysis.

Unit:3 **10hrs**

Electric field separation process: Zeta potential, electric double layer, Basic modeling of electric field enhanced filtration, Ionic separations like Electro dialysis, Electrophoresis. Ion exchange chromatography.

Unit:4 **10hrs**

Liquid membrane and its modeling. Basic design of gas separation and pervaporation.
Cryogenic separation; Super- critical extraction, Reactive distillation.

Teaching Method (s):Chalk & Board/PPT/Video Lectures

Text Books 1: C. J. King –"Separation Processes", Tata McGraw Hill Publishing Co Ltd.
2:Seperation Process Principle by Seader and Henly

Ref. Books 1: Ullmanns, Encyclopedia of Industrial Chemistry, Vol 32, Wiley - VCH.6.
2: Kausikh Nath-"Membrane separation Praocesses",PHI,New Delhi

Subject code	Course Title	L	T	P	C	QP
BCHPE8012	**INTEGRATED SOLID WASTE MANAGEMENT**	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1: To Understand the solid, hazardous waste and their treatment and disposal methods and Learn pollution control aspects for selected process industries.

CEO2:- To study various processing methods of polymers and elastomers.

Course Outcome

CO1	Explain about the different types of solid waste
CO2	Understand the various collection and disposal method
CO3	Apply the knowledge to utilize solid waste in different way.
CO4	Develop new method for degradation process of solid waste

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	2	-	-	2	1	-	-	-	-	-	1	
CO2	-	-	1	-	-	2	3	-	-	-	-	-	2	
CO3	-	-	1	-	-	2	2	-	-	-	-	-	1	
CO4	-	-	1	-	-	1	1	-	-	-	-	-	2	

Unit:1 **10hrs**

Solid waste management: Sources, Composition and Properties of Municipal Solid Waste, Engineering principles; Generation, Onsite handling, storage and processing including segregation; Collection, Recycling, Transfer and transport,Wasteprocessing, Recovery of resources,

Unit:2 **10hrs**

Waste processing technologies, Biological, chemical and thermal technologies – Composting, Anaerobic digestion, Incineration and pyrolysis,Disposal of solid waste including sanitary landfill, planning, siting, design, closure and post-closure monitoring;

Unit:3 **10hrs**

Regional/Integrated solid waste management related issues. Principles of E-waste Management. Biomedical waste: Regulatory framework, categorization; generation, collection, transport, treatment and disposal.

Unit:4 **12hrs**

Hazardous Waste Fundamentals, Definition, Classification, Generation, Regulatory process, Current Management Practices, Treatment and Disposal Methods, Physicochemical processes, Biological processes, Stabilization and solidification; Thermal methods; Land disposal, Remediation of Contaminated Sites.

Teaching Method (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Peavy H. S., Rowe D. R. and Tchobanoglous G., Environmental Engineering, McGraw-Hill International Edition.
2:3. LaGrega, M.D., Buckingham P.L., and EvansJ.C., Hazardous Waste Management, McGraw-Hill International Editions, 1994.

Ref. Books 1: Martin E.J. and Johnson J.H., Hazardous Waste Management Engineering, van Nostrand-Reinhold, 1987.
2: Wentz C.A., Hazardous Waste Management, 2nd Edition, McGraw Hill, 1995

Subject code	course title	L	T	P	C	QP
BCHPE8013	**GREEEN TECHNOLOGY**					

Pre-Requisites (If any)-

Course Educational Objective

CEO1:To make students aware of how chemical processes can be designed, developed and operated in a sustainable way.

CEO2:- To facilitate the growth of the Green Technology industry and enhance its contribution to the national economy.

Course Outcome

CO1	Explain the industrial ecology in green technology
CO2	Understand the material and energy balance
CO3	Compare benefit of non conventional ennergy over conventional energy
CO4	Apply the knowledge for utilization of non conventional energy

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0	-	-			-	-	-	-	-		2
CO2	2	3						-	-	-	-	-		2
CO3	2	3	3				1	-	-	-	-	-		2
CO4	1	2			1			-	-	-	-	-		1

Unit:1 **10hrs**

Green Technology – definition- Importance – Historical evolution – advantages and disadvantages of green technologies-factors affecting green technologies- Role of Industry, Government and Institutions – Industrial Ecology – role of industrial ecology in green technology.

Unit:2 **10hrs**

Definition – Importance – Historical evolution – Principles of Cleaner Production–Benefits–Promotion – Barriers – Role of Industry, Government and Institutions – clean development mechanism, reuse, recovery, recycle, raw material substitution-Wealth from waste, case studies. Overview of CP Assessment Steps and Skills, Process Flow Diagram, Material Balance, CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – CP Financing – Preparing a Program Plan – Measuring Progress- ISO 14000.

