



HINDUSTHAN
COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore– 641032

DEPARTMENT OF CHEMICAL ENGINEERING

CURRICULUM

(UNDER REGULATIONS 2022)

(Academic Council Meeting held on 03.03.2023)

DEPARTMENT OF CHEMICAL ENGINEERING

REGULATION-2022

B.TECH. CHEMICAL ENGINEERING

I TO VIII SEMESTERS CURRICULUM

S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER I											
Theory											
1.	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	22ME1201	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
Theory with Lab Component											
3.	22HE1151	English for Engineers	HSC	2	0	2	3	4	50	50	100
4.	22PH1151	Physics of Materials	BSC	2	0	2	3	4	50	50	100
5.	22IT1151	Python Programming and Practices	ESC	2	0	2	3	4	50	50	100
EEC Courses (SE/AE)											
6.	22HE1071	Universal Human Values	AEC	2	0	0	2	2	40	60	100
7.	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
Mandatory Courses											
8.	22MC1091/ 22MC1092	அறிவியல்தமிழ்/Indian Constitution	MC	2	0	0	0	2	0	0	0
TOTAL				15	5	6	19	27	370	330	700
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER II											
1	22MA2104	Fourier Analysis and Laplace Transforms	BSC	3	1	0	4	4	40	60	100
2	22PH2101	Basics of Material Science	BSC	2	0	0	2	2	40	60	100
3	22CY2101	Environmental Studies	ESC	2	0	0	2	2	40	60	100
4	22CH2201	Introduction to Chemical Engineering	PCC	3	0	0	3	3	40	60	100
Theory with Lab Component											
5	22CY2151	Chemistry for Engineers	BSC	2	0	2	3	4	50	50	100
6	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
Practical											
7.	22ME2001	Engineering Practices	ESC	0	0	4	2	4	60	40	100
EEC Courses (SE/AE)											
8.	22HE2071	Design Thinking	AEC	1	0	2	2	3	100	0	100
9.	22HE2072	Soft Skills and Aptitude-I	SEC	1	0	0	1	1	100	0	100
Mandatory Courses											
10.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
11.	22MC2091/ 22MC2092	தமிழர்மரபு/ Heritage of Tamil	MC	2	0	0	0	2	0	0	0
TOTAL				18	1	10	22	29	520	380	900
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER III											
Theory											
1.	22MA3107	Numerical Methods	BSC	3	1	0	4	4	40	60	100
2.	22CH3201	Chemical Process Calculations	PCC	3	1	0	4	3	40	60	100

3.	22CH3202	Fluid Flow Operations	PCC	3	0	0	3	3	40	60	100
4.	22CH3203	Chemical Engineering Thermodynamics – I	PCC	3	0	0	3	3	40	60	100
Theory with Lab Component											
5.	22CH3251	Mechanical Operations	PCC	2	0	2	3	4	50	50	100
6.	22ME3253	Basic Mechanical Engineering	ESC	2	0	2	3	4	50	50	100
Practical											
7.	22CH3001	Fluid Flow Operations Lab	AEC	0	0	4	2	4	60	40	100
8.	22CH3002	Technical Analysis Lab	PCC	0	0	4	2	4	60	40	100
EEC Courses (SE/AE)											
9.	22HE3071	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
Mandatory Course											
10	22MC3091	Essence of Indian Traditional Knowledge	AC	2	0	0	0	2	100	0	100
TOTAL				17	2	12	25	30	480	420	900
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER IV											
Theory											
1.	22HE4101	IPR and Start-ups(Common)	HSC	2	0	0	2	2	40	60	100
2.	22CH4201	Mass Transfer Operations - I	PCC	3	0	0	3	3	40	60	100
3.	22CH4202	Chemical Engineering Thermodynamics – II	PCC	3	0	0	3	3	40	60	100
4.	22CH4203	Process Heat Transfer	PCC	3	0	0	3	3	40	60	100
5.	22CH4204	Chemical Process Industries	PCC	2	0	0	2	2	40	60	100
Theory with Lab Component											
6.	22EE4251	Basics of Electrical & Electronics Engineering	ESC	1	0	2	2	3	50	50	100
7.	22CH4251	Chemical Reaction Engineering - I	PCC	2	0	2	3	4	50	50	100
8.	22MA4151	Probability and statistics with R programming	BSC	2	0	2	3	4	50	50	100
Practical											
9.	22CH4001	Heat Transfer Lab	PCC	0	0	4	2	4	60	40	100
EEC Courses (SE/AE)											
10.	22HE4071	Soft Skills -3(Common)	SEC3	1	0	0	1	1	100	0	100
TOTAL				19	0	10	24	29	510	490	1000
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER V											
Theory											
1.	22CH5201	Mass Transfer Operations - II	PCC	3	0	0	3	3	40	60	100
2.	22CH5202	Process Instrumentation Dynamics and Control	PCC	3	0	0	3	3	40	60	100
3.	22CH53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22CH53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22CH53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
Theory with Lab Component											
6.	22CH5251	Chemical Reaction Engineering - II	PCC	2	0	2	3	4	50	50	100
Practical											
7.	22CH5001	Mass Transfer Operations Lab	PCC	0	0	4	2	4	60	40	100
EEC Courses (SE/AE)											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
TOTAL				17	1	6	21	24	410	390	800
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER VI											
Theory											
1.	22CH6201	Transport Phenomena	PCC	3	0	0	3	3	40	60	100

2.	22HE6101	Professional Ethics (Common)	HSC	3	0	0	3	3	40	60	100
3.	22CH63XX	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4.	22CH63XX	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5.	22XX64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6.	22XX64XX	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
Practical											
7.	22CH6001	Process Control Lab	PCC	0	0	4	2	4	60	40	100
8.	22CH6002	Computational Chemical Engineering Lab	PCC	0	0	4	2	4	60	40	100
EEC Courses (SE/AE)											
9.	22HE6071	Soft Skills – 5(Common)	SEC	2	0	0	2	2	100	0	100
TOTAL				20	0	8	24	28	460	440	900
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER VII											
Theory											
1.	22CH7201	Process Economics and Engineering Management	PCC	3	0	0	3	3	40	60	100
2.	22CH7202	Process Equipment Design	PCC	3	1	0	4	4	40	60	100
3.	22CH73XX	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
4.	22XX74XX	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5.	22XX74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
Practical											
6.	22CH7001	Design and Simulation Lab	PCC	0	0	4	2	4	60	40	100
EEC Courses (SE/AE)											
7.	22CH7701	Internship	SEC	-	-	-	2	2	100	0	100
TOTAL				15	1	4	20	22	360	340	700
* - Four weeks internship carries 2 credit and it will be done in before Semester VI summer vacation/placement training and same will be evaluated in Semester VII.											
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER VIII											
EEC Courses (SE/AE)											
1.	22CH8901	Project Work/Granted Patent(Common)	SEC	0	0	20	10		100	0	100
TOTAL				0	0	20	10	20	100	0	100
<p>* 1. As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students' who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.</p> <p>2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.</p> <p>3. The above-mentioned NCC Courses will be offered to theStudents who are going to be admitted in the Academic Year 2021 – 22.</p>											

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH.PROGRAMMES										
S.No.	Course Area	Credits per Semester								TotalCredits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	3	-	-	-	-	23
3	ESC	6	4	3	2	-	-	-	-	15
4	PCC	-	3	15	16	11	7	9	-	61
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	6	6	-	12
7	EEC	3	3	3	1	1	2	2	10	25
8	MC	✓	✓							
Total		19	22	25	24	21	24	20	10	165

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

SL. NO.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial	OEC	3	0	0	3	3

		Instrumentation and Control						
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Bio refinery	OEC	3	0	0	3	3

Note: Non Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III (Offered by Chemical Engineering)

Students shall choose any one of the open elective courses such that the course content or title not belongs to their own programme.

SL. NO.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CH7401	Waste to Energy Conversion	OEC	3	0	0	3	3

OPENELECTIVE IV

SL. NO.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Petroleum Process Technology	Vertical II Energy Engineering	Vertical III Biochemical Engineering	Vertical IV Environmental and Safety Engineering	Vertical V Computational Chemical Engineering	Vertical VI Chemical Plant Design
Petroleum Chemistry and Refining Fundamentals	Bioenergy	Biochemistry	Air Pollution Engineering	Computational Techniques	Chemical Plant Design
Primary Refining Technology	Renewable Energy Resources	Bioprocess Technology	Waste Water Treatment	Optimization of Chemical Processes	Plant Layout
Secondary Refining Technology	Pinch Technology	Fermentation & Bioprocessing	Solid waste Management	Process Modeling and Simulation	Design Safety
Refinery Advancements and Environmental Regulations	Hydrogen and Fuel Cell Technology	Bio separation & Downstream Processing	Environmental Impact Assessment	Pinch Analysis and Heat Exchange Network Design	Material Selection
Petroleum Equipment Design	Power Plant Engineering	Enzyme Immobilisation Technology	Process Safety Management	Chemical Process Flowsheeting	Statutory Requirements & Customer Care
Petrochemical Technology	Non-Renewable Energy	Bioreactor Design	Risk and HAZOP	Computational Fluid Dynamics	Process Plant Utilities

	Sources		Analysis		
Note: Students are permitted to choose all Professional Electives from a particular vertical					

DETAILS OF VERTICAL I :PETROLEUM PROCESS TECHNOLOGY											
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
1.	22CH5301	Petroleum Chemistry and Refining Fundamentals	PEC	3	0	0	3	3	40	60	100
2.	22CH5302	PrimaryRefiningTechnology	PEC	3	0	0	3	3	40	60	100
3.	22CH5303	SecondaryRefiningTechnology	PEC	3	0	0	3	3	40	60	100
4.	22CH6301	RefineryAdvancementsandEnvironmentalRegulations	PEC	3	0	0	3	3	40	60	100
5.	22CH6302	PetroleumEquipmentDesign	PEC	3	0	0	3	3	40	60	100
6.	22CH7301	PetrochemicalTechnology	PEC	3	0	0	3	3	40	60	100

DETAILS OF VERTICAL II :ENERGY ENGINEERING											
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
1.	22CH5304	Bioenergy	PEC	3	0	0	3	3	40	60	100
2.	22CH5305	Renewable Energy Resources	PEC	3	0	0	3	3	40	60	100
3.	22CH5306	Pinch Technology	PEC	3	0	0	3	3	40	60	100
4.	22CH6303	Hydrogen And Fuel Cell Technology	PEC	3	0	0	3	3	40	60	100
5.	22CH6304	Power Plant Engineering	PEC	3	0	0	3	3	40	60	100
6.	22CH7302	Non-Renewable Energy Sources	PEC	3	0	0	3	3	40	60	100

DETAILS OF VERTICAL III :BIOCHEMICAL ENGINEERING											
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
1.	22CH5307	Biochemistry	PEC	3	0	0	3	3	40	60	100
2.	22CH5308	Bioprocess Technology	PEC	3	0	0	3	3	40	60	100
3.	22CH5309	Fermentation & Bioprocessing	PEC	3	0	0	3	3	40	60	100
4.	22CH6305	Bio separation & Downstream Processing	PEC	3	0	0	3	3	40	60	100
5.	22CH6306	Enzyme Immobilization Technology	PEC	3	0	0	3	3	40	60	100
6.	22CH7303	Bioreactor Design	PEC	3	0	0	3	3	40	60	100

DETAILS OF VERTICAL IV: ENVIORNMENTAL AND SAFETY ENGINEERING											
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
1.	22CH5310	Biochemistry	PEC	3	0	0	3	3	40	60	100
2.	22CH5311	Bioprocess Technology	PEC	3	0	0	3	3	40	60	100
3.	22CH5312	Fermentation & Bioprocessing	PEC	3	0	0	3	3	40	60	100
4.	22CH6307	Bio separation & Downstream Processing	PEC	3	0	0	3	3	40	60	100
5.	22CH6308	Enzyme Immobilisation Technology	PEC	3	0	0	3	3	40	60	100
6.	22CH7304	Bioreactor Design	PEC	3	0	0	3	3	40	60	100

DETAILS OF VERTICAL V: COMPUTATIONAL ENGINEERING											
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
1.	22CH5313	Computational Techniques	PEC	3	0	0	3	3	40	60	100
2.	22CH5314	Optimization of Chemical Processes	PEC	3	0	0	3	3	40	60	100
3.	22CH5315	Process Modeling and Simulation	PEC	3	0	0	3	3	40	60	100
4.	22CH6309	Pinch Analysis and Heat Exchange Network Design	PEC	3	0	0	3	3	40	60	100
5.	22CH6310	Chemical Process Flow sheeting	PEC	3	0	0	3	3	40	60	100
6.	22CH7305	Computational Fluid Dynamics	PEC	3	0	0	3	3	40	60	100

DETAILS OF VERTICAL VI :COMPUTATIONAL ENGINEERING											
S.No.	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	TOTAL
1.	22CH5316	Chemical Plant Design	PEC	3	0	0	3	3	40	60	100
2.	22CH5317	Plant Layout	PEC	3	0	0	3	3	40	60	100
3.	22CH5318	Design Safety	PEC	3	0	0	3	3	40	60	100
4.	22CH6311	Material Selection	PEC	3	0	0	3	3	40	60	100
5.	22CH6312	Statutory Requirements & Customer Care	PEC	3	0	0	3	3	40	60	100
6.	22CH7306	Process Plant Utilities	PEC	3	0	0	3	3	40	60	100

Enrolment for B.E. / B. Tech. Honours (Specialisation in the same discipline) / B.E. / B. Tech. Honours and B.E. / B. Tech. Minor Degree in other specialisation.

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

(i) B.E. / B.Tech. Honours (specialisation in the same discipline):

- a. The student should have earned additionally a minimum of 18 credits from a vertical of the same programme.
- b. Should have passed all the courses in the first attempt.
- c. Should have earned a minimum CGPA of 7.50.

(ii) B.E. / B.Tech. Honours:

- a. The students should have earned additional courses (minimum of 18 credits) from more than one vertical of the same programme.
- b. Should have passed all the courses in the first attempt.
- c. Should have earned a minimum CGPA of 7.50.

(iii) B.E. / B.Tech. (Minor in other specialisation):

The student should have earned additionally a minimum of 18 credits in any one of the verticals of other B.E. / B.Tech. programmes or from any one of the following verticals

VERTICAL I: FINTECH AND BLOCK CHAIN

VERTICAL II: ENTREPRENEURSHIP

VERTICAL III: ENVIRONMENT AND SUSTAINABILITY

- ❖ Students can earn maximum of 6 credits in online mode (SWAYAM platform), out of these 18 credits as approved by Centre for Academic Courses.
- ❖ B.E. / B. Tech. (Honours) Specialisation in the same discipline, B.E / B.Tech. Honours and B.E. / B.Tech. Minor in other specialisation degree will be optional for students.
- ❖ For the categories (i) to (ii), the students will be permitted to register the courses from V Semester onwards provided the marks earned by the students until III semester should be of CGPA 7.50 and above and cleared all the courses in the first attempt.
- ❖ For the category (iii), the students will be permitted to register the courses from Semester V onwards provided the marks earned by the students until Semester III is CGPA 7.50 and above.
- ❖ If a student decides not to opt for Honours, after completing certain number of additional courses, the additional courses studied shall be considered instead of the Professional Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the mark sheet, however, they will not be considered for calculation of CGPA.
- ❖ If a student decides not to opt for Minor, after completing certain number of courses, the additional courses studied shall be considered instead of Open Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the mark sheet, however, they will not be considered for calculation of CGPA.
- ❖ The Head of Department, shall forward the proposal to the Controller of Examinations after getting the approval from Head of the Institution / Dean Academics, before the commencement of the fifth semester of the programme for the students undergo optionally B.E. / B. Tech. Honours (Specialisation in the same discipline) / B.E. / B. Tech. Honours and B.E. / B. Tech. Minor Degree in other specialisation

VERTICALS FOR MINOR DEGREE
CHEMICAL ENGINEERING OFFERING MINOR DEGREE
Minor Specialization in Chemical Process Engineering

SL. NO.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CH5231	Introduction to Chemical Process	MDC	3	0	0	3	3
2	22CH6231	Fluid Flow Operations in Chemical Engineering	MDC	3	0	0	3	3
3	22CH6232	Fundamentals of Chemical Thermodynamics	MDC	3	0	0	3	3
4	22CH7231	Process Heat and Mass Transfer	MDC	3	1	0	4	4
5	22CH7232	Reaction Engineering	MDC	3	0	0	3	3
6	22CH8231	Unit Operations and Process Laboratory	MDC	0	0	4	4	2

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

VERTICAL I: FINTECH AND BLOCK CHAIN								
S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22MB5231	Financial Management	MDC	3	0	0	3	3
2	22MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	22MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	22MB7231	Introduction to Block chain and its Applications	MDC	3	0	0	3	3
5	22MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	22MB8231	Introduction to Fintech	MDC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP								
S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22MB5232	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	22MB6233	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	22MB6234	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	22MB7233	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	22MB7234	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	22MB8232	Financing New Business Ventures	MDC	3	0	0	3	3

VERTICAL III: ENVIRONMENT AND SUSTAINABILITY								
S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CE5232	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	22AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	22BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	22ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	22CE7233	Green Technology	MDC	3	0	0	3	3
6	22CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

VERTICALS FOR B Tech (Hons) and B Tech (Hons) in Chemical Engineering with Specialization

Vertical I Computer Aided Process Engineering	Vertical II Polymer Technology	Vertical III Petroleum Engineering	Vertical IV Instrumental Chemical Analysis
Process Flow Sheetting	Polymer Chemistry	Petroleum Geology	Principles of Mass Spectrometry
Transport Phenomena	Processing Technology	Petroleum Exploration	Advanced Analytical Separation Techniques
Advanced Process Optimization	Rubber Technology	Drilling Technology	Advanced Spectrometry: ICP-MS and LC-MS
Artificial Intelligence in Process Engineering	Polymer Product Design, Blends, and Alloys	Petroleum Production Engineering	Instruments for Morphology and Structural Characterization
Digital Twin and Soft Computing in Process Modelling	Polymer Structure and property relationships	Petroleum Reservoir Engineering	Statistical Analysis and Data Processing (Lab)
Advanced Process Modelling and Simulation	Polymer Compounding Technology	Offshore Engineering	Troubleshooting Analytical Methods and Instruments

B Tech (Hons) Chemical Engineering with Specialization in Computer Aided Process Engineering

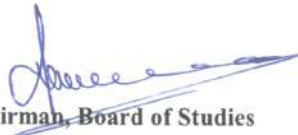
S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CH5203	Process Flow Sheetting	MDC	2	0	2	4	3
2	22CH6202	Transport Phenomena	MDC	3	1	0	3	4
3	22CH6203	Advanced Process Optimization	MDC	2	0	2	4	3
4	22CH7203	Artificial Intelligence in Process Engineering	MDC	2	0	2	4	3
5	22CH7204	Digital Twin and Soft Computing in Process Modelling	MDC	2	0	2	4	3
6	22CH8201	Advanced Process Modelling and Simulation	MDC	0	0	4	4	2


B Tech (Hons) Chemical Engineering with Specialization in Polymer Technology

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CHXXXX	Polymer Chemistry	MDC	3	0	0	3	3
2	22CHXXXX	Processing Technology	MDC	3	0	0	3	3
3	22CHXXXX	Rubber Technology	MDC	3	0	0	3	3
4	22CHXXXX	Polymer Product Design, Blends, and Alloys	MDC	3	0	0	3	3
5	22CHXXXX	Polymer Structure and property relationships	MDC	3	0	0	3	3
6	22CHXXXX	Polymer Compounding Technology	MDC	3	0	0	3	3

B Tech (Hons) Chemical Engineering with Specialization in Petroleum Engineering

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CHXXXX	Petroleum Geology	MDC	3	0	0	3	3
2	22CHXXXX	Petroleum Exploration	MDC	3	0	0	3	3
3	22CHXXXX	Drilling Technology	MDC	3	0	0	3	3
4	22CHXXXX	Petroleum Production Engineering	MDC	3	0	0	3	3
5	22CHXXXX	Petroleum Reservoir Engineering	MDC	3	0	0	3	3
6	22CHXXXX	Offshore Engineering	MDC	3	0	0	3	3


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Programme/ sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22MA1101	MATRICES AND CALCULUS (Common to all Branches)	3	1	0	4

- Course Objective
1. Construct the characteristic polynomial of a matrix and use it to identify eigenvalues and Eigenvectors
 2. To impart the knowledge of sequences and series.
 3. Analyse and discuss the maxima and minima of the functions of several variables.
 4. Evaluate the multiple integrals and apply in solving problems.
 5. Apply vector differential operator for vector function and theorems to solve engineering problems.