Unit:3 **10hrs**

Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading, Life Cycle Assessment – Elements of LCA – Life Cycle Costing – Eco Labelling.

Unit:4 **10hrs**

Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices, their principles, working and application

Definition-benefits and challenges – comparison of green fuels with conventional fossil fuels with reference to environmental, economical and social impacts- public policies and market-driven initiatives. Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes.

Teaching Method (s):Chalk & Board/PPT/Video Lectures /MOOC/ Internship/Industry Guest Lecture/Invited Guest Lecture Demonstration.
(can be chosen one or many)

Text Books 1: Pollution Prevention: Fundamentals and Practice' by Paul L Bishop (2000), McGraw Hill International.
2:Pollution Prevention and Abatement Handbook – Towards Cleaner Production' by World Bank Group (1998), World Bank and UNEP, Washington D.C.

Ref. Books 1:Handbook of Organic Waste Conversion' by Bewik M.W.M
2:Non-conventional Energy Sources' by Rai G.D.

Subject Code	Course Title	L	T	P	C	QP
BCHPE8014	POLLUTION AND ITS CONTROL	3	0	0	3	A

Pre -Requisite:

Course Educational Objectives

CEO1: Apply the principles of waste minimisation, source reduction, material use and recovery in the design of solid and hazardous waste management systems.

CEO2: Assess air and noise pollution problem and apply control approaches needed through solving real problem in engineering practice

CEO3: Understand the solid, hazardous waste and their treatment and disposal methods and Learn pollution control aspects for selected process industries.

CEO4:Demonstrate ability to use appropriate equipment and techniques in the identification and control of environmental pollution.

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

CO1	Gain awareness of current forms of environmental pollution and an overview of both their causes and consequences to natural, economic and social systems.
CO2	understand the fundamental principles governing the interactions between those systems (i.e. transport of pollutants in the environment),
CO3	learn examples of good practice of technologies and options used to remediate reduce/eliminate pollution of the environment,
CO4	analyse, synthesise, and evaluate evidence to understand problems in order to select control measures and techniques concerning atmospheric, water or terrestrial challenges.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1		-	-		1	2	-	-	-	0		2
CO2		3					3	2	-	-	-			2
CO3		3					3	2	-	-	-	3		2
CO4		2					2	1	-	-	-			1

UNIT:1 **(10 Hours)**

Introduction and importance of Environmental Pollution, case studies; Environmental indicators; Pollution prevention methodologies; methods for waste minimization; types of recycling; recycling of waste material; recovery effort index; ISOTC-207 standards; environmental audits.

Air Pollution: Sources; Types of air pollutants; Classification of industries and area.

Atmospheric dispersion: Micrometeorology; Lapse rate; Atmospheric classes; Plume and type of plume; Dispersion models; Ground and elevated sources with and without reflection; Calculation for plume rise and stack gas flow rates.

UNIT:2 **(10 Hours)**

Gaseous pollutants: Sources; Emission factors and control technology.

Particulate pollutants: Major sources; Effects; Emission factor and emission limits; Combustion generated pollutants and control; Particulate emission control equipment- Design and efficiency of centrifugal collectors, electrostatic precipitators, bag filters and scrubbers**;** Vehicular emission control.

UNIT:3 **(10 Hours)**

Water Pollution: Sources; Pollution laws and limits; Water quality modeling for streams; Characterization and classification of effluents; Effluent standards; Pretreatment and primary treatment methods; Physico-chemical methods of water pollution control; Biological wastewater treatment processes; Advanced treatment methods; Disinfections; Typical industrial and municipal applications.

UNIT:4 **(10 Hours)**

Noise Pollution: Definition of noise, effect of noise pollution, Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, Noise pollution control.

Solid Waste Management : Municipal, Industrial, Commercial, Agricultural, Domestic, biomedical , Electronic & Hazardous solid wastes;

Recovery and disposal method- Open dumping, Land filling, incineration, composting and recycling.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books:

C. S. Rao, Environmental Pollution Control, CBS Publishers

Reference Books:

1. Peavy, H.S., Rowe D.R. and Tchobanoglous, G., "Environmental Engineering", McGraw-Hill Book Co.
2. Metcalf &Eddy, Inc., "Waste Water Engineering-Treatment, Disposal, Reuse", Mcgraw-Hill, Inc.
3. Nevers, Noel de, "Air Pollution Control Engineering", McGraw-Hill, Inc.
4. K. Wark, C. F. Werner and W. T.Davis, Air Pollution: Ita origin and control, a Dun- Donnelley Publisher, New York
5. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd.,1991.