Unit	Description	Instructional Hours
	Matrices	12
I	Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) -Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	
	Single Variate Calculus	12
II	Rolle's Theorem–Lagrange's Mean Value Theorem–Maxima and Minima–Taylor's and Maclaurin's Series.	
	Functions of Several Variables	12
III	Partial derivatives–Total derivative, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.	
	Integral Calculus	12
IV	Double integrals in Cartesian coordinates–Area enclosed by plane curves (excluding surface area)– Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates.	
	Vector Calculus	12
V	Gradient, divergence and curl; Green's theorem, Stoke's and Gauss divergence theorem (statement only) for cubes only.	
Total Instructional Hours		60

- Course Outcome
- CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.
- CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.
- CO3: Compute partial derivatives of function of several variables and write Taylor's series for functions with two variables.
- CO4: Evaluate multiple integral and its applications in finding area, volume.
- CO5: Apply the concept of vector calculus in two and three dimensional spaces.

TEXTBOOKS:

T1: G.B. Thomas and R.L. Finney, "Calculus and Analytical Geometry", 9th Edition Addison Wesley Publishing company, 2016.

T2: Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2019.

T3: K.P. Uma and S. Padma, "Engineering Mathematics I (Matrices and Calculus)", Pearson Ltd, 2022.

REFERENCE BOOKS:

R1: Jerrold E. Marsden, Anthony Tromba, "Vector Calculus", W.H. Freeman, 2003

R2: Strauss M.J., G.L. Bradley and K.J. Smith, "Multivariable calculus", Prentice Hall, 2002.

R3: Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.

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Course Code &Name : 22MA1101/ MATRICES AND CALCULUS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	1	2
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2


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Programme/sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22HE1151	ENGLISH FOR ENGINEERS- (Common to all Branches)	2	0	2	3

- Course Objective**
1. To improve the communicative proficiency of learners
 2. To help learners use language effectively in professional writing
 3. To advance the skill of maintaining the suitable one of communication.
 4. To introduce the professional life skills.
 5. To impart official communication etiquette.

Unit	Description	Instructional Hours
I	Language Proficiency: Types of Sentences, Functional Units, Framing question. Writing: process description, Writing Checklist. Vocabulary – words on environment. Practical Component: Listening- Watching short videos and answer the questions, Speaking- Self introduction, formal & semi-formal	7+2
II	Language Proficiency: Tenses, Adjectives and adverbs. Writing: Formal letters (letters conveying positive and negative news), Formal and informal email writing (using emoticons, abbreviations & acronyms), reading comprehension. Vocabulary – words on entertainment. Practical Component: Listening- Comprehensions based on TED talks Speaking- Narrating a short story or an event happened in their life	7+2
III	Language Proficiency: Prepositions, phrasal verbs. Writing: Formal thanks giving, Congratulating, warning and apologizing letters, cloze test. Vocabulary – words on tools. Practical Component: Listening- Listening to songs and answering the questions Speaking- Just a minute	5+4
IV	Language Proficiency: Subject verb concord, Prefixes & suffixes. Writing: Preparing agenda & minutes, writing an event report. Vocabulary – words on engineering process. Practical Component: Listening- Comprehensions based on Talk of orators or interview shows Speaking- Presentation on a general topic with ppt.	5+4
V	Language Proficiency: Modal Auxiliaries, Active & passive voice, Writing: Project report (proposal & progress), sequencing of sentences Vocabulary – words on engineering material Practical Component: Listening- Listening- Comprehensions based on Nat Geo/Discovery channel videos Speaking- Preparing posters and presenting as a team.	6+3
Total Instructional Hours		45

- Course Outcome**
- CO1: To communicate in a professional forum
CO2: To speak or write a content in the proficient language
CO3: To maintain and use appropriate tone of the communication.
CO4: To read, write and present in a professional way.
CO5: To follow the etiquettes in formal communication.

TEXTBOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate". Cambridge University Press, 2016. T2-Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019.

REFERENCEBOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

R2-Raymond Murphy, "English Grammar in Use"-4th edition Cambridge University Press, 2004.

R3-Kamalesh Sadanan "A Foundation Course for the Speakers of Tamil-Part-I&II", Orient Blackswan, 2010.

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Course Code & Name : 22ME1201/ ENGINEERING DRAWING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	1	1	1	-	1	-	1	2	-	-
CO2	2	3	2	1	1	1	1	-	1	-	1	2	-	-
CO3	2	2	2	2	1	1	1	-	1	-	1	2	-	-
CO4	2	2	3	1	2	1	1	-	1	-	2	2	-	1
CO5	2	3	3	2	2	1	1	-	1	-	1	2	-	-
Avg	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	-	1


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Programme/sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22PH1151	PHYSICS FOR NON-CIRCUIT ENGINEERING	2	0	2	3

Course Objective	<p>The student should be able to</p> <ol style="list-style-type: none"> 1. Gain knowledge about laser, their applications and Conversant with principles of optical fiber, types and applications of optical fiber 2. Enhance the fundamental knowledge in properties of matter 3. Extend the knowledge about wave optics 4. Gain knowledge about magnetic materials. 5. Acquire fundamental knowledge of nano materials which is related to the engineering program
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Unit	Description	Instructional Hours
	LASER AND FIBRE OPTICS	6
I	Spontaneous emission and stimulated emission –Type of lasers – Nd:YAG laser - Laser Applications – Holography – Construction and reconstruction of images. Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index and modes) – Fiber optical communication link.	3
	Determination of Wavelength and particle size using Laser	
	PROPERTIES OF MATTER	
II	Elasticity – Hooke's law –Poisson's ratio – Bending moment – Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending theory and experiment. Twisting couple - torsion pendulum: theory and experiment	6
	Determination of Young's modulus by uniform bending method	3
	Determination of Rigidity modulus – Torsion pendulum	3
	WAVE OPTICS	6
III	Interference of light – air wedge –Thickness of thin paper - Diffraction of light – Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating.	3
	Determination of wavelength of mercury spectrum – spectrometer grating	3
	Determination of thickness of a thin wire – Air wedge method	
	QUANTUM PHYSICS	
IV	Black body radiation –Compton effect: theory and experimental verification – wave particle duality –concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box .	6
	THERMAL PHYSICS	
V	Transfer of heat energy –thermal conduction, convection and radiation – thermal conductivity - Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – applications: solar water heaters.	6
	Total Instructional Hours	45

After completion of the course the learner will be able to

Course Outcome	CO1: Understand the advanced technology of LASER and optical communication in the field of Engineering
	CO2: Illustrate the fundamental properties of matter
	CO3: Discuss the Oscillatory motions of particles
	CO4: Understand the advanced technology of magnetic materials in the field of Engineering
	CO5: Develop the technology of smart materials and Nano materials in engineering field

TEXT BOOKS:

- T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

- R1 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company Ltd., New Delhi 2016
R2 -Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2021

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Course Code & Name : 22PH1151/PHYSICS OF MATERIALS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	1	-	1	-	2	3	3	2
CO2	3	3	2	2	1	1	1	-	1	-	2	2	3	1
CO3	3	3	2	2	2	1	1	-	1	-	1	2	2	2
CO4	3	2	3	1	3	1	1	-	1	-	1	2	2	1
CO5	3	2	3	1	2	1	1	-	1	-	2	2	2	1
Ave	3	2.6	2.6	1.6	2.2	1	1	-	1	-	1.6	2.2	2.4	1.4

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Programme/sem B.E./B.Tech/I	Course Code 22IT1151	Name of the Course PYTHON PROGRAMMING AND PRACTICES	L 2	T 0	P 2	C 3
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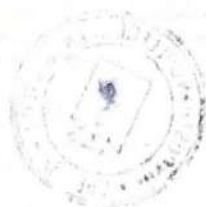
Course Objective	The learner should be able to <ol style="list-style-type: none"> 1. To know the basics of algorithmic problem solving 2. To read and write simple Python programs 3. To develop Python programs with conditionals and loops and to define Python functions and call them 4. To use Python data structures — lists, tuples, dictionaries 5. To do input/output with files in Python
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Unit	Description	Instructional Hours
I	ALGORITHMIC PROBLEM SOLVING Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: To find the Greatest Common Divisor (GCD) of two numbers, Fahrenheit to Celsius, Perform Matrix addition.	5 4
II	DATA, STATEMENTS, CONTROL FLOW Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.	5 4
III	FUNCTIONS, STRINGS Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module. Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs	5 4
IV	LISTS, TUPLES, DICTIONARIES Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension. Illustrative programs: List Manipulation, Finding Maximum in a List, String processing.	5 4
V	FILES, MODULES, PACKAGES Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages Illustrative programs: Reading writing in a file, word count, Handling Exceptions	9
Total Instructional Hours		45

Course Outcome	At the end of the course, the learner will be able to
	CO1: Develop algorithmic solutions to simple computational problems
	CO2: Read, write, execute by hand simple Python programs
	CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions
	CO4: Represent compound data using Python lists, tuples, dictionaries
	CO5: Read and write data from/to files in Python Programs.

TEXT BOOKS:


- T1: Guido van Rossum and Fred L. Drake Jr. An Introduction to Python – Revised and updated for Python 3.6.2. Shroff Publishers. First edition (2017).
T2: S. Annadurai, S. Shankar, I. Jasmine, M. Revathi. Fundamentals of Python Programming, Me-Graw Hill Education (India) Private Ltd. 2019



REFERENCE BOOKS:
R1: Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition, 2013.
R2: Timothy A. Budd, —Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015
R3: Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016




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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	1	1
CO2	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO3	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO4	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO5	2	3	3	-	2	-	-	-	2	-	-	2	1	1
AVG.	2	3	3	-	2	-	-	-	2	-	-	2	1	1


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Programme/ sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech /I	22HE1071	UNIVERSAL HUMAN VALUES	2	0	0	2

(COMMON TO ALL BRANCHES)

- Course Objective**
1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
 2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
 3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Unit	Description	Instructional Hours
	Introduction to Value Education	
I	Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations	6
II ₆	Harmony in the Human Being and Harmony in the Family Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body - Programme to ensure self-regulation and Health Harmony in the Family and Society	
III	Harmony in the Family – the Basic Unit of Human Interaction. Values in Human to Human Relationship 'Trust' – the Foundational Value in Relationship Values in Human to Human Relationship 'Respect' – as the Right Evaluation Understanding Harmony in the Society Harmony in the Nature / Existence	6
IV	Understanding Harmony in the Nature. Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasive space Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence. Vision for the Universal Human Order	6
V	Implications of the Holistic Understanding – a Look at Professional Ethics Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession	6

Total Instructional Hours 30



Course
Outcome

- CO1: To become more aware of holistic vision of life - themselves and their surroundings.
CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions.
CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior.
CO4: To able to apply what have learnt to their own self in different day-to-day settings in real life and In handling problems with sustainable solutions.
CO5: To develop competence and capabilities for maintaining Health and Hygiene.

Reference Books:

- R1. *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
R2. *Teachers' Manual for A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2
R3. *Jeevan Vidya: Ek Parichaya*, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
R4. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.


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Course Code & Name : 22HE1071 / UNIVERSAL HUMAN VALUES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	3	1	1	-	1	-	-	2
CO2	-	-	-	-	-	2	3	2	1	-	2	-	-	2
CO3														2
CO4	-	-	-	-	-	2	1	1	1	-	2	-	-	3
CO5	-	-	-	-	-	1	2	1	1	-	1	-	-	2
Avg	-	-	-	-	-	1	2	1	1	-	2	-	-	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22MC1091	INDIAN CONSTITUTION	2	0	0	0

Course Objective

1. Sensitization of student towards self, family (relationship), society and nature
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals
3. Strengthening of self-reflection
4. Development of commitment and courage to act

Unit	Description	Instructional Hours
	BASIC FEATURES AND FUNDAMENTAL PRINCIPLES	
I	Meaning of the constitution law and constitutionalism— Historical perspective of the constitution of India— salient features and characteristics of the constitution of India.	6
	FUNDAMENTAL RIGHTS	
II	Scheme of the fundamental rights—fundamental duties and its legislative status—The directive principles of state policy—its importance and implementation—Federal structure and distribution Of legislative and financial powers between the union and states.	6
III	PARLIAMENTARY FORM OF GOVERNMENT The constitution powers and the status of the president in India.—Amendment of the constitutional Powers and procedures—The historical perspective of the constitutional amendment of India—Emergency provisions: National emergency, President rule, Financial emergency.	6
	LOCAL GOVERNANCE	
IV	Local self-government—Rural Local Government—Panchayath Raj, Elections of Panchayat—State Election Commission—Urban Local Government—Amendment Act, Urban Local Government Structures in India	6
	INDIAN SOCIETY	
V	Constitutional Remedies for citizens—Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	6

Total Instructional Hours 30

Course Outcome

Upon completion of the course, students will be able to

CO1: Understand the functions of the Indian government.

CO2: Understand and abide the rules of the Indian constitution

TEXTBOOKS:

T1-Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 1997. T2-Agarwal RC., "Indian Political System", S. Chand and Company, New Delhi, 1997. T3-Maciver and Page, "Society: An Introduction Analysis", MacMillan India Ltd., New Delhi. T4-Sharma KL., "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi, 1997.

REFERENCE BOOKS:

R1-Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi. R2-Ghai UR., "Indian Political System", New Academic Publishing House, Jaalandhar. R3-Sharma RN., "Indian Social Problems", Media Promoters and Publishers Pvt. Ltd.

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Programme/sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22HE1072	ENTREPRENEURSHIP & INNOVATION	1	0	0	1

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement the plans.
5. To make students understand organizational performance and its importance.

Module	Description
--------	-------------

- | | |
|----|---|
| 1 | Entrepreneurial Thinking |
| 2 | Innovation Management |
| 3 | Design Thinking |
| 4 | Opportunity Spotting/Opportunity Evaluation |
| 5 | Industry and Market Research |
| 6 | Innovation Strategy and Business Models |
| 7 | Financial Forecasting |
| 8 | Business Plans/Business Model Canvas |
| 9 | Entrepreneurial Finance |
| 10 | Pitching to Resources Providers/Pitch Deck |
| 11 | Negotiating Deals |
| 12 | New Venture Creation |
| 13 | Lean Start-ups |
| 14 | Entrepreneurial Ecosystem |
| 15 | Velocity Venture |

Course Outcome

- CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.
- CO2: Understand the processes by which innovation is fostered, managed, and commercialized.
- CO3: Remember effectively and efficiently the potential of new business opportunities.
- CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.
- CO5: Develop a business model for a new venture, including revenue, margins, operations, working capital, and investment

TEXTBOOKS

- T1: Arya Kumar "Entrepreneurship—Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).
- T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition (2016).


REFERENCE BOOKS

- R1: Christopher Golis "Enterprise & Venture Capital", Allen & Unwin Publication, Fourth Edition (2007).
- R2: Thomas Lock Wood & Edger Papke "Innovation by Design", Career Press.com, Second Edition (2017).
- R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, First Edition (2010).

WEB RESOURCES

- W1: <https://blof.forgeforward.in/tagged/startup-lessons>
- W2: <https://blof.forgeforward.in/tagged/entrepreneurship>
- W3: <https://blof.forgeforward.in/tagged/minimum-viable-product>
- W4: <https://blof.forgeforward.in/tagged/minimum-viable-product>
- W5: <https://blof.forgeforward.in/tagged/innovation>


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SEMESTER II

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22MA2104	FOURIER ANALYSIS AND LAPLACETRANSFORMS (CHEM)	3	1	0	4

Course Objective	The student should be able
	1 Analyze Fourier series which is central to many applications in engineering.
	2 Apply the effective tools for the solutions of one dimensional boundary value problems.
	3 Apply Fourier transform techniques in various situations.
	4 Analyze the techniques of Laplace transform.
	5 Analyze the techniques of Inverse Laplace transform

Unit	Description	Instructional Hours
	FOURIER SERIES	
I	Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Change of Interval - Parseval's Identity - Harmonic analysis.	12
	BOUNDARY VALUE PROBLEMS	
II	Classification of PDE - Solutions of one-dimensional wave equation-One dimensional equation of heat conduction (excluding insulated edges).	12
	FOURIER TRANSFORMS	
III	Fourier Transform Pair - Fourier sine and cosine transform Pair – Properties-Transforms of Simple functions – Convolution Theorem (Statement only).	12
	LAPLACE TRANSFORM	
IV	Laplace transform-Basic properties –Transforms of derivatives and integrals of functions-Transform of periodic functions - Unit step function - Dirac delta function.	12
	INVERSE LAPLACE TRANSFORM	
V	Inverse Laplace transform-Convolution theorem (with out proof) –Solution of linear ODE of second order with constant coefficients using Laplace transforms.	12
Total Instructional Hours		60

Course Outcome	CO1	Understand the principles of Fourier series which helps them to solve physical problems of engineering
	CO2	Employ Fourier series in solving the boundary value problems
	CO3	Apply Fourier transform techniques which extend its applications
	CO4	Apply Laplace transform and its properties to solve periodic functions
	CO5	Solve certain linear differential equations using inverse Laplace Transform

TEXT BOOK:


- T1 Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2022.
- T2 Kreyszig.E. "Advanced Engineering Mathematics", Eight Edition, John Wiley & sons (Asia) Ltd 2018.

REFERENCES:

- R1 C.Roy Wylie " Advance Engineering Mathematics" Louis C. Barret, 6 th Edition, Mc Graw Hill Education India Private Limited, New Delhi 2019
- R2 Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand & Company Ltd., New Delhi, 2018


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Course Code & Name : 22MA2104/ FOURIER ANALYSIS & LAPLACE TRANSFORM

PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
Avg	3	3	3	2.4	2.4	-	-	-	-	-	-	2	2	2

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22CY2101	ENVIRONMENTAL STUDIES (Common to all branches except CSE, IT & AIML)	3	0	0	3

The student should be able

- Course Objective**
- 1 Grasp the importance and issues related to ecosystem and biodiversity and their protection.
 - 2 Acquire knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
 - 3 Identify the various natural resources, exploitation and its conservation
 - 4 Gain knowledge on the scientific, technological, economic and political solutions to environmental problems.
 - 5 Become aware on the national and international concern for environment and its protection

Unit	Description	Instructional Hours
	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY Main objectives and scope of environmental studies-Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – food chain, food web and ecological pyramids - energy flow in the ecosystem – ecological succession processes - Introduction, types, characteristic features, structure and function of the forest and ponds ecosystem – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	
I	NATURAL RESOURCES Renewable and Non-renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non-renewable energy sources – Solar energy and wind energy - role of an individual in conservation of natural resources.	12
II	ENVIRONMENTAL POLLUTION Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- nuclear hazards – role of an individual in prevention of pollution.	12
III	SOCIAL ISSUES AND THE ENVIRONMENT From unsustainable to sustainable development – urban problems related to energy-environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones.	12
IV	HUMAN POPULATION AND THE ENVIRONMENT Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health.	12
V		

Total Instructional Hours 45

Course Outcome	CO1 Discuss the importance of ecosystem and biodiversity for maintaining ecological balance.
	CO2 Identify the causes of environmental pollution and hazards due to manmade activities
	CO3 Develop an understanding of different natural resources including renewable resources.
	CO4 Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues.
	CO5 Describe about the importance of women and child education, existing technology to protect environment.

TEXT BOOK:

- T1 S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2020.
T2 Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

REFERENCES:

- R1 Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, Hyderabad, 2015.
R2 G.Tyler Miller, Jr and Scott E. Spoolman "Environmental Science" Thirteenth Edition, Cengage Learning, 2010.
R3 Gilbert M. Masters and Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2013.

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Course Code & Name : 22CY2151/ ENVIRONMENTAL SCIENCE

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO2	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO3	2	1	1	-	-	2	3	3	2	-	-	2	-	-
CO4	2	1	2	-	-	2	3	3	2	-	-	2	-	-
CO5	2	1	2	-	-	2	3	3	2	-	-	2	-	-
Avg	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22PH2101	BASICS OF MATERIAL SCIENCE	2	0	0	2

Course Objective	The student should be able
	1 Gain knowledge about Crystal systems and crystal structures
	2 Understand the knowledge about electrical properties of materials
	3 Enhance the fundamental knowledge in semiconducting materials.
	4 Gain knowledge about magnetic materials
	5 Acquire fundamental knowledge new engineering materials which is related to the engineering program


Unit	Description	Instructional Hours
	CRYSTAL PHYSICS	
I	Crystal systems - Bravais lattice - Lattice planes - Miller indices - Inter planar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
	ELECTRICAL PROPERTIES OF MATERIALS	
II	Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Widemann - Franz law - Success and failures - Fermi-Dirac statistics - Density of energy states .	6
	SEMICONDUCTING MATERIALS	
III	Introduction - Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Intrinsic semiconductor—electrical conductivity - band gap determination. Extrinsic semiconductor - n type and p type semiconductor - Light Emitting Diode.	6
	MAGNETIC MATERIALS	
IV	Origin of magnetic moment - Bohr magnetron - comparison of Dia, Para and Ferro magnetism - Domain theory - Hysteresis - soft and hard magnetic materials - anti ferromagnetic materials - Ferrites and its applications.	6
	NEW ENGINEERING MATERIALS	
V	Metallic glasses: melt spinning process, Preparation and applications - shape memory alloys: phases, shape memory effect - Characteristics of SMA: Pseudoelastic effect, Super elasticity and Hysteresis. Applications of SMA. Nanomaterials preparation (bottom up and top-down approaches) - various techniques - pulsed laser deposition - Chemical vapor deposition	6
	Total Instructional Hours	30
Course Outcome	CO1 Understand the Crystal systems and crystal structures in the field of Engineering.	
	CO2 Illustrate the fundamental of electrical properties of materials	
	CO3 Discuss concept of acceptor or donor levels and the band gap of a semiconducting materials	
	CO4 Develop the technology of the magnetic materials and its applications in engineering field	
	CO5 Understand the advanced technology of new engineering materials in the field of Engineering	

TEXT BOOK:

- T1 Rajendran V, "Materials Science", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2 M.N Avadhanulu and P G Kshirsagar "A Text Book of Engineering physics" S. Chand and Company Ltd., New Delhi 2022

REFERENCES:

- R1 Charles Kittel "Introduction to Solid State Physics". Wiley., New Delhi 2017.
R2 Dr.M.Arumugam "Materials Science " Anuradha publications., 2019.


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Course Code & Name : 22PH2151/ BASICS OF MATERIAL SCIENCE

PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	1	2	2	-	-	-	-	-	-	1	2	3
CO4	3	3	1	2	2	1	-	-	-	-	-	1	2	2
CO5	3	2	2	3	2	1	2	-	-	-	-	1	2	3
Avg	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22CH2201	INTRODUCTION TO CHEMICAL ENGINEERING	3	0	0	3

Course Objective	The student should be able					
	1	To understand the historical evolution of chemical engineering, its significance, and its role in modern society.				
	2	To develop an awareness of the diverse fields associated with chemical engineering				
	3	To gain knowledge about the challenges faced by chemical process industries.				
	4	To understand the fundamental principles of chemical engineering, such as mass, energy balances and chemical reaction kinetics.				
	5	To Explore the role of computers and software in chemical engineering, including the use of chemical engineering software.				

Unit	Description	Instructional Hours
I	FOUNDATION & SIGNIFICANCE: Historical evolution of chemical engineering; what is chemical Engineering; Origin and growth of chemical Engineers in chemical process industries, unit operations and unit processes concepts; chemical processes using process diagrams and flow sheets understanding prevalent symbols; roles of the modern chemical engineer.	9
II	VERSATILITY IN DIVERSE FIELDS: Chemical Engineering in Everyday Life; Scaling Up or Down; Engineering Application of Portable Devices; Challenges in the Petroleum Sector; Operations in a Refinery; Versatility of a Chemical Engineer; Role of Chemical Engineers in Biomedical Engineering; Similarities in Dissimilar Applications	9
III	CHALLENGES IN PLANTS: Chemical process industries: evolution, broad classification, characteristics, origin, growth, present scenario, & projections; opportunities and challenges; Batch Processing; Paint Manufacture ; The Transition from Batch to Continuous Processing; Implications of Coupling and Recycling; Start-up and Shutdown; Processes with Recycle Streams ; Reverse Osmosis Plants.	9
IV	CONCEPTS IN CHEMICAL ENGINEERING: Basic concepts of material and energy balances, energy and mass transport, and kinetics of chemical reactions. Introduction to heat and mass transfer.	9
V	ADVANCEMENT & OPPORTUNITIES: Role of Computer in Chemical Engineering; Chemical Engineering Software. Paradigm shifts in chemical engineering; range of scales in chemical engineering; opportunities for chemical engineers; future of chemical engineering.	9

Total Instructional Hours 45

Course Outcome	CO1	Understand various fields to which chemical engineers have been contributed and Identify the role of a modern Chemical Engineer
	CO2	Interpret day to day activities with the principles of chemical Engineering.
	CO3	Extend batch process of a chemical production into a continuous process
	CO4	Assess the mass and energy involved in any chemical plant..
	CO5	Demonstrate modelling and simulation using software tools.

TEXT BOOK:

- T1 S. Pushpavanam, Introduction to Chemical Engineering, Prentice Hall India, 2011
T2 K.A. Solen and J.N. Harb, Introduction to Chemical Engineering – Tools for Today and Tomorrow, 5th Edition, Wiley, 2011.

REFERENCES:

- R1 Morton M. Denn, Chemical Engineering – An Introduction, Cambridge University Press, 2012
R2 Walter L. Badger and Julius T. Banchero, Introduction to Chemical Engineering, Tata McGraw-Hill, 1955

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Course Code & Name : 22CH2201/ INTRODUCTION TO CHEMICAL ENGINEERING

PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		1				1				2	1	2	2
CO2	2	3	1				1				2	1	2	2
CO3	2	2	1			1	1				2	1	2	2
CO4	2		2	3	1	1	1				2		2	2
CO5	2		1			1	1				2		2	2
Avg	2	2.5	1.2	3	1	1	1				2	1	2	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22CY2151	CHEMISTRY FOR ENGINEERS (FT, CHEM, AGRI)	2	0	2	3

Course Objective	The student should be able					
	1	Acquire knowledge on the concepts of chemistry involved in day today life.				
	2	Identify the water related problems and water treatment techniques.				
	3	Enhance the fundamental knowledge on electrochemistry and the mechanism of corrosion and its control.				
	4	Acquire knowledge on various thermodynamical laws and its importance in engineering applications.				
	5	Extend the knowledge on the concepts of spectroscopy and its applications				

Unit	Description	Instructional Hours
	CHEMISTRY IN EVERYDAY LIFE Chemicals in food – Food colors – Artificial sweeteners – Food preservatives. Soaps and Detergents – Soaps – Types of Soap – Detergents – Types of detergents. Drugs – Classification of drugs - Therapeutic Action of Different Classes of Drugs. Chemicals in Cosmetics – Creams – Talcum powders- Deodorants – Perfumes. Plastics – Thermoplastics- Preparation, properties and uses of PVC, Teflon and Thermosetting plastics - Preparation, propertiesand uses of Polyester and Polyurethane.	
I		9+6=15
	WATER TECHNOLOGY Impurities in Water, Hardness of Water, Boiler feed Water – Boiler troubles -Sludge and scale formation, Caustic embrittlement, priming and foaming, boiler corrosion- -Softening Methods (Zeolite & Ion-Exchange Methods)- Desalination of Brackish Water - Reverse Osmosis, Potable water and treatment. Estimation of total, permanentand temporary hardness of water by EDTA Determination of Dissolved Oxygen in sewage water by Winkler'smethod. Estimation of alkalinity of water sample by indicator method.	
II		9+2=11
	ELECTROCHEMISTRY AND CORROSION Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods. Conductometric titration of strong acid vs strong base (HCl vs NaOH). Estimation of Ferrous iron by Potentiometry.	
III		9+5=14
	CHEMICAL THERMODYNAMICS Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs Helmholtz equation- Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore.	
IV		9+2=11
	SPECTROSCOPY Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) - applications – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – Estimation of nickel by atomic absorption spectroscopy.	
V		9

Total Instructional Hours 45+15=60

Course Outcome	CO1	List out the chemicals used in food, soaps and detergents, drugs, cosmetics and plastics
	CO2	Differentiate hard and soft water and solve the related problems on water purification in domestic as well as in industries.
	CO3	Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design
	CO4	Develop sound knowledge on second law of thermodynamics and second law based derivations and its importance in engineering applications in all disciplines.
	CO5	List out the applications of spectroscopic techniques in various engineering fields

TEXT BOOK:

- T1 P.C. Jain & Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).
T2 O.G. Palanna, "Engineering chemistry" McGraw Hill Education India (2017).

REFERENCES:

- R1 Shikha Agarwal "Engineering Chemistry - Fundamentals and Applications, Cambridge University Press, Delhi, 2019
R2 S.S. Dara "A Text book of Engineering Chemistry" S. Chand & Co. Ltd., New Delhi (2018).

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22ME2001	ENGINEERING PRACTICES	0	0	4	2

Course Objective	The student should be able
1	To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering.

Unit	Description
	Instructional Hours
1.	Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2.	Arrangement of bricks using English Bond for one brick thick wall for right angle corner junction and T- junction
3.	Arrangement of bricks using English Bond for one and a half brick thick wall for right angle corner and T- junction
4.	Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5.	Practice on sheet metal Models- Trays and funnels
6.	Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7.	Practice on simple step turning, taper turning and drilling.
8.	Demonstration on Smithy operation.
9.	Demonstration on Foundry operation.
10.	Demonstration on Power tools.

GROUP B (ELECTRICAL ENGINEERING)

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
5. Measurement of energy using single phase energy meter.
6. Soldering practice using general purpose PCB.
7. Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8. Study of Energy Efficient Equipment's and Measuring Instruments.

Total Instructional Hours 45+15=60

Course Outcome	
CO1	Fabricate wooden components and pipe connections including plumbing works.
CO2	Fabricate simple weld joints.
CO3	Fabricate different electrical wiring circuits and understand the AC Circuits.


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Course Code & Name : 22ME2001/ ENGINEERING PRACTICES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	3	-	1	-	1	-	-	-	1	2
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg	3		3		3	-	-	-	1	-	-	-	1	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION (Common to all Branches)	2	0	2	3

The student should be able

- Course Objective**
- 1 To improve essential business communication skills.
 - 2 To enrich employability knowledge.
 - 3 To acquire the crucial organizing ability in official forum.
 - 4 To impart important business writings.
 - 5 To make effective presentation with essential etiquette.

Unit	Description	Instructional Hours
I	Language Proficiency: Types of sentences in English according to structure Writing: writing definitions, Describing product, work place and service (purpose, appearance, function) Vocabulary – words on nature Practical Component: Listening- Watching and interpreting advertisements/short films Speaking- Extempore speech	9
II	Language Proficiency: Direct and Indirect speech. Writing: Formal memos, Job application and resume preparation Vocabulary - words on offense and ethics Practical Component: Listening- Comprehensions based on telephonic conversation Speaking- Vote of thanks& welcome address	9
III	Language Proficiency: Homophones and Homonyms, Writing: Preparing a detail plan for an official visit, schedule and Itinerary, reading comprehension, Vocabulary– words on society Practical Component: Listening- Listening- paraphrasing the listened content Speaking- Group Discussion with preparation	9
IV	Language Proficiency: Idioms Writing: Report writing (marketing, investigating) Vocabulary-words involved in business Practical Component: Listening- Watching technical discussions and preparing MoM Speaking- On the spot Group Discussion	9
V	Language Proficiency: spotting errors Writing: making /interpreting chart, sequencing of sentences Vocabulary- words involved in finance Practical Component: Listening- Comprehensions based on announcements Speaking- Presentation on a technical topic with ppt.	9
Total Instructional Hours		45
Course Outcome	CO1 Interpret the structure and properties of carbohydrates CO2 Recall the structure and properties of lipids CO3 Recognize the structural and functional role of proteins CO4 Classify the enzymes and interpret the enzyme action and their immobilization CO5 Infer the structure of nucleic acids and illustrate the basics of energy metabolism	

TEXT BOOK:

- T1 Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.
T2 Ian Wood and Anne Williams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.

REFERENCES:

- R1 Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009.
R2 Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.
R3 Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 2001.


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Course Code & Name : 22HE1071 / UNIVERSAL HUMAN VALUES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	3	1	1	-	1	-	-	2
CO2	-	-	-	-	-	2	3	2	1	-	2	-	-	2
CO3														2
CO4	-	-	-	-	-	2	1	1	1	-	2	-	-	3
CO5	-	-	-	-	-	1	2	1	1	-	1	-	-	2
Avg	-	-	-	-	-	1	2	1	1	-	2	-	-	2.2

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22HE2071	DESIGN THINKING	2	0	0	2

Course Objective	The student should be able					
	1	To expose students to the design process				
	2	To develop and test innovative ideas through a rapid iteration cycle.				
	3	To provide an authentic opportunity for students to develop teamwork and leadership skills				

Unit	Description	Instructional Hours
	DESIGN ABILITY	
I	Asking Designers about what they Do – Deconstructing what Designers Do – Watching	6
	what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	
	DESIGNING TO WIN	
II	Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
	DESIGN TO PLEASE AND DESIGNING TOGETHER	
III	Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
	DESIGN EXPERTISE	
IV	Design Process – Creative Design - Design Intelligence – Development of Expertise –	6
	Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	
	DESIGN THINKING TOOLS AND METHODS	
V	Purposeful Use of Tools and Alignment with Process - Journey Mapping - Value Chain Analysis - Mind Mapping – Brainstorming - Design Thinking Application: Design Thinking Applied to Product Development	7

Total Instructional Hours 30

Course Outcome	CO1	Interpret the structure and properties of carbohydrates
	CO2	Recall the structure and properties of lipids
	CO3	Recognize the structural and functional role of proteins

TEXT BOOK:

T1 Nigel Cross, "Design Thinking", Kindle Edition.

REFERENCES:

R1 Tom Kelley, "Creative Confidence", 2013.

R2 Tim Brown, "Change by Design", 2009.


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22HE2072	SOFT SKILLS AND APPITUDE I	1	0	0	1

The student should be able

- Course Objective**
1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice.
 2. To enhance the student's ability to deal with numerical and quantitative skills.
 3. To identify the core skills associated with critical thinking.
 4. To develop and integrate the use of English language skills

Unit	Description	Instructional Hours
I	Lessons on excellence Skill introspection, Skill acquisition, consistent practice	2
II	Logical Reasoning Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	Quantitative Aptitude Addition and Subtraction of bigger numbers - square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	11
IV	Recruitment Essentials Resume Building - Impression Management	4
V	Verbal Ability Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
Total Instructional Hours		30
Course Outcome	CO1 Students will analyze interpersonal communication skills. public speaking skills.	
	CO2 Students will exemplify tautology, contradiction and contingency by logical thinking.	
	CO3 Students will be able to develop an appropriate integral form to solve all sorts of	
	CO4 Quantitative problems.	
	CO5 Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity	

REFERENCES:

- R1 Quantitative Aptitude – Dr. R S Agarwal
R2 Speed Mathematics: Secret Skills for Quick Calculation - Bill Handley
R3 Verbal and Non – Verbal Reasoning – Dr. R S Agarwal
R4 Objective General English – S.P.Bakshi


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அலகு I மொழி மற்றும் இலக்கியம்:

3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி

இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை:

3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:

3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின்

விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்:

3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:

3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த, மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference Book.


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மேல்க்கண்டவற்றைப் பற்றி
பெரிய அளவில்



Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22MC2093	SOCIAL SERVICES AND COMMUNITY DEVELOPMENT	1	0	0	1

The student should be able

- | | | |
|-------------------------|----|--|
| Course Objective | 1. | Acquire the knowledge and active participate in social service and community development activities. |
| | 2. | Understand the concept of disaster management and role of NCC cadets in disaster management. |
| | 3. | Understand the concept thinking and reasoning process. |
| | 4. | Understand about maps and use of bearing and service protector |
| | 5. | Know about the principles of flight and Aero foil structure and ATC procedures. |

Unit	DESCRIPTION	Instructional Hours
	SOCIAL SERVICES AND COMMUNITY DEVELOPMENT	
I	Basics of social services and its need - Rural development programs - Contribution of youth towards social welfare - NGOs in social services Swachbharath Abhiyan - Social evils - Mission Indra danush - Beti bacho Beti pado - Digital awareness - Constitution Day.	3
	DISASTER MANAGEMENT	
II	Organization of Disaster management -Types of emergencies - Natural and manmade disasters - fire service and firefighting - prevention of fire.	3
	PERSONALITY DEVELOPMENT	
III	Introduction to personality development - public speaking Intra and Inter personal skills -self-awareness - critical thinking - Decision making and problem solving.	3
	MAP READING	
IV	Types of maps - conventional signs - scales and Grid system - relief and contour gradient - cardinal points - Types of North - types of bearing and use of service protector - Prismatic compass and its uses - setting of maps - finding North and own position.	3
	PRINCIPLES OF FLIGHT AND AIRMANSHIP	
V	Introduction to principle of flight - Forces acting on the aircraft - Angle of attack - Angle of incidence - Newton's - law of motion - Bernauli's theorem and Venturi effect - Aerofoil - Airfield layout - ATC (Air Traffic Control) - circuit procedures - Aviation medicine.	3

Total Instructional Hours 15

Course Outcome	CO1	Perform the social services on various occasions for better community and social life.
	CO2	Appreciate the need and requirement for disaster management and NCC role in disaster management activities.
	CO3	Define thinking, reasoning, critical thinking and creative thinking.
	CO4	Use of bearing and service protector and locate the places and objects on the ground.
	CO5	Understand the principles of flight and Aerofoil structure.

TEXT BOOK:

- T1 NCC cadet Guide (SD/SW) Army.
T2 NCC cadet Guide (SD/SW) Airforce.
T3 ANOs Guide (SD/SW) by DG NCC, Ministry of Defence, New Delhi.
T4 Digital Forum App 1.0 & 2.0, by DG NCC DG NCC, Ministry of Defence, New Delhi.

REFERENCES:

- R1 UGC and AICTE circulated syllabus


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22MC2092	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	1	0	0	1

The student should be able
 Comprehend the basic principles of Indian Tradition.
 Understand that Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
Course Objective Realize the Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature is also important in modern society with rapid technological advancements and societal disruptions.
 Apprehend the Indian linguistic tradition and Indian artistic tradition.

Unit	DESCRIPTION	Instructional Hours
I	Basic Structure of Indian Knowledge System	3
II	Modern Science and Indian Knowledge System	3
III	Yoga and Holistic Health care	3
IV	Philosophical tradition	3
V	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics), Indian artistic tradition and Case Studies.	3
Total Instructional Hours		15
Course Outcome	CO1 Ability to understand the structure of Indian system of life. CO2 Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective	

REFERENCES:

- R1 V. Sivaramakrishna (Ed.)
- R2 Swami Jitatmanand
- R3 V N Jha (Eng. Trans
- R4 GN Jha (Eng. Trans.) Ed. R N Jha
- R5 P R Sharma (English translation)
- R6 V. Sivaramakrishna (Ed.)
- R7 Swami Jitatmanand
- R8 V N Jha (Eng. Trans
- R9 GN Jha (Eng. Trans.) Ed. R N Jha


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**HINDUSTHAN
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***HINDUSTHAN
COLLEGE OF ENGINEERING AND TECHNOLOGY***

(An Autonomous Institution)

Coimbatore – 641032

DEPARTMENT OF CHEMICAL ENGINEERING

Revised Curriculum and Syllabus for the Batch 2021-2025

(Academic Council Meeting Held on 03.03.2023)

UNDER REGULATIONS 2019 WITH AMENDMENT



Hindusthan College of Engineering and Technology

(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi & Accredited by NAAC with 'A' Grade)
Valley Campus, Pollachi Highways, Coimbatore, Tamilnadu.



DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.TECH. CHEMICAL ENGINEERING (UG)

REGULATION-2019 WITH AMENDMENT

The course code 21 indicates that the students joined in the academic year 2021

(For the students admitted during the academic year 2021-2025)

SEMESTER I

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2	21MA1102	Calculus and Linear Algebra	BS	3	1	0	4	40	60	100
THEORY WITH LAB COMPONENT										
3	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	21CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	21CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6	21ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	21HE1001	Language Competency Enhancement Course-I	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
8	21HE1072	Career Guidance Level – I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
Total :				14	2	12	20	480	320	800

SEMESTER II

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2	21MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	40	60	100
3	21EE2103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	40	60	100
4	21CH2101	Principles of Chemical Engineering	ES	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21PH2151	Material Science	BS	2	0	2	3	50	50	100
6	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
PRACTICAL										
7	21ME2001	Engineering Practices	ES	0	0	4	2	60	40	100
8	21HE2001	Language Competency Enhancement Course-II	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
9	21HE2072	Career Guidance Level – II Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE2073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total :				18	2	10	22	620	380	1000

SEMESTER III

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21MA3103	Fourier Analysis and Numerical Methods	BS	3	1	0	4	40	60	100
2	21CH3201	Chemical Process Calculations	PC	3	1	0	4	40	60	100
3	21CH3202	Fluid Mechanics for Chemical Engineers	PC	3	0	0	3	40	60	100
4	21CH3203	Chemical Engineering Thermodynamics – I	PC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21CH3251	Analytical Instruments for Analysis	PC	2	0	2	3	50	50	100
PRACTICAL										
6	21CH3001	Fluid Mechanics Lab	PC	0	0	3	1.5	60	40	100
7	21CH3002	Chemical Analysis Lab	PC	0	0	3	1.5	60	40	100
MANDATORY COURSES										
8	21AC3191	Indian Constitution	AC	2	0	0	0	100	0	100
9	21HE3072	Career Guidance Level – III Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
Total				19	2	8	20	630	370	1000

SEMESTER IV

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21CH4201	Process Heat Transfer	PC	3	1	0	4	40	60	100
2	21CH4202	Mass Transfer – I	PC	3	0	0	3	40	60	100
3	21CH4203	Chemical Engineering Thermodynamics - II	PC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
4	21CH4251	Mechanical Operations	PC	3	0	2	4	50	50	100
5	21MA4153	Applied Probability Statistics	BS	3	0	2	4	50	50	100
PRACTICAL										
6	21CH4001	Heat Transfer Lab	PC	0	0	3	1.5	60	40	100
7	21CH4002	Petrochemical Analysis Lab	PC	0	0	3	1.5	60	40	100
MANDATORY COURSES										
8	21AC4191	Essence of Indian tradition knowledge/Value Education	AC	2	0	0	0	100	0	100
9	21HE4072	Career Guidance Level – IV Personality, Aptitude and Career Development	EEC	2	0	0	0	100	-	100
10	21HE4073	Ideation Skills	EEC	2	0	0	0	100	-	100
Total				21	1	10	21	640	360	1000

SEMESTER V

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21CH5201	Chemical Reaction Engineering – I	PC	3	1	0	4	40	60	100
2	21CH5202	Mass Transfer – II	PC	3	1	0	4	40	60	100
3	21CH5203	Process Instrumentation Dynamics and Control	PC	3	1	0	4	40	60	100
4	21CH5204	Safety in Chemical Industries	PC	3	0	0	3	40	60	100
5	21CH53XX	Professional Elective -I	PE	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
6	21CH5251	Water Treatment and Solid Waste Management	PC	2	0	2	3	50	50	100
PRACTICALS										
7	21CH5001	Mass Transfer Lab	PC	0	0	3	1.5	60	40	100
8	21CH5002	Process Control Lab	PC	0	0	3	1.5	60	40	100
MANDATORY COURSES										
9	21HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
10	21HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
Total				19	3	8	26	570	430	1000

SEMESTER VI

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21CH6201	Chemical Reaction Engineering– II	PC	3	1	0	4	40	60	100
2	21CH6202	Chemical Process Industries	PC	3	0	0	3	40	60	100
3	21CH6181	Professional Ethics in Engineering	HS	3	0	0	3	40	60	100
4	21CH63XX	Professional Elective - II	PE	3	0	0	3	40	60	100
5	21XX64XX	Open Elective– I	OE	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENTS										
6	21CH6251	Fluidization Engineering	PC	2	0	2	3	50	50	100
PRACTICALS										
7	21CH6001	Chemical Reaction Engineering Lab	PC	0	0	4	2	60	40	100
MANDATORY COURSES										
8	21CH6701	Internship/Industrial Training/Skill Development Course (Minimum 3 weeks)	EEC	-	-	-	1	100	0	100
9	21HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
Total				19	1	6	24	610	390	1000

SEMESTER VII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21CH7201	Process Economics and Engineering Management	PC	3	0	0	3	40	60	100
2	21CH7202	Process Equipment Design	PC	3	1	0	4	40	60	100
3	21CH73XX	Professional Elective-III	PE	3	0	0	3	40	60	100
4	21XX74XX	Open Elective – II	OE	3	0	0	3	40	60	100
PRACTICALS										
5	21CH7001	Design and Simulation Lab	PC	0	0	3	1.5	60	40	100
6	21CH7002	Rubber Testing Lab	PC	0	0	3	1.5	60	40	100
PROJECT WORK										
7	21CH7901	Project Work – Phase I	EEC	0	0	4	2	50	50	100
Total				12	1	10	18	330	370	700

SEMESTER VIII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21CH83XX	Professional Elective –IV	PE	3	0	0	3	40	60	100
2	21CH83XX	Professional Elective- V	PE	3	0	0	3	40	60	100
PROJECT WORK										
3	21CH8901	Project Work – Phase II	EEC	0	0	16	8	100	100	200
Total				6	0	16	14	180	220	400

TOTAL NO OF CREDITS: 165

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	21CH5301	Energy Technology	PE	3	0	0	3	40	60	100
2	21CH5302	Petroleum Technology	PE	3	0	0	3	40	60	100
3	21CH5303	Electrochemical Engineering	PE	3	0	0	3	40	60	100
4	21CH5304	Polymer Technology	PE	3	0	0	3	40	60	100
5	21CH5305	Food Technology	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE II										
1	21CH6301	Petroleum Exploration and Exploitation Techniques	PE	3	0	0	3	40	60	100
2	21CH6302	Enzyme Engineering	PE	3	0	0	3	40	60	100
3	21CH6303	Fundamentals of Nano science	PE	3	0	0	3	40	60	100
4	21CH6304	Corrosion Science and Engineering	PE	3	0	0	3	40	60	100
5	21CH6305	Piping and Instrumentation	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE III										
1	21CH7301	Natural Gas Engineering	PE	3	0	0	3	40	60	100
2	21CH7302	Pulp and Paper Technology	PE	3	0	0	3	40	60	100
3	21CH7303	Transport Phenomena	PE	3	0	0	3	40	60	100
4	21CH7304	Multicomponent Distillation	PE	3	0	0	3	40	60	100
5	21CH7305	Chemical Process Optimization	PE	3	0	0	3	40	60	100
6	21CH7306	Fundamentals and Testing of Rubber Compounds	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE IV										
1	21CH8301	Industrial Management	PE	3	0	0	3	40	60	100
2	21CH8302	Sugar Technology	PE	3	0	0	3	40	60	100
3	21CH8303	Total Quality Management	PE	3	0	0	3	40	60	100
4	21CH8304	Foundation Skills in Integrated Product Development	PE	3	0	0	3	40	60	100
5	21CH8305	Supply Chain Management	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE V										
1	21CH8306	Process Plant Utilities	PE	3	0	0	3	40	60	100
2	21CH8307	Fermentation Technology	PE	3	0	0	3	40	60	100
3	21CH8308	Frontiers of Chemical Technology	PE	3	0	0	3	40	60	100
4	21CH8309	Industrial Nanotechnology	PE	3	0	0	3	40	60	100
5	21CH8310	Drugs and Pharmaceutical Technology	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVES										
CHEMICAL ENGINEERING										
S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21CH6401	Waste to Energy Conversion	OE	3	0	0	3	40	60	100
2	21CH7401	Biomass Conversion and Biorefinery	OE	3	0	0	3	40	60	100
LIFE SKILL COURSES										
3	21LSZ401	General Studies for Competitive Examinations	OE	3	0	0	3	40	60	100
4	21LSZ402	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	40	60	100
5	21LSZ403	Indian Ethos and Human Values	OE	3	0	0	3	40	60	100
6	21LSZ404	Indian Constitution and Political System	OE	3	0	0	3	40	60	100
7	21LSZ405	Yoga for Human Excellence	OE	3	0	0	3	40	60	100
NCC COURSES										
(Only for the students' who have opted NCC subjects in Semester I, II, III & IV are eligible)										
8	21HEZ401	NCC course level 1	OE	3	0	0	3	40	60	100
9	21HEZ402	NCC course level 2	OE	3	0	0	3	40	60	100

(Note: Z Stands for semester, students can't choose twice the course)

ADDITIONAL CREDIT COURSE FOR NCC CADETS										
S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	21HE1074	NCC General and National Integration	VA	1	0	0	1	100	-	100
2	21HE2074	Social services and community development	VA	1	0	0	1	100	-	100
3	21HE3074	Leadership Qualities and camp activities	VA	1	0	0	1	100	-	100
4	21HE4074	General awareness, communication and Aero engines	VA	1	0	0	1	100	-	100

ADDITIONAL CREDIT COURSE FOR CHEMICAL ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1.	21VACH01	Industrial Automation	VA	30 hrs	Internal	1
2.	21VACH02	Bulk Solid Handling for Chemical Engineers	VA	30 hrs	Internal	1
3.	21VACH03	Fundamentals of AI and it's Chemometric Applications	VA	30 hrs	Internal	1
4.	21VACH04	Introduction to Chemical Engineering MATLAB	VA	30 hrs	Internal	1
5.	21VACH05	IOT- Basics and Application in Unit Operations	VA	30 hrs	Internal	1

**Enrolment for B.E. / B. Tech. Honours (Specialisation in the same discipline) /
B.E. / B. Tech. Honours and B.E. / B. Tech. Minor Degree in other
specialisation.**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

(i) B.E. / B.Tech. Honours (specialisation in the same discipline):

- a. The student should have earned additionally a minimum of 18 credits from a vertical of the same programme.
- b. Should have passed all the courses in the first attempt.
- c. Should have earned a minimum CGPA of 7.50.

(ii) B.E. / B.Tech. Honours:

- a. The students should have earned additional courses (minimum of 18 credits) from more than one vertical of the same programme.
- b. Should have passed all the courses in the first attempt.
- c. Should have earned a minimum CGPA of 7.50.

(iii) B.E. / B.Tech. (Minor in other specialisation):

The student should have earned additionally a minimum of 18 credits in any one of the verticals of other B.E. / B.Tech. programmes or from any one of the following verticals

VERTICAL I: FINTECH AND BLOCK CHAIN

VERTICAL II: ENTREPRENEURSHIP

VERTICAL III: ENVIRONMENT AND SUSTAINABILITY

□

- ❖ Students can earn maximum of 6 credits in online mode (SWAYAM platform), out of these 18 credits as approved by Centre for Academic Courses.
- ❖ B.E. / B. Tech. (Honours) Specialisation in the same discipline, B.E / B.Tech. Honours and B.E. / B.Tech. Minor in other specialisation degree will be optional for students.
- ❖ For the categories (i) to (ii), the students will be permitted to register the courses from V Semester onwards provided the marks earned by the students until III semester should be of CGPA 7.50 and above and cleared all the courses in the first attempt.

- ❖ For the category (iii), the students will be permitted to register the courses from Semester V onwards provided the marks earned by the students until Semester III is CGPA 7.50 and above.
- ❖ If a student decides not to opt for Honours, after completing certain number of additional courses, the additional courses studied shall be considered instead of the Professional Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the mark sheet, however, they will not be considered for calculation of CGPA.
- ❖ If a student decides not to opt for Minor, after completing certain number of courses, the additional courses studied shall be considered instead of Open Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the mark sheet, however, they will not be considered for calculation of CGPA.
- ❖ The Head of Department, shall forward the proposal to the Controller of Examinations after getting the approval from Head of the Institution / Dean Academics, before the commencement of the fifth semester of the programme for the students undergo optionally B.E. / B. Tech. Honours (Specialisation in the same discipline) / B.E. / B. Tech. Honours and B.E. / B. Tech. Minor Degree in other specialisation

**VERTICALS FOR MINOR DEGREE
CHEMICAL ENGINEERING OFFERING MINOR DEGREE**

Minor Specialization in Chemical Process Engineering

SL. NO.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CH5231	Introduction to Chemical Process	MDC	3	0	0	3	3
2	21CH6231	Fluid Flow Operations in Chemical Engineering	MDC	3	1	0	4	4
3	21CH6232	Fundamentals of Chemical Thermodynamics	MDC	3	1	0	4	4
4	21CH7231	Process Heat and Mass Transfer	MDC	3	0	0	3	3
5	21CH7232	Reaction Engineering	MDC	0	0	4	4	2
6	21CH8231	Unit Operations and Process Laboratory	MDC	0	0	4	4	2

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

VERTICAL I: FINTECH AND BLOCK CHAIN

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	2MB5231	Financial Management	MDC	3	0	0	3	3
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	21MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	21MB7231	Introduction to Block chain and its Applications	MDC	3	0	0	3	3
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21MB5232	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	21MB6233	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	21MB6234	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	21MB7233	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	21MB7234	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	21MB8232	Financing New Business Ventures	MDC	3	0	0	3	3

VERTICAL III: ENVIRONMENT AND SUSTAINABILITY

VERTICAL III: ENVIRONMENT AND SUSTAINABILITY								
S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CE5232	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21CE7233	Green Technology	MDC	3	0	0	3	3
6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

VERTICALS FOR B Tech (Hons) and B Tech (Hons) in Chemical Engineering with Specialization

Vertical I Computer Aided Process Engineering	Vertical II Polymer Technology	Vertical III Petroleum Engineering
Process Flow Sheetting	Polymer Chemistry	Petroleum Geology
Transport Phenomena	Processing Technology	Petroleum Exploration
Advanced Process Optimization	Rubber Technology	Drilling Technology
Artificial Intelligence in Process Engineering	Polymer Product Design, Blends, and Alloys	Petroleum Production Engineering
Digital Twin and Soft Computing in Process Modelling	Polymer Structure and property relationships	Petroleum Reservoir Engineering
Advanced Process Modelling and Simulation	Polymer Compounding Technology	Offshore Engineering

B Tech (Hons) Chemical Engineering with Specialization in Computer Aided Process Engineering

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CH5203	Process Flow Sheetting	MDC	2	0	2	4	3
2	21CH6202	Transport Phenomena	MDC	3	1	0	3	4
3	21CH6203	Advanced Process Optimization	MDC	2	0	2	4	3
4	21CH7203	Artificial Intelligence in Process Engineering	MDC	2	0	2	4	3
5	21CH7204	Digital Twin and Soft Computing in Process Modelling	MDC	2	0	2	4	3
6	21CH8201	Advanced Process Modelling and Simulation	MDC	0	0	4	4	2

B Tech (Hons) Chemical Engineering with Specialization in Polymer Technology

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CHXXXX	Polymer Chemistry	MDC	3	0	0	3	3
2	21CHXXXX	Processing Technology	MDC	3	0	0	3	3
3	21CHXXXX	Rubber Technology	MDC	3	0	0	3	3
4	21CHXXXX	Polymer Product Design, Blends, and Alloys	MDC	3	0	0	3	3
5	21CHXXXX	Polymer Structure and property relationships	MDC	3	0	0	3	3
6	21CHXXXX	Polymer Compounding Technology	MDC	3	0	0	3	3



B Tech (Hons) Chemical Engineering with Specialization in Petroleum Engineering


S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CHXXXX	Petroleum Geology	MDC	3	0	0	3	3
2	21CHXXXX	Petroleum Exploration	MDC	3	0	0	3	3
3	21CHXXXX	Drilling Technology	MDC	3	0	0	3	3
4	21CHXXXX	Petroleum Production Engineering	MDC	3	0	0	3	3
5	21CHXXXX	Petroleum Reservoir Engineering	MDC	3	0	0	3	3
6	21CHXXXX	Offshore Engineering	MDC	3	0	0	3	3


CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	26	24	18	14	165

* Student can earn extra credit 35 over and above the total credits



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 Dean (Academics)
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PRINCIPAL
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 COIMBATORE - 641 032

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21MA3103	FOURIER ANALYSIS AND NUMERICAL METHODS	3	1	0	4

Course Objectives	<ul style="list-style-type: none"> • Introduce Fourier series analysis which is central to many applications in Engineering. • Solve boundary value problems by applying Fourier series. • Apply Fourier transform techniques used in wide variety of situations. • Apply various methods to solve numerical differentiation and numerical integration. • Explain the numerical solution of ordinary differential equations as most of the engineering problems are expressed in the form of differential equations.
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UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	FOURIER SERIES Introduction - Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	BOUNDARY VALUE PROBLEMS Classification – solution of one dimensional wave equation – one dimensional heat equation – Fourier series solution in Cartesian coordinates.	12
III	FOURIER TRANSFORMS Fourier Transform Pair - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem – Parseval's identity.	12
IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION Interpolation: Newton's forward and backward difference formulae – Newton's divided difference formula and Lagrangian interpolation for unequal intervals. Differentiation: Newton's forward and backward interpolation formulae for equal intervals – Newton's divided difference formula for unequal intervals. Numerical integration: Trapezoidal and Simpson's 1/3 and 3/8 rules.	12
V	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS Single step methods: Taylor's series method – Modified Euler's method for first order equation – Fourth order Runge- kutta method for solving first order equations – Multi step method: Milne's predictor and corrector method.	12

Total Instructional Hours 60

Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1: Understand the function in terms of sine and cosine terms in fourier series and also to get knowledge in fourier transforms.</p> <p>CO2: Demonstrate the application of Fourier series in solving the heat and wave equations.</p> <p>CO3: Understand the mathematical principles on Fourier transforms and able to solve some of the Physical problems of engineering.</p> <p>CO4: Understand and apply the concepts of interpolation, numerical differentiation and integration.</p> <p>CO5: Understand the concept of solving ordinary differential equations using single and multi step methods.</p>
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TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.
2. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2012.

REFERENCE BOOKS:

1. Kreyszig.E. "Advanced Engineering Mathematics", Eight Edition, John Wiley & sons (Asia) ltd 2010.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd. Second reprint, New Delhi, 2012.
3. S.K.Gupta, Numerical Methods for Engineers", New Age International Pvt.Ltd Publishers, 2015.

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**Chairman - BOSS
OHE - HICET**



Principal / Dean - Academics

**Dean (Academics)
HiCET**

PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
<u>Avg</u>	3	3	3	2.4	2.4	-	-	-	-	-	-	2	2	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH3201	CHEMICAL PROCESS CALCULATIONS	3	1	0	4

- Course Objectives**
- To acquire knowledge on laws of chemistry and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Units & Dimensions – Unit Conversion; Process variables and Properties; Stoichiometric Equations, Degrees of freedom.	12
II	Introduction to material balances - Material balance problems for single units, multiple units – Distillation, Humidification, Adsorption & Stripping, Extraction & Leaching, Crystallization, Psychrometry, Drying, Evaporation; Stoichiometry and Chemical reaction equations; Material balance for processes involving reaction; Bypass, Purging, Recycle operations.	12
III	Ideal gases, Real gases, Single component two phase systems, Multiple component phase systems, Phase rule, Phase equilibria, Combustion processes –Flue gas analysis, Ultimate and Proximate analyses of coal.	12
IV	Energy balances, Conservation of Energy processes without reaction, Heat capacity, Energy balances with chemical reaction, Efficiency applications.	12
V	Application of energy balances; Unsteady state material and energy balances; Solving material and energy balances using process simulators.	12
Total Instructional Hours		45 + 15 = 60

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1: Remember the units, unit's conversion and degrees of freedom.
 - CO2: Understand the reactor systems and perform material and energy balances for process flowsheets by applying degree of freedom.
 - CO3: Remember the calculations associated with gases in two phase systems, in combustion processes.
 - CO4: Understand energy balance and heat capacity calculations.
 - CO5: Understand about the simulation of steady-state and unsteady state processes using process simulators.

TEXT BOOKS:

- David M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall of India, New Delhi, 2012.
- Bhatt B.I. and Vora S.M., "Stoichiometry", 2nd Edition, Tata McGraw Hill, New Delhi, 2004.