Subject code	Course Title	L	T	P	C	QP
BCHPE8021	NANOTECHNOLOGY	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1:To introduce and provide a broad view of the nascent field of nanotechnology to undergraduates

CEO2:- To gain an understanding of the principles of nanotechnology; characterization of nano structured materials; and tools and equipment for producing and assembling at the nano scale.

Course Outcome

CO1	Explain properties on nano particle .
CO2	Make use of various instrument like SEM, TEM , STM and DLS
CO3	Describe about the chemical engineering process and nano synthesis process
CO4	Apply the knowledge of nano technology in different field

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	0	-	-	-	-	-	-	-	-	-	1	
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	
CO3	1	3	2	-	-	-	1	-	-	-	-	-	1	
CO4	2	2			1	-	-	-	-	-	-	-	2	

Unit:1 **10hrs**

Nano Scale, history and Scope of Nano Technology., Nanomaterials, Morphology. Enhanced properties at nano scale. Comparison with bulk materials.

Unit:2 **13hrs**

Top Down Approach, Grinding, Planetary milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Micro emulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Son chemical Approach, Microwave and Atomization, Gas phase Production Methods : Chemical Vapour Depositions.

Introduction to Instrumentation and characterization Instrumentation Fractionation principles of Particle size measurements, Particle size and its distribution, XRD, Zeta potential,SEM, TEM, AFM, STM, DLS, Spectroscopy. etc.

Unit:3 **12hrs**

Kinetics at Nanoscale,Nucleation and growth of particles, Issues of Aggregation of Particles, Oswald Ripening, Stearic hindrance, Layers of surface Charges, Zeta Potential and pH,

Carbon Nanomaterials,Synthesis of carbon buckyballs, List of stable carbon allotropes extended fullerenes, metallofullerenes solid C60, bucky onions nanotubes, nanocones ,Difference between Chemical Engineering processes and nanosynthesis processes

Unit:4 **10hrs**

Applications of Nano Technology.Applications in Chemical Engineering like nanocatalyst, bio analytical tools, nano/micro arrays, nano devices

Teaching Method (s):Chalk & Board/PPT/Video Lectures

Text Books 1: Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, Capital Publishing Company, 2007.
2.Gabor L. Hornyak., H.F. Tibbals, Joydeep Dutta, John J. Moore, Introduction to Nanoscience and Nanotechnology, CRC Press, 2008.

Ref. Books 1: Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
2:. Poole C., and Owens F., Introduction to Nanotechnology, John Wiley, New Jersey, 2003.

Subject code	Course Title	L	T	P	C	QP
BCHPE8022	**PINCH TECHNOLOGY**	3	0	0	3	

Pre-Requisites (If any)-

Course Educational Objective

CEO1:To learn process integration with regard to energy efficiency, waste minimization and an efficient use of raw materials.

CEO2;To learn the modeling skills necessary to describe and formulate optimization problems arising in process systems engineering

Course Outcome

CO1	Explain about the various disposal and biological treatment process
CO2	Describe various air and water treatment methods
CO3	Apply the knowledge in devloping new digestor for treatment process
CO4	Make use of various chemicl and biological process for effluent treatment.

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	0	1								2			2
CO2	2	1	2	1			3							1
CO3	2	1	2	-	-	-	-	-	-	-	-	-		2
CO4	1	0	0	-	-	-	-	-	-	-	-	-		1

Unit:1 **10hrs**

Introduction: Pinch analysis, History and industrial experience ,concept of process synthesis, role of thermodynamics in process design, Capital and energy costsLearning and applying the techniques Key concepts of pinch analysis ,Heat recovery and heat exchange Basic concepts of heat exchangeThe temperature–enthalpy diagram The pinch and its significance Heat exchanger network design Methodology of pinch analysis, range of pinch analysis technique , pinch study

Unit:2 **10hrs**

Hazardous Waste Fundamentals, Definition, Classification, Generation, Regulatory process, Current Management Practices, Treatment and Disposal Methods, Physicochemical processes, Biological processes.

Unit:3 **10hrs**

Targeting of Heat Exchanger Network (HEN): Energy targeting, areatargeting, number of units targeting, shell targeting, cost targeting. Designing of HEN: Pinch design methods,Heuristic rules, and stream splitting. Design of maximum energy recovery (MER). Design of multiple utilities and pinches. Design for threshold problem, Loops and Paths.

Unit:4 **10hrs**

Heat integration of equipments: Heat engine, heatpump, distillation column, reactor,evaporator, drier, refrigeration systems. Heat and power integration: Cogeneration,steam turbine, and gas turbine.