REFERENCE BOOKS:

- Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, 2nd Edition, CBS publishers, 2004.
- Venkatramani. V, Anatharaman. N and MeeraShariffaBegam "Process Calculations" Printice Hall of India, New Delhi, 2nd Edn, 2011.
- Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes", 3rd Edition, John Wiley & Sons, New York, 2005.

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HiCET**

PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	1	1
CO2	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO3	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO4	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO5	2	3	3	-	2	-	-	-	2	-	-	2	1	1
AVG.	2	3	3	-	2	-	-	-	2	-	-	2	1	1


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH3202	FLUID MECHANICS FOR CHEMICAL ENGINEERS	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> To impart to the student knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium, flow measurement and fluid machineries. 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Fluid Properties and Statics: Nature of fluids - properties of fluids; Types of fluids-Newtonian and Non-Newtonian fluids, Compressible and incompressible fluids; Introduction-Hydrostatic equilibrium; Pressure measurement – Manometers.	9
II	Principles of Fluid Flow: Types of flow – laminar and turbulent flow in pipes and closed channels; Equation of Continuity; shear stress distribution; friction factors; Bernoulli's equation and applications; Introduction - Boundary layer concept. Dimensional analysis: Basics of dimensional analysis: Rayleigh's method and Buckingham's π method.	9
III	Flow Past Immersed Bodies: Drag- types, drag coefficient, friction factor for flow through beds of solids, applications to packed and fluidized beds; packing materials; determination of pressure drop using Ergun equation, Fluidization-types, determination of minimum fluidization velocity and pressure drop; Motion of particles through fluids – calculation of terminal settling velocity.	9
IV	Metering of Fluids: Classification and selection of flow meters; variable head and variable area meters: venturi, orifice and rotameters; determination of discharge and discharge coefficient; Pitot tube; Anemometer; Introduction to notches, weirs, turbine, Vortex and Magnetic flow meters.	9
V	Transportation of Fluids: Classification of fluid moving machinery; Centrifugal pump- characteristics and applications; elementary principles of Reciprocating, gear, air lift, diaphragm and submersible pumps; Introduction to valves and pipe fittings.	9
Total Instructional Hours		45

Course Outcomes	Upon completion of the course, students can be able to
	CO1: Understand the principles of fluid properties and fluid statics.
	CO2: Understand the principles of fluid flow problems like pressure drop power and loss coefficient and apply the same in chemical process industries.
	CO3: Understand the flow behavior of solid and liquid and to demonstrate the understanding of packed and fluidized bed.
	CO4: Understand and select fluid moving machinery for different applications in process industries.
	CO5: Understand and select characteristics of pumps, flow meters and valves for different applications in process industries.

TEXT BOOKS:

- McCabe W.L., Smith J.C. and Harriot P., — "Unit Operations in Chemical Engineering", 7th Edition, McGraw Hill International Edition, New York, 2006.
- Bansal R.K., "Fluid Mechanics & Hydraulic Machines", Laxmi Publications, 2015.

REFERENCE BOOKS:

- Cengel, Yunus and Cimbala John M., — "Fluid Mechanics Fundamentals and Applications", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2006.
- Munson B.R., Young D.F., Okiishi T.H. and Huebsch W.W., — "Fundamentals of Fluid Mechanics", 6th Edition, Wiley India, New Delhi, 2010.
- Noel de Nevers, "Fluid Mechanics for Chemical Engineers", 3rd Edition, McGrawHill, New York, 2004.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	1	1
CO2	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO3	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO4	2	3	3	-	2	-	-	-	2	-	-	2	1	1
CO5	2	3	3	-	2	-	-	-	2	-	-	2	1	1
AVG.	2	3	3	-	2	-	-	-	2	-	-	2	1	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH3203	CHEMICAL ENGINEERING THERMODYNAMICS - I	3	0	0	3

Course Objectives

- To introduce students to PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Scope of thermodynamics; Definition of system, control volume, state and path function, equilibrium, reversibility, energy, work and heat. Zeroth law; temperature scales. Joule's experiment, internal energy, first law, energy balance for closed systems, mass and energy balance for open systems.	9
II	PVT behaviour of fluids; Mathematical representation of PVT behaviour; generalized compressibility factor correlation; generalized equations of state.	9
III	Statements of the second law of thermodynamics, heat engine and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, second law of thermodynamics for a control volume. Third law of thermodynamics, entropy from a microscopic point of view.	9
IV	Thermodynamic potentials – Internal energy, Enthalpy, Helmholtz free energy, Gibbs free energy; thermodynamic property relations – Maxwell relations - partial derivatives and Jacobian method; residual properties; thermodynamic property tables and diagrams.	9
V	Duct flow of compressible fluids, Compression and expansion processes, steam power plant, internal combustion engines, jet and rocket engines.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

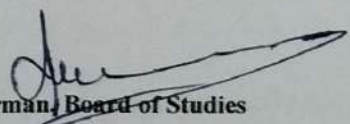
- Course Outcomes**
- CO1: Remember the concepts of heat, work and energy.
 - CO2: Understand the properties and relationships of thermodynamic fluids.
 - CO3: Understand the laws of thermodynamics and correctly use thermodynamic terminology.
 - CO4: Remember the fundamental thermodynamic properties.
 - CO5: Understand the basic thermodynamic cycles.

TEXT BOOKS:

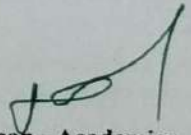
- Smith, J.M., Van Ness, H.C and Abbot M.M "Introduction to Chemical Engineering Thermodynamics", McGraw Hill Publishers, VI edition, 2003.
- Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004.

REFERENCE BOOKS:

- Kyle, B.G., "Chemical and Process Thermodynamics III Edition", Prentice Hall of India Pvt. Ltd., 3rd edition, 2004.
- Elliott J.R., Lira, C.T., "Introductory Chemical Engineering Thermodynamics", Prentice Hall, Second Edition, 2011.
- Rao, Y.V.C., "Chemical Engineering Thermodynamics" Universities Press, 2005.



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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH3251	ANALYTICAL INSTRUMENTS FOR ANALYSIS	2	0	2	3
Course Objectives	<ul style="list-style-type: none"> To develop the ability to select the instruments based on appropriate criteria, analyze and interpret the experimental data. 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Introduction: Introduction to classical qualitative and quantitative analysis, classification of instrumental methods, Errors, precision and accuracy of instruments, statistical methods of data handling.	6
II	Spectroscopy: Beer's Law, deviation of Beer's Law, instrumentation of UV and IR spectroscopy: Monochromatic Source, grating systems and types of detectors, different sampling techniques and application of UV & IR Spectroscopy: Determination of Pka value of a component using UV-spectroscopy, Study of Chemical Reaction Kinetics using UV-System, Determination of wavelength using UV- spectroscopy., Verification of beer's lamberts law, Determination of unknown concentration of an analyte by using the Beer-Lambert Law.	6+9
III	Gravimetric analysis: Principle of Thermogravimetric analyzer (TGA), construction of TGA, principle of bomb Calorimeter (BC), principle of Differential scanning calorimeter (DSC), Instrumentation of TGA and BC, Application of TGA and BC instruments: Effect of temperature on viscosity of oils using red woodviscometer, Saybolt viscometer.	6+6
IV	Gas chromatography: Introduction, Principle, carrier gas, stationary phase, instrumentation, column detectors (TCD, FID, ECD), qualitative and quantitative analysis. Ion exchange Chromatography: Introduction, Principle, advantages, disadvantages and applications.	6
V	High performance liquid chromatography: Principle, instrumentation, types of columns, sample injection, detectors used like (absorbance, refractive index, and electrochemical measurements), criteria for mobile phase selection and application of HPLC.	6
Total Instructional Hours		45

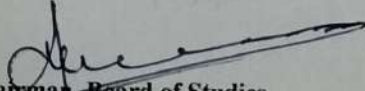
Course Outcomes	Upon completion of the course, students can be able to
	CO1: Understand qualitative and quantitative analysis
	CO2: Understand the operation and analyze the samples using UV-spectroscopy
	CO3: Understand the principles of gravimetric analysis of samples
	CO4: Understand about the sample analyses using gas chromatography
	CO5: Understand about the sample analyses using HPLC

TEXT BOOKS:

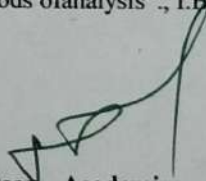
1. Instrumental Methods of Chemical Analysis; Gurudeep R. Chatwal and Sham K. Anand, Himalaya PublishingHouse.
2. Douglas A. Skoog, F. James Holler, Stanley R. Crouch., "Principles of Instrumental Analysis", 6th Edition, published by Thomson Brooks/Cole,2007.

REFERENCE BOOKS:


1. Lloyd R. Snyder, Joseph J. Kirkland, John W. Dolan., "Introduction to Modern Liquid Chromatography", 3rd Edition, Wiley-Blackwell, scholarlypublishing.
2. H.H. Willard, L.L. Merritt, J.N. Dean and F.A. Settle, "Instrumental methods of analysis", I.B.H. Publishing House, New Delhi.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH3001	FLUID MECHANICS LAB	0	0	3	1.5

Course Objectives

- To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.

S.No.	DESCRIPTION
-------	-------------

- | | |
|-----|--|
| 1. | Viscosity measurement of non Newtonian fluids |
| 2. | Calibration of constant and variable head meters |
| 3. | Calibration of weirs and notches |
| 4. | Open drum orifice and draining time |
| 5. | Flow through straight pipe |
| 6. | Flow through annular pipe |
| 7. | Flow through helical coil and spiral coil |
| 8. | Losses in pipe fittings and valves |
| 9. | Characteristic curves of pumps |
| 10. | Pressure drop studies in packed column |
| 11. | Hydrodynamics of fluidized bed |
| 12. | Drag coefficient of solid particle |

Total Practical Hours 45


Upon completion of the course, students can be able to

Course Outcomes

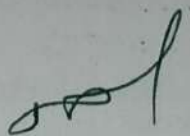
- Use variable area flow meters and variable head flowmeters.
- Analyze the flow of fluids through closed conduits, open channels and flow past immersed bodies.
- Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties.

REFERENCE BOOKS:


- McCabe W.L, Smith, J C and Harriot. P "Unit Operations in Chemical Engineering", McGraw Hill, VII Edition, 2005
- White, F.M., "Fluid Mechanics ", McGraw-Hill Inc., VII Edition, 2011.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme
B.Tech

Course Code
21CH3002

Name of the Course
CHEMICAL ANALYSIS LAB

L	T	P	C
0	0	3	1.5

Course
Objectives

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of nitrite in water, cement, oil, coal and Phenol.

DESCRIPTION

- S.No.
- Determination of Redwood / Saybolt numbers, kinematic viscosity and viscosity index of Lubricating oils.
 - Determination of flash point, fire point, cloud and pour point of oils.
 - Determination of acid value and iodine value of oils.
 - Determination of COD of water samples.
 - Cement Analysis a. Estimation of silica content b. Estimation of mixed oxide content c. Estimation of calcium oxide content d. Estimation of calcium oxide by rapid method.
 - Coal Analysis a. Ultimate analysis of coal b. Proximate analysis of coal.
 - Soap Analysis a. Estimation of total fatty acid b. Estimation of percentage alkali content.
 - Estimation of phenol.
 - Determination of calorific value using bomb calorimeter.
 - Determination of nitrite in water.

Total Instructional Hours

45

Course
Outcomes

Upon completion of the course, students can be able to

- Develop the ability to handle and work with the equipment like viscometers, flash and fire point apparatus etc.,
- Understand the methods for determining COD.
- Understand the few simple synthetic techniques for soap.

REFERENCE BOOKS:

- Environmental pollution analysis, S.M.Khopkar, New age international.2011.
- Manual of environmental analysis, N.C Aery, Ane books.2010.
- Text book of quantitative chemical analysis, J.Mendham, Pearson education 2008.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
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CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the course	L	T	P	C
B.E. / B.Tech	21AC3191	INDIAN CONSTITUTION	2	0	0	0

COURSE OBJECTIVES

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

UNIT	DESCRIPTIVE	INSTRUCTIONAL HOURS
UNIT I : BASIC FEATURES AND FUNDAMENTALE PRINCIPLES		4

Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.

UNIT II : FUNDAMENTAL RIGHTS	4
------------------------------	---

Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.

UNIT III : PARLIAMENTARY FORM OF GOVERNMENT	4
---	---

The constitution powers and the status of the president in India. – Amendment of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions : National emergency, President rule, Financial emergency.

UNIT IV : LOCAL GOVERNANCE	4
----------------------------	---

Local self government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article 19 – scope of the right to life and personal liberty under article 19.

UNIT V : INDIAN SOCIETY	4
-------------------------	---

Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TOTAL INSTRUCTIONAL HOURS: 20

OUTCOMES:

Upon completion of the course, students will be able to:

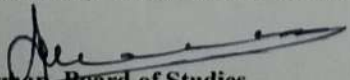
1. Understand the functions of the Indian government
2. Understand and abide the rules of the Indian constitution.

TEXT BOOKS:

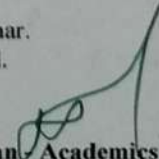
- T1. Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.
- T2. R.C. Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
- T3. Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
- T4. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCE BOOKS:

- R1. Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
- R2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
- R3. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.


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Course code	Course title	L	T	P	C
21HE3072	Career Guidance – Level III	2	0	0	0
Pre-requisite	Personality, Aptitude and Career Development None	Syllabus version 1			

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]
- Display good writing skills while dealing with essays [SLO 12]

Expected Course Outcome:

Enable students to solve Aptitude questions of placement level with ease, as well as write effective essays.

Student Learning Outcomes (SLO): 6, 7, 8, 12

Module:1 Logical Reasoning

6 hours

SLO:6

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Data interpretation and Data sufficiency

- Data Interpretation – Tables
- Data Interpretation - Pie Chart
- Data Interpretation - Bar Graph
- Data Sufficiency

Module:2 Quantitative Aptitude

7 hours

SLO: 7

Time and work

- Work with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

Time, Speed and Distance

- Basics of time, speed and distance
- Relative speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on races

Profit and loss, Partnerships and averages

- Basic terminologies in profit and loss
- Partnership
- Averages
- Weighted average

Module:3 Verbal Ability

5 hours

SLO: 8

Sentence Correction

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Sentence Completion and Para-jumbles

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Module:4 Writing skills for placements

2 hours

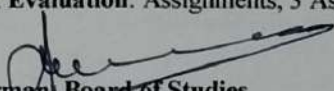
SLO: 12

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)


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Programme	Course Code	Name of the Course	L	T	P	C
BE/BTECH	21HE3073	Leadership Management Skills	1	0	0	0

- Course Objective
1. To know about the leadership skills that is to be acquired for success.
 2. To become a teamwork expert, real world problem solver, your views will be challenged
 3. To gain global perspective and becoming an effective communicator
 4. To understand about learning, negotiation and decision making
 - 5: To get first hand information about the skills we possess and to work on improvement.

Module	Description	Instructional Hours
1.	Strategic thinking skills	
2.	Planning and Delivery skills	
3.	People management skills (Delegation)	
4.	Change management and Innovation skills	
5.	Communication skills	
6.	Persuasion and influencing skills	
7.	Learning Agility	
8.	Motivation	
9.	Personality	
10.	Emotions	
11.	Perception	
12.	Negotiation	
13.	Decision making	
14.	Problem solving	
15.	Building trust	
Total Instructional Hours		15

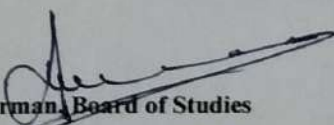
- Course Outcome
- CO1: To practice essential leadership skills in day to day operations
CO2: To work on leadership skills in the study environment
CO3: To understand and develop the skills consciously.
CO4: To know about the real worth of all the skills for success
CO5: To Analyze the real worth of the person and suggestion for improvement

TEXT BOOKS

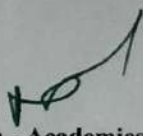
- T1: A REVIEW OF LEADERSHIP THEORY AND COMPETENCY FRAMEWORKS, Bolden, R., Gosling, J., Marturano, A. and Dennison, P. June 2003
T2: LEADING FROM WITHIN: Building Organizational Leadership Capacity-David R. Kolzow, PhD, 2014

REFERENCE BOOKS

- R1: Seven habits of highly effective people – Stephen R. Covey
R2: The Art of Business Leadership: Indian Experiences – G. Balasubramaniam
R3: DEVELOPING the LEADER WITHIN YOU-JOHN C. MAXWELL


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IV SEMESTER

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	21CH4201	PROCESS HEAT TRANSFER	3	1	0	4
Course Objective	The student should be able					
	1	To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipment like evaporator and heat exchanger.				

Unit	Description	Instructional Hours
I	Conduction: Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.	12
II	Convection: Concepts of heat transfer by convection - Natural and forced convection, analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds.	12
III	Heat Transfer with Phase Change: Heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Boiling regimes.	12
IV	Radiation: Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzmann law, Plank's law, radiation between surfaces.	12
V	Evaporation: Theory of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation. Heat Exchangers: Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors.	12

Total Instructional Hours 60

Course Outcome	CO1	Recognize the modes of heat transfer and ability to solve conduction based problems.
	CO2	Comprehend the concept of convective heat transfer model using dimensional analysis.
	CO3	Understand the heat transfer process with phase change.
	CO4	Understand the difference between radiation and evaporation and ability to design evaporator.
	CO5	Apprehend the design concepts of heat exchangers.

TEXT BOOK:

- T1 Binay K. Dutta., "Heat Transfer Principles and Applications", Prentice Hall of India, 14thn Edition, 2015
- T2 McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005
- T3 G.K. Roy, Fundamentals of Heat and Mass Transfer, Khanna Publishers, Sixth Edition, 2017.

REFERENCES:

- R1 Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
- R2 Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.
- R3 Holman, J. P., 'Heat Transfer, 8th Edition., Tata McGraw Hill, 1997.
- R4 Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol.II, 4th Edition, Asian Books Pvt. Ltd., India, 1998.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
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CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	21CH4202	MASS TRANSFER - I	3	0	0	3

Course Objective	The student should be able
1	To present the principles of mass transfer and their application to various unit operations and to determine mass transfer rates under laminar and turbulent conditions

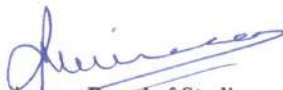
Unit	Description	Instructional Hours
	DIFFUSION	
I	Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion.	9
	MASS TRANSFER COEFFICIENTS	
II	Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.	9
	HUMIDIFICATION	
III	Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and types of cooling tower, dehumidifiers and humidifiers using enthalpy transfer unit concept.	9
	DRYING	
IV	Drying– Equilibrium; classification of dryers; batch drying – Mechanism and time of cross through circulation drying, continuous dryers – material and energy balance; determination of length of rotary dryer using rate concept.	9
	CRYSTALLISATION	
V	Crystallization - Equilibrium, classification of crystallizers, mass and energy balance; kinetics of crystallization – nucleation and growth; design of batch crystallizers; population balance model and design of continuous crystallizers.	9
	Total Instructional Hours	45
Course Outcome	CO1 Understand the diffusion process in all three phases. CO2 Examine the concept of mass transfer coefficients and theories. CO3 Illustrate the principle of Humidification operation. CO4 Understand the classification and demonstration of dryers. CO5 Sketch the design concepts of the crystallizer.	

TEXT BOOK:

- T1 Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill, 1981.
T2 G.K. Roy, Fundamentals of Heat and Mass Transfer, Khanna Publishers, Sixth Edition, 2017.
T3 McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition., McGraw-Hill, 2005.

REFERENCES:

- R1 Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I and II, 4th Edition, Asian Books Pvt. Ltd., India, 1998.
R2 Foust A.S., "Principles of Unit Operations", 2nd Edition, John Wiley, 2008.
R3 Seader J.D & Henley E.J., "Separation Process Principles", 2nd Edition, John Wiley, 2006.
R4 Geankoplis, C.J., "Transport Processes and Separation Process Principles Includes Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.



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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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HICET

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	21CH4203	CHEMICAL ENGINEERING THERMODYNAMICS - II	3	0	0	3

Course Objective	The student should be able
1.	Enable the students to understand the behavior of fluids under PVT conditions and also apply them for practical purpose.

Unit	DESCRIPTION	Instructional Hours
	PROPERTIES OF SOLUTIONS	
I	Partial molar properties - ideal and non-ideal solutions - standard states definition and choice - Gibbs-Duhem equation - excess properties of mixtures.	9
	PHASE EQUILIBRIA	
II	Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity - application of phase rule - vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap - effect of temperature and pressure on azeotrope composition - liquid-liquid equilibrium - ternary liquid-liquid equilibrium.	9
	CORRELATION AND PREDICTION OF PHASE EQUILIBRIA	
III	Activity coefficient-composition models - thermodynamic consistency of phase equilibria - application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.	9
	CHEMICAL REACTION EQUILIBRIA	
IV	Standard free energy change and reaction equilibrium constant - evaluation of reaction equilibrium constant - prediction of free energy data - equilibria in chemical reactors - calculation of equilibrium compositions for homogeneous chemical reactors - thermodynamic analysis of simultaneous reactions.	9
	REFRIGERATION	
V	Principles of refrigeration- methods of producing refrigeration, air refrigeration cycle, cascade refrigeration system- liquefaction process-Claude and Linde process-co-efficient of performance - evaluation of the performance of vapour compression and gas refrigeration cycles.	9

Total Instructional Hours 45

Course Outcome	
CO1	Examine the terminologies such as chemical potential, fugacity, fugacity coefficient, activity and activity coefficient.
CO2	Apply the equations of state and activity coefficient models to describe VLE
CO3	Illustrate and develop the relations to phase equilibrium and to solve chemical engineering problems.
CO4	Calculate the equilibrium constants and predict the effects of temperature, pressure, and composition on equilibrium conversion.
CO5	Understand and solve mass, energy and entropy balances to flow processes

TEXT BOOK:

- T1 Smith, J.M., VanNess, H.C., & Abbot M.C, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill VII Edition 2004.
- T2 Narayanan K.V "A Text Book of Chemical Engineering Thermodynamics" Prentice Hall of India Pvt. Ltd. 2001.

REFERENCES:

- R1 Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II", Thermodynamics, John Wiley, 1970.
- R2 Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill, 1960.
- R3 Sandler, S.I., "Chemical and Engineering Thermodynamics", 2nd Edition, Wiley, 1989.
- R4 Stanley M. Walas "Phase equilibrium in Chemical Engineering", Elsevier Science and Technology books. 1984.


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HiCET**

PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	21CH4251	MECHANICAL OPERATIONS	3	0	2	4

Course Objective
The student should be able
In this course, the students will learn characterization of solids, size reduction, techniques of solid – fluid separation and mixing

Unit	DESCRIPTION	Instructional Hours
	PARTICLE CHARACTERIZATION AND MEASUREMENT General characteristics of solids, different techniques of size analysis- Static - Image analysis and Dynamic analysis - Light scattering techniques, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques. Screening methods and equipment, screen efficiency, ideal and actual screens: Sieve analysis.	
I	PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; Advanced size reduction techniques - Nanoparticle fabrication - Topdown approach - Bottom-up approach. Size enlargement - Importance of size enlargement, principle of granulation, briquetting, pelletisation, and flocculation. Fundamentals of particle generation: Reduction ratio in Jaw Crusher, Ballmill, Drop Weight Crusher.	9+3
II	PARTICLE SEPARATION Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging: Characteristics of batch Sedimentation, Separation characteristics of Cyclone separator, Air Elutriator.	9+4
III	FILTRATION AND FILTRATION EQUIPMENT Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids. Batch filtration studies using Leaf Filter and Plate and Frame Filter press.	9+4
IV	MIXING Concept of mixing, Homogeneous and Heterogeneous mixtures, Importance of mixing, Mixing liquids with liquids, Mixing of gases with liquids, Mixing of solids with liquids, Mixing of viscous and plastic masses, Types of mixers.	9
V		

Total Instructional Hours 45+15=60

Course Outcome	CO1 Understand the general characteristics of solids, screening and sieve analysis.
	CO2 Examine the particle size reduction processes and to operate the size reduction equipment
	CO3 Illustrate the methods of particles separation
	CO4 Remember the theory of filtration and filtration equipment
	CO5 Estimate the particle handling and the power required for mixing.

TEXT BOOK:

- T1 McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
T2 Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I, 5th Edn., Asian Books Pvt. Ltd., India, 2006

REFERENCES:

- R1 Brown G.G., et.al., "Unit Operations", 1st edition., CBS Publisher, New Delhi, 2005.
R2 Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1st Edition, 2002.
R3 Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", 2nd Edn., John Wiley & Sons, 2008.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	21MA4153	APPLIED PROBABILITY STATISTICS (CHEMICAL)	3	0	2	4

Course Objective	The student should be able
	1. Construct a well defined knowledge of random variables.
	2. Explain the concept of two dimensional random variables and determine covariance.
	3. Introduce Correlation concepts to understand the relation between two random variables.
	4. Describe some basic concepts of statistical methods for testing the hypothesis.
	5. Analyze the design of experiment techniques to solve various engineering problems.

Unit	DESCRIPTION	Instructional Hours
	PROBABILITY AND RANDOM VARIABLE	
	Axioms of probability - Conditional probability - Total probability - Baye's theorem. Random variable -Discrete and continuous random variables - Probability mass function - Probability density function - Cumulative distribution functions - Moment generating functions. Introduction to R programming and Application of descriptive statistics - Mean, Median, Mode, variance and Box plot	9+3
I	TWO DIMENSIONAL RANDOM VARIABLES	
	Joint probability mass function - Joint probability density function - Marginal Probability mass function - Marginal probability density function - Conditional Probability mass function - Conditional Probability density function - Independent random variables.	9+6
II	Application of Normal distribution.	
	CORRELATION AND REGRESSION	9+3
III	Correlation - Karl Pearson's correlation coefficient - Spearman's Rank Correlation - Regression lines (problems based on Raw data only). Applications of Correlation and Regression	
	HYPOTHESIS TESTING	9
IV	Large sample test based on Normal distribution - test of significance for single mean and difference of means -Small sample test - t test for single mean and difference of mean - F distribution for variance, Chi - Square test for independence of attributes - Goodness of fit. Application of Student t- test for Single mean and difference of means	
	Application of Chi - square test	
	ANALYSIS OF VARIANCE	9
V	Introduction, assumptions of analysis of variance, completely randomized design, randomized block design, Latin square design. Applications of Latin square design.	

Total Instructional Hours 45+15=60

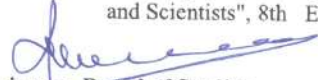
Course Outcome	CO1	Understand the concepts of random variables.
	CO2	Express the phenomenon of two dimensional random variables..
	CO3	Compute correlation and predict unknown values using regression.
	CO4	Understand the concepts of statistical methods for testing the hypothesis.
	CO5	Apply Design of Experiment techniques to solve various engineering problems

TEXT BOOK:

- T1 Saeed Ghahramani, "Fundamentals of probability with stochastic processes", Prentice Hall New Jersey, 2016
T2 Medhi J., "stochastic Processes", New Age International Publishers, New Delhi, 2014

REFERENCES:

- R1 O.C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, First Indian Reprint, 2010.
R2 Applied statistics and Probability for Engineers by C.Mont Gomery ,6th Edition, Wiley Publications
R3 Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.



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PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
<u>Avg</u>	3	3	3	2.4	2.4	-	-	-	-	-	-	2	2	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH4001	HEAT TRANSFER LAB	0	0	3	1.5

Course Objectives

- To enable the students to develop a sound working knowledge on different types of heat transfer equipment.

S.No.	DESCRIPTION
-------	-------------

- | | |
|-----|--|
| 1. | Transient heat conduction with constant heat flux |
| 2. | Heat transfer through natural convection |
| 3. | Heat transfer through forced convection |
| 4. | Heat transfer in a shell and tube heat exchanger |
| 5. | Heat transfer in a double pipe heat exchanger |
| 6. | Heat transfer in a bare and finned tube heat exchanger |
| 7. | Heat transfer in helical coils |
| 8. | Heat transfer through packed bed |
| 9. | Heat transfer in agitated vessels |
| 10. | Heat transfer in a condenser |
| 11. | Heat transfer in single effect evaporator |
| 12. | Heat transfer in multi effect evaporator |
| 13. | Stefan boltzmann experiment |
| 14. | Emissivity measurement |

Total Instructional Hours 45

Upon completion of the course, students can be able to

- | | |
|------------------------|---|
| Course Outcomes | <ul style="list-style-type: none"> Understand the heat transfer calculations by conduction, convection and radiation. Implement the heat exchanger design and structure of this equipment. Remember the theoretical and empirical models for heat transfer calculations. Integrate the applications of heat transfer equipment in various operating process plants. |
|------------------------|---|

REFERENCE BOOKS:

- McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
- Holman, J. P., 'Heat Transfer ', 8th Edn., Tata McGraw Hill, 1997.



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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH4002	PETROCHEMICAL ANALYSIS LAB	0	0	3	1.5

- Course Objectives**
- To learn basic principles involved in analysis of petrochemical products.

S.No.	DESCRIPTION
1.	Sulphur content determination.
2.	Flue gas Analysis – Orsat Apparatus.
3.	Aromatic Content determination.
4.	Determination of Lead, Acid and Salt content.
5.	Analysis of petrochemicals using UV spectrophotometer.
6.	Biodegradation of petrochemicals.
7.	Bioremediation of petrochemicals.
8.	Refractive index of petrochemicals.
9.	Determination of moisture content – KF Titrator.
10.	Total acidity determination.
11.	Dynamic viscosity measurement.
12.	Calorific value of fuels.

Total Instructional Hours 45

Upon completion of the course, students can be able to

- Course Outcomes**
- Acquire knowledge through carry out experiments about physical and chemical characterization of petrochemical products and apply knowledge in industries.
 - Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

REFERENCE BOOKS:

- Text book of quantitative chemical analysis, J.Mendham, Pearson education 2008.
- BhaskaraRao, B.K., "A Text on Petrochemicals", Khanna Publishers, 2000.
- SukumarMaiti, "Introduction to Petrochemicals", 2nd Edition, Oxford and IBH Publishers, 2002.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.E./B.TECH.	21MC4191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0


The student should be able

1. The course aims at imparting basic principles of thought process, reasoning and inferencing.
2. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
3. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature is also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian Knowledge System, Indian perspective of
4. modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.
5. The course aims at imparting basic principles of thought process, reasoning and inferencing.

Unit	DESCRIPTION	Instructional Hours
I	Basic Structure of Indian Knowledge System	4
II	Modern Science and Indian Knowledge System	4
III	Yoga and Holistic Health care	4
IV	Philosophical tradition	4
V	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics),	4
Total Instructional Hours		20
Course Outcome	CO1 Ability to understand the structure of Indian system of life.	
	CO2 Connect and explain basics of Indian Traditional knowledge in modern scientific perspective.	

REFERENCES:

- R1 Sivarama krishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya
- R2 Bhavan, Mumbai, 5th Edition, 2014
- R3 Swami Jitatanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
- R4 Fritz of Capra, The wave of Life.
- R5 VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Amakuram
- R6 Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
- R7 GN Jha (Eng. Trans.) Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016.
- R8 RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016.
- R9 PR Sharma (English translation), Shodhashang Hridayam.


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	21HE4072	CAREERGUIDANCE –LEVELIV Personality, Aptitude and Career Development	2	0	0	0

The student should be able

- | | |
|-------------------------|--|
| Course Objective | 1. Solve Logical Reasoning questions of easy to intermediate level[SLO6] |
| | 2. Solve Quantitative Aptitude questions of easy to intermediate level[SLO7] |
| | 3. Solve Verbal Ability questions of easy to intermediate level[SLO8] |
| | 4. Crack mock interviews with ease[SLO13] |
| | 5. Be introduced to problem-solving techniques and algorithms[SLO14] |

Expected Course Outcome:

Enable students to solve Aptitude questions of placement level with ease,as well as write effective essays.

Student Learning Outcomes(SLO): 6,7,8,13, 14

Module	DESCRIPTION	Instructional Hours
I	Logical Reasoning Logical connectives,Syllogism and Venn diagrams	3
	<ul style="list-style-type: none"> • Logical Connectives • Syllogisms • Venn Diagrams–Interpretation • Venn Diagrams -Solving 	
II	Quantitative Aptitude Logarithms, Progressions, Geometry and Quadratic equations	6
	<ul style="list-style-type: none"> • Logarithm • Arithmetic Progression • Geometric Progression • Geometry • Mensuration • Coded inequalities • Quadratic Equations 	
III	Permutation,CombinationandProbability	2
	<ul style="list-style-type: none"> • Fundamental Counting Principle • Permutation and Combination • Computation of Permutation • Circular Permutations • Computation of Combination • Probability 	
IV	Verbal Ability Critical Reasoning Argument– IdentifyingtheDifferentParts(Premise,assumption,conclusion)	1
	<ul style="list-style-type: none"> • Strengthening statement • Weakening statement • Mimic the pattern 	
	Recruitment Essentials Cracking interviews-demonstration through a few mocks Sample mock interviews to demonstrate how to crack the:	
	<ul style="list-style-type: none"> • HR interview • MR interview • Technical interview 	
	Cracking other kinds of interviews	
	<ul style="list-style-type: none"> • Skype/Telephonic interviews • Panel interviews • Stress interviews 	
	Resume building –workshop A workshop to make students write an accurate resume	

V	Problem solving and Algorithmic skills		8
	<ul style="list-style-type: none"> Logical methods to solve problem statements in Programming 		
	Basic algorithms introduced		

Total Instructional Hours 20

Course Outcome	CO1	Enable students to solve Aptitude questions of placement level with ease, as well as write effective essays.
Mode of Evaluation		
Assignments, Mock interviews, 3 Assessments with End Semester (Computer Based Test)		

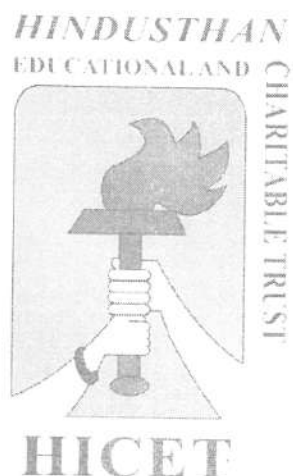
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HINDUSTHAN
COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore – 641032

DEPARTMENT OF CHEMICAL ENGINEERING
Revised Curriculum and Syllabus for the Batch 2020-2024
(Academic Council Meeting Held on 03.03.2023)

2019 REGULATIONS

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.TECH. CHEMICAL ENGINEERING (UG)

REGULATION-2019 (Revised on July 2021)

(For the students admitted during the academic year 2020-2024)

SEMESTER I

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1102	Calculus and Linear Algebra	BS	3	1	0	4	25	75	100
THEORY WITH LAB COMPONENT										
3	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	19CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6	19ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	19HE1001	Language Competency Enhancement Course-I	HS	0	0	2	1	0	100	100
MANDATORY COURSES										
8	19HE1072	Career Guidance Level – I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
Total :				14	2	12	20	350	450	800

As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course

SEMESTER II

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	25	75	100
3	19EE2103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
4	19CH2101	Principles of Chemical Engineering	ES	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19PH2151	Material Science	BS	2	0	2	3	50	50	100
6	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices	ES	0	0	4	2	50	50	100
8	19HE2001	Language Competency Enhancement Course-II	HS	0	0	2	1	0	100	100
MANDATORY COURSES										
9	19HE2072	Career Guidance Level – II Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE2073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total :				18	2	10	22	450	550	1000

SEMESTER III

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3103	Fourier Analysis and Numerical Methods	BS	3	1	0	4	25	75	100
2	19CH3201	Chemical Process Calculations	PC	3	1	0	4	25	75	100
3	19CH3202	Fluid Mechanics for Chemical Engineers	PC	3	0	0	3	25	75	100
4	19CH3203	Chemical Engineering Thermodynamics – I	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19CH3251	Analytical Instruments for Analysis	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19CH3001	Fluid Mechanics Lab	PC	0	0	3	1.5	50	50	100
7	19CH3002	Chemical Analysis Lab	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	19MC3191	Indian Constitution	AC	2	0	0	0	100	0	100
9	19HE3072	Career Guidance Level – III Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
Total				19	2	8	20	550	450	1000

SEMESTER IV

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH4201	Process Heat Transfer	PC	3	1	0	4	25	75	100
2	19CH4202	Mass Transfer – I	PC	3	0	0	3	25	75	100
3	19CH4203	Chemical Engineering Thermodynamics - II	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
4	19CH4251	Mechanical Operations	PC	3	0	2	4	50	50	100
5	19MA4153	Applied Probability Statistics	BS	3	0	2	4	50	50	100
PRACTICAL										
6	19CH4001	Heat Transfer Lab	PC	0	0	3	1.5	50	50	100
7	19CH4002	Petrochemical Analysis Lab	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	19AC4191	Essence of Indian tradition knowledge/Value Education	AC	2	0	0	0	100	0	100
9	19HE4072	Career Guidance Level – IV Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE4073	Ideation Skills	EEC	2	0	0	0	100	0	100
Total				21	1	10	21	575	425	1000

SEMESTER V

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH5201	Chemical Reaction Engineering – I	PC	3	1	0	4	25	75	100
2	19CH5202	Mass Transfer – II	PC	3	1	0	4	25	75	100
3	19CH5203	Process Instrumentation Dynamics and Control	PC	3	1	0	4	25	75	100
4	19CH5204	Safety in Chemical Industries	PC	3	0	0	3	25	75	100
5	19CH53XX	Professional Elective -I	PE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
6	19CH5251	Water Treatment and Solid Waste Management	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19CH5001	Mass Transfer Lab	PC	0	0	3	1.5	50	50	100
8	19CH5002	Process Control Lab	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	19HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
10	19HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
Total				19	3	8	26	475	525	1000

SEMESTER VI

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH6201	Chemical Reaction Engineering– II	PC	3	1	0	4	25	75	100
2	19CH6202	Chemical Process Industries	PC	3	0	0	3	25	75	100
3	19CH6181	Professional Ethics in Engineering	HS	3	0	0	3	25	75	100
4	19CH63XX	Professional Elective - II	PE	3	0	0	3	25	75	100
5	19XX64XX	Open Elective– I	OE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENTS										
6	19CH6251	Fluidization Engineering	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19CH6001	Chemical Reaction Engineering Lab	PC	0	0	4	2	50	50	100
MANDATORY COURSES										
8	19CH6701	Internship/Industrial Training/Skill Development Course (Minimum 3 weeks)	EEC	-	-	-	1	100	0	100
9	19HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	19HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
Total				19	1	6	24	525	475	1000

SEMESTER VII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH7201	Process Economics and Engineering Management	PC	3	0	0	3	25	75	100
2	19CH7202	Process Equipment Design	PC	3	1	0	4	25	75	100
3	19CH73XX	Professional Elective-III	PE	3	0	0	3	25	75	100
4	19XX74XX	Open Elective – II	OE	3	0	0	3	25	75	100
PRACTICALS										
5	19CH7001	Design and Simulation Lab	PC	0	0	3	1.5	50	50	100
6	19CH7002	Rubber Testing Lab	PC	0	0	3	1.5	50	50	100
PROJECT WORK										
7	19CH7901	Project Work – Phase I	EEC	0	0	4	2	50	50	100
Total				12	1	10	18	250	450	700

SEMESTER VIII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH83XX	Professional Elective –IV	PE	3	0	0	3	25	75	100
2	19CH83XX	Professional Elective- V	PE	3	0	0	3	25	75	100
PROJECT WORK										
3	19CH8901	Project Work – Phase II	EEC	0	0	16	8	100	100	200
Total				6	0	16	14	150	250	400