Teaching Method (s):Chalk & Board/PPT/Video Lectures /MOOC/ Internship/Industry Guest Lecture/Invited Guest Lecture Demonstration

Text Books 1:Pinch Analysis and Process Integration: A User Guide on Process Integration for the Efficient Use of Energy, 2nd ed. by I C Kemp, Butterworth-Heinemann.
2.Chemical Process Design and Integration, 2nd ed. by R Smith, Wiley.

Ref. Books 1:Heat Exchanger Network Synthesis: Process Optimization by Energy and Resource Analysis by U V Shenoy, Gulf Publishing.
2: Sustainable Design Through Process Integration: Fundamentals and Applications to Industrial Pollution Prevention, Resource Conservation, and Profitability Enhancement by MMEl-Halwagi, Butterworth-Heinemann

Subject code	Course Title	L	T	P	C	QP
BCHPE8023	**Optimization Methods**	**3**	**0**		**3**	

Pre -Requisite:

CEO1:To introduce the students how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science

CEO2:To provide students with opportunity using various software package for solving liner programming and integer programming models

CEO3:To introduce the students to use of basic methodology for solution of linear programs and integer programs

CEO4:To introduce the students to advance methods for large scale transportation and assignment problems

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

CO1	**Analyze,** formulate and solve linear programming problems using appropriate techniques.
CO2	**Conduct** and **interpret** post-optimal and sensitivity analysis
CO3	**Develop** mathematical skills related to heat, mass & fluid phenomenon
CO4	**Communicate** ideas, explain procedures and interpret results and solutions related to chemical reactors

UNIT:1 **[14 Hours]**

Introduction

Basic concept of Optimization, Formulation of objective function, Linear Programming: revised simplex method, sensitivity analysis, Kermarkar algorithm, Dynamic programming Problem, Non-linear programming: Introduction to non-linear programming, Random search method

UNIT:2 **[14 Hours]**

Application of Optimization in Heat transfer & fluid flow:

Optimal recovery of waste heat, optimum shell & tube heat exchanger design, optimum heat exchanger network, optimum evaporator design, optimal pipe diameter, minimum work of gas compression, optimal design of gas transmission network.

UNIT:3 **[10 Hours]**

Application of Optimization in separation processes:

Optimization of liquid-liquid extraction process, optimization design of distillation column, optimum reflux ratio, regression to fit VLE data.

UNIT:4 **[10 Hours]**

Application of Optimization in chemical reactors:

Formulation of chemical reactor optimization problem, use of differential calculus in reactor optimization, use of LPP in reactor optimization, use of NLPP calculus in reactor optimization.

Teaching Methods: Chalk& Board/PPT

Text Books:

1. Taha H.A., Operations Research 9th Edition, Prentice Hall of India, New Delhi, 2010Book
2.Edgar, Himmelblau, Optimization of Chemical processes, Mc Graw-Hill International Edition

Ref. Books:

1. P.K.Gupta, D.S.Hira, “Operations Research”, S.Chand and Company Ltd

Subject Code	Course Title	L	T	P	C	QP
BCHPE8024	**Fermentation Technology**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To provide knowledge on different of fermentation process

CEO2:To have theory and practicle knowledge on purification of products

Course Outcome

CO1	Under graduate will get idea on different fermentation technologies
CO2	They understand the importance on enzyme in fermentation process
CO3	Importance of micro organism in fermentation
CO4	T o get knowledge of downstream process

UNIT:1 **(8 Hours)**

Range of Fermentation processes, Microbial growth kinetics, Microbial biomass, Microbial enzymes, Microbial metabolites, Recombinant products, Batch culture, continuous culture, Microbial culture selection for fermentation processes. Media formulation and process optimization.

UNIT:2 **(10 Hours)**

Industrial production of proteases, cellulases, amylase, lipase; Process parameters that influence enzyme production during submerged and solid state fermentation, production of biofuel.

UNIT:3 **(10 Hours)**

Isolation, preservation and improvement of industrial micro organism, development of media for industrial fermentation. Development of inoculums for yeast and bacterial processes.

UNIT:4 **(10 Hours)**

Removal of microbial cells, Precipitation, filtration, centrifugation. Cell disruption, extraction and chromatography, Drying and crystallization.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1Principles of Fermentation Technology by P.F. Stanbury, A. Whitaker, and S.J Hall, Pergamon

2 Basic Fermentation Technology by S.M.Reddy, New Age International Pvt.ltd.s

Ref. Books 1Bioprocess Engineering by Bjorn K. Lydersen, et. al ,Wiley India Edition

2 2 Bioprocess Engineering by M.L. Shuler and F.Kargei Person