TOTAL NO OF CREDITS: 165

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	19CH5301	Energy Technology	PE	3	0	0	3	25	75	100
2	19CH5302	Petroleum Technology	PE	3	0	0	3	25	75	100
3	19CH5303	Electrochemical Engineering	PE	3	0	0	3	25	75	100
4	19CH5304	Polymer Technology	PE	3	0	0	3	25	75	100
5	19CH5305	Food Technology	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE II										
1	19CH6301	Petroleum Exploration and Exploitation Techniques	PE	3	0	0	3	25	75	100
2	19CH6302	Enzyme Engineering	PE	3	0	0	3	25	75	100
3	19CH6303	Fundamentals of Nano science	PE	3	0	0	3	25	75	100
4	19CH6304	Corrosion Science and Engineering	PE	3	0	0	3	25	75	100
5	19CH6305	Piping and Instrumentation	PE	3	0	0	3	25	75	100
6	19CH6306	Sugar Technology	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE III										
1	19CH7301	Natural Gas Engineering	PE	3	0	0	3	25	75	100
2	19CH7302	Pulp and Paper Technology	PE	3	0	0	3	25	75	100
3	19CH7303	Transport Phenomena	PE	3	0	0	3	25	75	100
4	19CH7304	Multicomponent Distillation	PE	3	0	0	3	25	75	100
5	19CH7305	Chemical Process Optimization	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE IV										
1	19CH8301	Industrial Management	PE	3	0	0	3	25	75	100
2	19CH8303	Total Quality Management	PE	3	0	0	3	25	75	100
3	19CH8304	Foundation Skills in Integrated Product Development	PE	3	0	0	3	25	75	100
4	19CH8305	Supply Chain Management	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE V										
1	19CH8306	Process Plant Utilities	PE	3	0	0	3	25	75	100
2	19CH8307	Fermentation Technology	PE	3	0	0	3	25	75	100
3	19CH8308	Frontiers of Chemical Technology	PE	3	0	0	3	25	75	100

4	19CH8309	Industrial Nanotechnology	PE	3	0	0	3	25	75	100
5	19CH8310	Drugs and Pharmaceutical Technology	PE	3	0	0	3	25	75	100
6	19CH8311	Membrane Separation Process	PE	3	0	0	3	25	75	100

*Students can replace the course in NPTEL platform by opting Membrane Technology (12 Weeks)

LIST OF OPEN ELECTIVES										
CHEMICAL ENGINEERING										
S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	19CH6401	Waste to Energy Conversion	OE	3	0	0	3	25	75	100
2	19CH7401	Biomass Conversion and Biorefinery	OE	3	0	0	3	25	75	100
LIFE SKILL COURSES										
3	19LSZ401	General Studies for Competitive Examinations	OE	3	0	0	3	25	75	100
4	19LSZ402	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	25	75	100
5	19LSZ403	Indian Ethos and Human Values	OE	3	0	0	3	25	75	100
6	19LSZ404	Indian Constitution and Political System	OE	3	0	0	3	25	75	100
7	19LSZ405	Yoga for Human Excellence	OE	3	0	0	3	25	75	100

(Note: Z Stands for semester, students can't choose twice the course)


ADDITIONAL CREDIT COURSE FOR CHEMICAL ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1.	19VACH01	Industrial Automation	VA	30 hrs	Internal	1
2.	19VACH02	Bulk Solid Handling for Chemical Engineers	VA	30 hrs	Internal	1
3.	19VACH03	Fundamentals of AI and it's Chemometric Applications	VA	30 hrs	Internal	1
4.	19VACH04	Introduction to Chemical Engineering MATLAB	VA	30 hrs	Internal	1
5.	19VACH05	IOT- Basics and Application in Unit Operations	VA	30 hrs	Internal	1

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	26	24	18	14	165

* Student can earn extra credit 35 over and above the total credits


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 COIMBATORE - 641 032

Programme B.Tech	Course Code 19CH5201	Name of the Course CHEMICAL REACTION ENGINEERING - I	L 3	T 1	P 0	C 4
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Course Objectives

- To enable the students to gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis.	12
II	Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, Equal sized CSTRs in series and parallel, Equal sized PFRs in series and parallel, size comparison of reactors.	12
III	Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.	12
IV	Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.	12
V	The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors	12
Total Instructional Hours		60

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the concept of rate equation and batch reactors.
 CO2- Understand the working of CSTR and PFR.
 CO3- Understand the design and working of multiple reactors.
 CO4- Understand the non-isothermal effect on reactors.
 CO5- Understand the concept of RTD in analyzing reactor performances.

TEXT BOOKS:


- Levenspiel O, "Chemical Reaction Engineering", Wiley Eastern Ltd., II Edition, 2000.
- Smith, J.M., "Chemical Engineering Kinetics", McGraw Hill, III Edition, 1981.

REFERENCES BOOKS:


- Froment. G.F. & K.B. Bischoff, "Chemical Reactor Analysis and Design", John Wiley and Sons, 1979.
- Fogler. H.S., "Elements of Chemical Reaction Engineering", Prentice Hall of India Ltd., 3rd Edition, 2000.
- Lanny D. Schmidt The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005
- L.K Doraiswamy, Deniz Uner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press, 2014.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5203	PROCESS INSTRUMENTATION DYNAMICS AND CONTROL	3	1	0	4

Course Objectives

- To introduce open and closed loop systems and its responses, control loop components and stability of control systems along with instrumentation.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INSTRUMENTATION: Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.	12
II	OPEN LOOP SYSTEMS: Laplace transformation and its application in process control. 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.	12
III	CLOSED LOOP SYSTEMS: 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, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.	12
IV	FREQUENCY RESPONSE: Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controllers Z-N tuning rules, C-C tuning rules.	12
V	ADVANCED CONTROL SCHEMES: Feedback control of systems with dead time and inverse response. Control systems with multiple loops. Advanced Control Schemes a) Feed forward b) ratio control. Control of distillation towers and heat exchangers.	12

Total Instructional Hours 60

Course Outcomes

Upon completion of the course, students can be able to

- CO1- Understand the classification of various process instruments.
- CO2- Understand the open loop systems in process control.
- CO3- Understand the closed loop systems in process control.
- CO4- Understand Frequency response of control systems and tune the PID controllers
- CO5- Understand the advanced control schemes and to control the equipment in chemical industries.

TEXT BOOKS:

- Coughnour, D., "Process Systems Analysis and Control", 3rd Edn., McGraw Hill, New York, 2008.
- Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2003.

REFERENCES BOOKS:


- Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Process dynamics and control I - 2nd ed. John Wiley & Sons, Inc.
- Marlin, T. E., "Process Control", 2nd Edn., McGraw Hill, New York, 2000.
- Ogunnaike, B. A., & Ray, W. H. (1994). Process dynamics, modeling, and control (Vol. 1). New York: Oxford University Press.
- Seborg, D. E., Mellichamp, D. A., Edgar, T. F., & Doyle III, F. J. (2010). Process dynamics and control. John Wiley & Sons.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3			2	2	2	2	2		3	3	3
CO2	3	3	3			2	2	2	2	2		3	3	3
CO3	3	3	3			2	2	2	2	2		3	3	3
CO4	3	3	3			2	2	2	2	2		3	3	3
CO5	3	3	3			2	2	2	2	2		3	3	3
AVG.	3	3	3	-	-	2	2	2	2	2	-	3	3	3


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5203	PROCESS INSTRUMENTATION DYNAMICS AND CONTROL	3	1	0	4

Course Objectives

- To introduce open and closed loop systems and its responses, control loop components and stability of control systems along with instrumentation.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INSTRUMENTATION: Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.	12
II	OPEN LOOP SYSTEMS: Laplace transformation and its application in process control. 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.	12
III	CLOSED LOOP SYSTEMS: 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, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.	12
IV	FREQUENCY RESPONSE: Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controllers Z-N tuning rules, C-C tuning rules.	12
V	ADVANCED CONTROL SCHEMES: Feedback control of systems with dead time and inverse response. Control systems with multiple loops. Advanced Control Schemes a) Feed forward b) ratio control. Control of distillation towers and heat exchangers.	12

Total Instructional Hours 60

Course Outcomes

Upon completion of the course, students can be able to

- CO1- Understand the classification of various process instruments.
- CO2- Understand the open loop systems in process control.
- CO3- Understand the closed loop systems in process control.
- CO4- Understand Frequency response of control systems and tune the PID controllers
- CO5- Understand the advanced control schemes and to control the equipment in chemical industries.

TEXT BOOKS:

- Coughnour, D., "Process Systems Analysis and Control", 3rd Edn., McGraw Hill, New York, 2008.
- Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2003.

REFERENCES BOOKS:

- Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Process dynamics and control I - 2nd ed. John Wiley & Sons, Inc.
- Marlin, T. E., "Process Control", 2nd Edn., McGraw Hill, New York, 2000.
- Ogunnaike, B. A., & Ray, W. H. (1994). Process dynamics, modeling, and control (Vol. 1). New York: Oxford University Press.
- Seborg, D. E., Mellichamp, D. A., Edgar, T. F., & Doyle III, F. J. (2010). Process dynamics and control. John Wiley & Sons.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	1	-	-	2	-	-	-	-	-	3	3
CO2	3	3	2	1	-	-	2	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	2	-	-	-	-	-	3	2
CO4	3	3	2	1	2	-	3	-	2	-	-	-	3	3
CO5	3	3	2	1	2	-	3	-	2	-	-	-	3	3
AVG.	3	3	2	1	2	-	2.4	-	2	-	-	-	3	2.6


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5204	SAFETY IN CHEMICAL INDUSTRIES	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> Educate Students about implementation of safety procedures, risk analysis and assessment, hazard identification 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Need for safety in chemical industries; Safety Programmes – components and realization; Types of hazards-chemical, physical, mechanical, ergonomics, biological and noise hazards, toxic chemicals; safe handling.	9
II	Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety.	9
III	Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.	9
IV	Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-VizagBopal analysis	9
V	Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.	9

Total Instructional Hours 45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the need for safety in chemical industries and operating conditions

CO2- Understand the Plant inspection, safe handling of chemicals

CO3- Understanding on risk management iso 14000, ems

CO4- Understand the hazard identification safety audits, checklist, what if analysis

CO5- Understand the vulnerability models event tree analysis fault tree analysis, hazan, hazop

TEXT BOOKS:

1. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
2. Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.

REFERENCES BOOKS:

1. Handley, W., "Industrial Safety Hand Book", 2nd Edn., McGraw-Hill Book Company, 1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGraw- Hill Book Co., 1980.
3. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5251	WATER TREATMENT AND SOLID WASTE MANAGEMENT	2	0	2	4

Course Objectives

- To focus on the types of pollution and the treatment technologies.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	WATER POLLUTION: Water as Resource, Drinking water quality, water consumption standards, Types of Water Pollutants and sources, State and central wastewater quality and its various discharge standards. Wastewater Sampling and Characteristics - Physical, Chemical and Biological characteristics of wastewater:	6+6
II	WASTEWATER TREATMENT: Preliminary/Primary/physical unit operations, Chemical unit processes, Secondary/Biological treatment process, aerobic/anaerobic attached and suspended growth process, Sludge treatment & Disposal.	6+3
III	TERTIARY/ADVANCED WASTEWATER TREATMENT: Ultrafiltration, Filtration, Adsorption on Activated Carbon, Ion Exchange, Reverse Osmosis, Electro dialysis cell. Wastewater treatment in Industries: Paper and Pulp, distillery, Leather, Food processing such dairy and fruit processing and Textile processing.	6+6
IV	RECENT TECHNOLOGIES IN WATER TREATMENT INDUSTRIES: Electro coagulation process in water and waste water treatment process. The Purpose of the Electro-Coagulation system is for the removal of Colour, Suspended solids, reduction of BOD, COD, and Hardness. Zero discharge process for waste water treatment plant. Acoustic nanotube, photocatalytic water purification, aquaporin, automatic variable filtration (AVF) technologies.	6
V	SOLID WASTE MANAGEMENT: Definition, types, sources, properties and impact of solid waste. Solid waste management techniques – solid waste management hierarchy, waste prevention and waste reduction techniques. Method of collecting, transportation storage and handling of solid waste.	6
Total Instructional Hours		45

Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1- Remember the types of water pollutants and sources.</p> <p>CO2- Understand the Primary/ Secondary/Biological treatment process of waste water.</p> <p>CO3- Understand the tertiary/advanced treatment process of waste water.</p> <p>CO4- Understand the sources of air and noise pollution and control techniques.</p> <p>CO5- Understand the types of solid waste, sources and solid waste management techniques.</p>
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TEXT BOOKS:

- Environmental Engineering by Howard S. Peavey, Donald R. Rowe, George Tchobanoglous, McGraw-Hill International Editions.
- Wastewater Engineering – Treatment, Disposal and Reuse, METCALF AND EDDY, INC. 3rd Edition Tata McGraw-Hill Publishing Company Limited.

REFERENCES BOOKS:

- C S Rao, Environmental Pollution Control Engineering, New Age International Publisher, 2011.
- M N. Rao, Air Pollution, Tata McGraw-Hill Publishing Company Limited.
- Waste water Engineering Treatment and Reuse: Mc Graw Hill, G. Tchobanoglous, FI Biston, 2002.
- Industrial Waste Water Management Treatment and Disposal by Waste Water Mc Graw Hill III Edition 2008.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	2	3	3	-	-	2	3	3	3
CO2	3	3	3	3	-	2	2	-	-	-	3	3	3	3
CO3	3	2	3	3	-	2	2	-	2	-	3	3	3	3
CO4	3	2	3	3	-	2	2	-	2	-	3	3	3	3
CO5	3	3	3	3	-	2	3	-	-	-	2	3	3	3
AVG.	3	2.6	2.8	2.8	-	2	2.4	3	2	-	2.6	3	3	3


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Programme B.Tech	Course Code 19CH5001	Name of the Course MASS TRANSFER LAB	L 0	T 0	P 3	C 1.5
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Course Objectives

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

S.No.	DESCRIPTION
1.	Separation of binary mixture using Steam distillation
2.	Separation of binary mixture using Packed column distillation
3.	Measurement of diffusivity
4.	Drying characteristics of Tray dryer
5.	Drying characteristics of Rotary dryer
6.	Water purification using ion exchange columns
7.	Mass transfer characteristics of Rotating disc contactor
8.	Estimation of mass/heat transfer coefficient for cooling tower
9.	Evaporation studies (Single effect)
10.	Evaporation studies (Multiple effect)
11.	Adsorption studies
12.	Liquid-liquid extraction studies
13.	Leaching studies
14.	Demonstration of Gas – Liquid absorption
15.	Vapor liquid equilibrium

Total Practical Hours 45

Upon completion of the course, students can be able to

Course Outcomes

- Understand the determination of important data for the design and operation of the process equipment like distillation, extraction, diffusivity and drying principles which are having wide applications in various industries.

REFERENCE BOOKS:


- McCabe W.L, Smith, J C and Harriot. P "Unit Operations in Chemical Engineering", McGraw Hill, VII Edition, 2005
- White, F.M., "Fluid Mechanics ", McGraw-Hill Inc., VII Edition, 2011.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5002	PROCESS CONTROL LAB	0	0	3	1.5

Course Objectives

- To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

S.No. DESCRIPTION

1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level system
4. Response of Interacting level system
5. Open loop study on a thermal system
6. Closed loop study on a level system
7. Closed loop study on a flow system
8. Closed loop study on a thermal system
9. Tuning of a level system
10. Tuning of a pressure system
11. Tuning of a thermal system
12. Flow co-efficient of control valves
13. Characteristics of different types of control valves
14. Closed loop study on a pressure system
15. Closed loop response of cascade control system

Total Practical Hours 45

Course Outcomes

Upon completion of the course, students can be able to

- Understand the development and use of right type of control dynamics for process control under different operative conditions.

REFERENCE BOOKS:

- Coughnower, D., "Process Systems Analysis and Control", 3rd Edn., McGraw Hill, New York, 2008.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	3		1	1	1	1		1	2	3
CO2	3	3	2	3	3		1	1	1	1		1	2	3
CO3	3	3	2	3	3		1	1	1	1		1	2	3
CO4	3	3	2	3	3		1	1	1	1		1	2	3
CO5	3	3	2	3	3		1	1	1	1		1	2	3
AVG.	3	3	2	3	3		1	1	1	1		1	2	3


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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	19HE5071	Soft Skills - I	1	0	0	1

Course Objectives:

- 1.To employ soft skills to enhance employability and ensure workplace and career success.
- 2.To enrich students' numerical ability of an individual and is available in technical flavor.
- 3.To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	Introduction to Soft Skills: Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self Management-Critical Thinking-Reflective thinking and writing- p2p Interaction	3
II	Art of Communication: Verbal Communication - Effective Communication - Active listening -Paraphrasing - Feedback - Non-Verbal Communication – Roles-Types- How nonverbal communication can go wrong- How to Improve nonverbal Communication - Importance of feelings in communication - dealing with feelings in communication.	4
III	World of Teams: Self Enhancement - importance of developing assertive skills- developing self-confidence – developing emotional intelligence - Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	3
IV	Quantitative Aptitude: Averages - Profit and loss - Partnerships - Time and work - Time, Speed and Distance - Problems based on trains - Problems based on boats and streams	3
V	Logical Reasoning: Clocks - Calendars - Direction Sense - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	2

Course Outcome:

CO1: Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.

CO2: Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others

CO3: Students will understand how teamwork can support leadership skills

CO4: Students will be able to make sense of problems, develop strategies to find solutions, and persevere in solving them.

CO5: Students will demonstrate an enhanced ability to draw logical conclusions and implications to solve logical problems.

REFERENCE BOOKS:

- R1: Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz
- R2: How to prepare for data interpretation for CAT by Arun Sharma.
- R3: How to Crack TEST OF REASONING in all competitive examinations by Jaikishan and Premkishan.
- R4: A New Approach To Reasoning Verbal & Non-Verbal By B.S. Sijwali
- R5: Quantitative Aptitude for Competitive Examinations - Dr. R.S. Aggarwal, S. Chand

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech.	19HE5072	DESIGN THINKING	1	0	0	1

OBJECTIVES:

Course Objective

- To expose students to the design process
- To develop and test innovative ideas through a rapid iteration cycle.
- To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
	DESIGN ABILITY	
I	Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	4
	DESIGNING TO WIN	
II	Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	4
	DESIGN TO PLEASE AND DESIGNING TOGETHER	
III	Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	4
	DESIGN EXPERTISE	
IV	Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	3
Total Instructional Hours		15

Course Outcome	Upon completion of the course, students will be able to CO1: Develop a strong understanding of the Design Process CO2: Learn to develop and test innovative ideas through a rapid iteration cycle. CO3: Develop teamwork and leadership skills
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TEXT BOOKS:

T1 - 1. Nigel Cross, "Design Thinking", Kindle Edition.

REFERENCE BOOKS:

R1 - Tom Kelley, "Creative Confidence", 2013.

R2 - 3. Tim Brown, "Change by Design", 2009.


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Programme B.Tech **Course Code** 19CH5301 **Name of the Course** ENERGY TECHNOLOGY

L **T** **P** **C**
3 0 0 3

Course Objectives
UNIT • Students will gain knowledge about different energy sources
DESCRIPTION

INSTRUCTIONAL HOURS

- | | | |
|-----|---|---|
| I | ENERGY: Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives. | 9 |
| II | CONVENTIONAL ENERGY: Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion. | 9 |
| III | NON-CONVENTIONAL ENERGY: Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy. | 9 |
| IV | BIOMASS ENERGY: Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification. | 9 |
| V | ENERGY CONSERVATION: Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit - Types methodology, reports, instruments. Benchmarking and energy performance, material and energy balance, thermal energy management. | 9 |

Total Instructional Hours 45

Course Outcomes
Upon completion of the course, students can be able to
CO1- Understand about the energy and its classification
CO2- Understand about the conventional energy resources and its production
CO3- Understand about non-conventional energy resources and its production
CO4- Understand about production of biomass energy
CO5- Understand about the energy conservation and management

TEXT BOOKS:

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Energy Management, Paul W.O'Callaghan McGraw – Hill, 1993

REFERENCE BOOKS:

1. Nejat Veziroglu, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Energy - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
4. Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5302	PETROLEUM TECHNOLOGY	3	0	0	3

Course Objectives

- To make the students understand petroleum engineering principles, their application to petroleum and natural gas manufacturing problems.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION: Refinery products – Refinery Feeds – Crude distillation – Coking and thermal process.	9
II	CATALYTIC CRACKING: Catalytic Cracking - Catalytical hydro cracking – Hydroprocessing and Reused processing hydro treating.	9
III	CATALYTICAL: Reforming and isomerization alkylation and polymerization – Product blending – Supporting processes.	9
IV	LUBRICATING: Lubricating oil blending stocks petrochemical feedstocks.	9
V	COST EVALUATION: Cost Evaluation – Economic evaluation of petroleum reused and refineries.	9
Total Instructional Hours		45

Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1- Understand the basic refinery products by unit operation and process</p> <p>CO2- Understand about the process of catalytic cracking and hydro treating for the production of petroleum products</p> <p>CO3- Understand about the catalytical process of petroleum products production</p> <p>CO4- Understand about the lubrication of petroleum feed stock</p> <p>CO5- Understand the cost evaluation process in petroleum refineries</p>
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TEXT BOOKS:

1. Petroleum Refining: Technology and economics CRC Press V Edition 2007 J.CH Garry, Hardward G.E and M.J.Kaiser.
2. Nelson, W. L., "Petroleum Refinery Engineering", 4th Edition., McGraw Hill, New York, 1985.

REFERENCE BOOKS:

1. Modern Petroleum Technology Upstream Vol I A.G. Lucas Hurley Edition 2002.
2. Wiseman. P., "Petrochemicals", UMIST Series in Science and Technology, John Wiley & Sons, 1986.
3. Bhaskara Rao, B. K. "A Text on Petrochemicals", 1st Edition, Khanna Publishers, New Delhi, 1987.
4. Bhaskara Rao, B. K., "Modern Petroleum Refining Processes", 2nd Edition, Oxford and IBH Publishing Company, New Delhi, 1990.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5303	ELECTROCHEMICAL ENGINEERING	3	0	0	3

Course Objectives

- Students will gain knowledge about electrochemical process and its application.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	REVIEW BASICS OF ELECTROCHEMISTRY: Faraday's law - Nernst potential -Galvanic cells - Polarography, The electrical double layer: 94It's role in electrochemical processes -Electrocapillary curve - Helmholtz layer - Guoy - Steven's layer - fields at the interface.	9
II	MASS TRANSFER IN ELECTROCHEMICAL SYSTEMS: Diffusion controlled electrochemical reaction - the importance of convention and the concept of limiting current. over potential, primary-secondary current distribution - rotating disc electrode.	9
III	Introduction to corrosion, series, corrosion theories derivation of potential-current relations of activities controlled and diffusion controlled corrosion process. Potential-pH diagram, Forms of corrosion- definition, factors and control methods of various forms of corrosion-corrosion control measures- industrial boiler water corrosion control - protective coatings -Vapor phase inhibitors - cathodic protection, sacrificial anodes - Paint removers.	9
IV	Electro deposition - electro refining - electroforming - electro polishing - anodizing - Selective solar coatings, Primary and secondary batteries - types of batteries, Fuel cells.	9
V	ELECTRODES USED IN DIFFERENT ELECTROCHEMICAL INDUSTRIES: Metals-Graphite - Lead dioxide - Titanium substrate insoluble electrodes - Iron oxide - semi conducting type etc. Metal finishing-cell design. types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical reactors.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the basic electrochemistry

CO2- Understand the diffusion transfer in electrochemical systems

CO3- Understand the corrosion formation and control measures

CO4- Understand the process of electro plating and fuel cells

CO5- Understand the various types of electrodes in electrochemical industries

TEXT BOOKS:

1. Picket, "Electrochemical Engineering", Prentice Hall. 1977.
2. Newman, J. S., "Electrochemical systems", Prentice Hall, 1973.

REFERENCE BOOKS:

1. Barak, M. and Stevenge, U. K., "Electrochemical Power Sources - Primary and Secondary Batteries" 1980.
2. Mantell, C., "Electrochemical Engineering", McGraw Hill, 1972.


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5304	POLYMER TECHNOLOGY	3	0	0	3

Course Objectives

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION: History of Macromolecules – structure of natural products like cellulose, rubber, proteins – concepts of macro molecules – Staudinger's theory of macromolecules – difference between simple organic molecules and macromolecules.	9
II	ADDITION POLYMERIZATION: Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals – monomers – functionality – Polymerization: Initiation – types of initiation – free radical polymerization – cationic polymerization – anionic polymerization – coordination polymerization – industrial polymerization – bulk, emulsion, suspension and solution polymerization techniques – Kinetics – Copolymerization concepts.	9
III	CONDENSATION POLYMERIZATION: Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation- Carother's equation – Linear polymers by polycondensation – Interfacial polymerization – crosslinked polymers by condensation – gel point.	9
IV	MOLECULAR WEIGHTS OF POLYMERS: Difference in molecular weights between simple molecules and polymers – number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering.	9
V	TRANSITIONS IN POLYMERS: First and second order transitions – Glass transition, T _g – multiple transitions in polymers – experimental study – significance of transition temperatures – crystallinity in polymers – effect of crystallization – in polymers – factors affecting crystallization crystal nucleation and growth – relationship between T _g and T _m – Relationship between properties and crystalline structure.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes

- CO1- Understand about the various macromolecules and its difference with organic molecules
- CO2- Understand about the initiation of addition polymerization and its types
- CO3- Understand about condensation polymerization reaction for polymer synthesis
- CO4- Understand the molecular distribution and the methods of determination
- CO5- Understand the transition in polymers and crystallization process

TEXT BOOKS:

1. Billmeyer.F.W., Jr, Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.
2. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, Wiley Eastern Ltd., 1988.

REFERENCE BOOKS:

1. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
2. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor and Francis.
3. Vishu Shah, Hand book of Plastics Testing and Failure Analysis, 3rd Edition, John-Wiley & Sons, New York, 2007.
4. Birley, Haworth, Batchelor, Physics of Plastics – Processing Properties and Materials Engineering, Hamer Publication, 1992.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH5305	FOOD TECHNOLOGY	3	0	0	3

Course Objectives

- To enable the students to learn to design processing equipments for Food Industries.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	AN OVERVIEW: General aspects of food industry; world food needs and Indian situation.	9
II	FOOD CONSTITUENTS, QUALITY AND DERIVATIVE: Constituents of food; quality and nutritive aspects; food additives; standards; deteriorative factors and their control.	9
III	GENERAL ENGINEERING ASPECTS AND PROCESSING: Preliminary processing methods; conversion and preservation operations.	9
IV	FOOD PRESERVATION METHODS: Preservation by heat and cold; dehydration; concentration; drying irradiation; microwave heating; sterilization and pasteurization; fermentation and pickling; packing methods.	9
V	PRODUCTION AND UTILISATION OF FOOD PRODUCTS: Cereal grains; pulses; vegetables; fruits; spices; fats and oils; bakery; confectionery and chocolate products; soft and alcoholic beverages; dairy products; meat; poultry and fish products.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

- CO1- Understand the basic and general aspects of food industry
- CO2- Understand the quality standards and control of food constituents
- CO3- Understand the preliminary and general methods of food processing
- CO4- Understand about the different food preservation methods
- CO5- Understand about the production of different food products and utilization

TEXT BOOKS:

1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, The AVI publishing Co., West port 1967.
2. Potter N.N., Food Science, The AVI publishing Co., Westport, 1963.

REFERENCE BOOKS:

1. Heldman D.R., Food Process Engineering, The AVI publishing co., 1975.
2. Charm S.E., The Fundamentals of Foods Engineering, The AVI Publishing Co., Westport, 1963.
3. Chakraverty, Amalendu, and Dhiren Sankar De. "Post harvest technology of cereals and pulses.1981.
4. Fellows, Peter John. Food processing technology: principles and practice. Elsevier, 2009.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
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CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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VI SEMESTER

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH6201	CHEMICAL REACTION ENGINEERING– II	3	0	0	4

Course Objective The student should be able

- To enable the students to learn the gas-solid catalytic and non-catalytic reactors and gas-liquid reactors.

Unit	Description	Instructional Hours
I	CATALYSTS: Nature of catalysts, surface area and pore-volume distribution, catalyst preparation.	12
II	HETEROGENEOUS REACTORS: Rate equations for heterogeneous reactions, adsorption isotherms, rates of adsorption and desorption, surface reaction analysis of rate equation and rate controlling steps.	12
III	GAS-SOLID CATALYTIC REACTORS: Diffusion within catalyst particle, effective thermal conductivity, mass and heat transfer within catalyst pellets, effectiveness factor, Thiele Modulus, fixed bed reactors.	12
IV	GAS-SOLID NON-CATALYTIC REACTORS: Models for explaining kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidized and static reactors.	12
V	GAS-LIQUID REACTORS: Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film, penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.	12
Total Instructional Hours		60
Course Outcome	CO1 Understand the nature, preparation and required properties of catalyst.	
	CO2 Apply the rate and isotherms studies of heterogeneous reactors.	
	CO3 Analyze the heat and mass transfer in gas-solid catalytic reactors.	
	CO4 Evaluate the rate kinetics and controlling steps in gas-solid non-catalytic reactors.	
	CO5 Estimate the mass transfer effects on gas-liquid reactors.	

TEXT BOOK:

- T1 Levenspiel O, "Chemical Reaction Engineering", Wiley Eastern Ltd., II Edition, 2000.
T2 Smith, J.M, "Chemical Engineering Kinetics", McGraw Hill, III Edition, 1981.

REFERENCES:

- R1 Froment. G.F. & K.B.Bischoff, "Chemical Reactor Analysis and Design", John Wiley and Sons, 1979.
R2 Fogler.H.S., "Elements of Chemical Reaction Engineering", Prentice Hall of India Ltd., 3rd Edition, 2000.
R3 Lanny D. Schmidh The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005
R4 L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press, 2014.


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CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH6202	CHEMICAL PROCESS INDUSTRIES	3	0	0	3

Course Objective

- The student should be able to
1. To impart knowledge on various aspects of production engineering and make the student understand the practical methods of production in a chemical factory.

Unit	Description	Instructional Hours
I	SULFUR, SULFURIC ACID AND CEMENT: Sulfur, Raw materials Sources, Mining and production of Sulfur – Sulfuric acid, Methods of production of Sulfuric acid – Contact process – Chamber process. Cement – properties of Cement – Methods of production – Overall factors for Cement industry.	9
II	FERTILIZER INDUSTRY: Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries - Phosphorus, Phosphoric acid, Super Phosphate – Potassium chloride, Potassium Sulphate.	9
III	PULP, PAPER, SUGAR AND STARCH INDUSTRIES: Pulp – Methods of production – Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production. Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivations.	9
IV	PETRO CHEMICAL INDUSTRIES: Petroleum – Chemical Composition, Classification of crude petroleum, Petroleum Refinery products – Petroleum Conversion processes – Pyrolysis and Cracking, Reforming Polymerization, isomerization and Alkylation – petrochemicals – methanol, chloro methanol, Acetylene and ethylene, Isopropanol, Acrylonitrile, Butadiene – Chemicals from Aromatics - Benzene, Toluene and Xylene.	9
V	FUEL AND INDUSTRIAL GASES: Fuel Gases – Producer gas, Water gas, Coke oven gas, Natural gas, Liquefied natural gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen.	9

Total Instructional Hours 45

Course Outcome	
CO1	Understand the various unit operations, chemical reactions involved in the production process of sulfur, sulfuric acid and cement
CO2	Illustrate the various unit operations, chemical reactions involved in the production process of fertilizers and its major components.
CO3	Determine the various unit operations, chemical reactions involved in the production process of pulp, paper, sugar and starch
CO4	Examine the various unit operations, chemical reactions involved in the production process of petroleum and petro chemical products
CO5	Sketch the various unit operations, chemical reactions involved in the production process of fuel and industrial gases.

TEXT BOOK:


- T1 Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.
T2 Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001.

REFERENCES:


- R1 Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.
R2 Srikumar Koyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd..


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH6251	FLUIDIZATION ENGINEERING	3	0	0	3
Course Objective	The student should be able to Learn the design aspects of fluidized beds.					

Unit	Description	Instructional Hours
I	BASICS OF FLUIDIZATION: Packed bed – Velocity – Pressure drop relations – Correlations of Ergun, Kozney karman – On set of fluidization – Properties of fluidized beds – Development of fluidization from fixed bed.	6+6
II	FLUIDIZED BED TYPES: Minimum fluidization conditions – Expanded bed – Elutriation – Moving solids and dilute phase – spouted bed.	6+6
III	DESIGN ASPECTS: Channeling – Bed expansion in liquid – Solid and gas – Solid fluidizations. Design aspects of fluidized bed systems.	6+3
IV	HEAT AND MASS TRANSFER IN FLUIDIZED BEDS: Heat and mass transfer in fluidized bed systems – Industrial applications and case studies of fluidized bed systems.	6
V	OTHER TYPES OF FLUIDIZATION: Single stage and multistage fluidization – Collection of fines – Use of cyclones.	6

Total Instructional Hours 30+15=45

Course Outcome	CO1	Understand the properties and basics of fluidization.
	CO2	Categorize the different types of fluidized beds based on different fluidization conditions.
	CO3	Illustrate the various design aspects of fluidized bed systems.
	CO4	Examine the effects of heat and mass transfer in fluidized beds.
	CO5	Compare the other types of fluidization for collection of fines.

TEXT BOOK:

- T1 Levenspiel, "Fluidization Engineering", 2nd Edition, Butterworth – Heinmann, 1991
T2 Leva, M., "Fluidization", McGraw Hill Book Co, 1959.

REFERENCES:

- R1 Rowe and Davidson, "Fluidization", Academic Press, 1971.
R2 Robert H. Perry and Don W. Green, "Perry's Chemical Engineer's Hand Book", 7th Edition, Mc Graw Hill – International, 1997.
R3 Wen-Ching Yang., "Handbook of Fluidization and Fluid-Particle Systems", Marcel Dekker Inc, 2003.



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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH	19CH6181	PROFESSIONAL ETHICS IN ENGINEERING	3	0	0	3

Course Objective	The student should be able to
1.	To enable the students to create an awareness on Engineering Ethics and Human Values, to in still Moral and Social Values and Loyalty and to appreciate the rights of others

Unit	Description	Instructional Hours
I	HUMAN VALUES: Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	9
II	ENGINEERING ETHICS: Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.	9
III	ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	9
IV	SAFETY, RESPONSIBILITIES AND RIGHTS: Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	9
V	GLOBAL ISSUES: Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.	9
	Total Instructional Hours	45
Course Outcome	CO1 Illustrate the importance of human values in the society. CO2 Understand the ethics in engineering and its theories. CO3 Examine how the engineers are experimenters in the society. CO4 Implement the safety, risk assessment and intellectual property rights. CO5 Highlight the various global issues and social responsibilities.	

TEXT BOOK:

- T1 Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
T2 Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

- R1 Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
R2 Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
R3 John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
R4 Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH6001	CHEMICAL REACTION ENGINEERING LAB	0	0	4	2

Course Objectives • To impart knowledge on design of reactors, Kinetics, Catalytic reactions.

S.No. **DESCRIPTION**

1. Kinetic studies in a Batch reactor.
2. Kinetic studies in a Semi Batch reactor.
3. Kinetic studies in a Plug flow reactor.
4. Kinetic studies in a CSTR.
5. Kinetic studies in a Packed bed reactor.
6. Combined reactor studies in a PFR and CSTR.
7. RTD studies in a PFR.
8. RTD studies in a Packed bed reactor.
9. RTD studies in a CSTR / CSTR in series.
10. Studies on micellar catalysis.
11. Study of temperature dependence of rate constant.
12. Kinetic studies in Sono chemical reactor.
13. Kinetics of photochemical reaction.
14. Demonstration of heterogeneous catalytic reaction.
15. Demonstration of gas-liquid reaction.

Total Practical Hours 45

Course Outcomes Upon completion of the course, students can be able to
• Get a sound working knowledge on different types of reactors.

REFERENCE BOOKS:


- McCabe W.L, Smith, J C and Harriot. P "Unit Operations in Chemical Engineering", McGraw Hill, VII Edition, 2005
- White, F.M., "Fluid Mechanics ", McGraw-Hill Inc., VII Edition, 2011.


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CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19HE6071	SOFT SKILL-II	1	0	0	1

The student should be able to

Course Objective	1.	To make the students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.
	2.	To learn everything from equations to probability with a completely different approach.
	3.	To make the students learn on an increased ability to explain the problem comprehensively.

Unit	Description	Instructional Hours
I	Group Discussion & Presentation Skills: GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback. - Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback	9
II	Interview Skills and Personality Skills: Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback - Interpersonal skills-creative thinking-problem solving-analytical skills	9
III	Business Etiquette & Ethics: Etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress. Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.	9
IV	Quantitative Aptitude: Permutation, Combination - Probability - Logarithm - Quadratic Equations - Algebra - Progression - Geometry - Mensuration.	9
V	Logical Reasoning: Logical Connectives - Syllogisms - Venn Diagrams – Cubes - Coded inequalities - Conditions and Grouping	9
Total Instructional Hours		45

Course Outcome	CO1	Students will have learnt to keep going according to plan, coping with the unfamiliar, managing disappointment and dealing with conflict.
	CO2	Students will Actively participate meetings, Group Discussions / interviews and prepare & deliver presentations
	CO3	Students will define professional behavior and suggest standards for appearance, actions and attitude in a business environment
	CO4	Students will be able to apply quantitative reasoning and mathematical analysis methodologies to understand and solve problems.
	CO5	Students will excel in complex reasoning.

REFERENCES:

- R1 Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent- Bruce Tulgan
R2 Quantitative Aptitude for Competitive Examinations (5th Edition) - Abhjit Guha
R3 How to crack test of Reasoning - Jaikishan and Premkishan
R4 The hand on guide to Analytical Reasoning and Logical Reasoning - Peeyush Bhardwaj

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19HE6072	INTELLECTUAL PROPERTY RIGHTS (IPR)	1	0	0	1

The student should be able to

Course Objective	1.	To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
	2.	To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
	3.	To disseminate knowledge on copyrights and its related rights and registration aspects.
	4.	To disseminate knowledge on trademarks and registration aspects.
	5.	To disseminate knowledge on Design, Geographical Indication (GI) and their registration aspects.

Unit	Description	Instructional Hours
	INTRODUCTION TO INTELLECTUAL PROPERTY	
I	Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.	3
	PATENTS	
II	Patents -Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application -Non -Patentable Subject Matter -Registration Procedure, Rights and Duties of Patentee, Assignment and license.	3
	COPYRIGHTS	
III	Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.	3
	TRADEMARKS	
IV	Concept of Trademarks -Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) -Non-Registrable Trademarks -Registration of Trademarks.	3
	DESIGN AND GEOGRAPHICAL INDICATION	
V	Design: meaning and concept of novel and original -Procedure for registration. Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration.	3

Total Instructional Hours 15

Course Outcome	CO1	Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.
	CO2	Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.
	CO3	Identify, apply and assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing.
	CO4	Identify different types of trademarks and procedure for registration
	CO5	Recognize the concept of design, geographical indication and procedure for registration

TEXT BOOK:

- T1 Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
- T2 V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt. Ltd, 2012.

REFERENCES:

- R1 Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
- R2 Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.


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PROFESSIONAL ELECTIVE

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH6301	PETROLEUM EXPLORATION AND EXPLOITATION TECHNIQUES	3	0	0	3

Course Objective	The student should be able to
1	To make the students understand the stages of oil and gas formation, exploration and production

Unit	Description	Instructional Hours
I	ORIGIN AND OCCURRENCE OF PETROLEUM AND SEDIMENTARY ENVIRONMENT: Origin of oil – Rock cycle - Important factors that control petroleum occurrence – Source, cap and reservoir rocks - Oil bearing rocks - Migration and accumulation - Continental environment – Transitional environment – Marine environment.	9
II	EXPLORATION METHODS, WELL PROGNOSIS AND ECONOMIC: Geological exploration methods – Geophysical exploration methods – Geochemical methods - Prognostication – Classification of drilling locations – Economic analysis – Well programme – Geotechnical order.	9
III	GEOLOGICAL STRUCTURE AND GEOLOGGING: Various traps and faults – Core Collection Techniques – Sample logging, Drilling time logging, Mud/Gas/Oil logging – Formation Evaluation Techniques using wire line well logging include – Spontaneous potential logging, Natural Gamma Ray Logging, Caliber Logging, Formation Density Logging, Neutron Porosity logging, Sonic velocity Logging, Electrical Resistance Logging, etc.	9
IV	DRILLING FLUIDS AND WORK COMPLETION: Drilling Technology - Drilling Fluids: Function, composition, and classification – Packer fluid – Casing packs – Cementing – Various well completion methods – Various stimulation methods.	9
V	OFF – SHORE TECHNOLOGY: Seismic technology – Sniffer survey – Drilling technology – Off-shore rigs – Primary, secondary and enhanced oil recovery techniques and methods – Major well complication and Remedies.	9
Total Instructional Hours		45
Course Outcome	CO1 Determine the origin and occurrence of petroleum CO2 Examine the various exploration methods and economic analysis of exploration CO3 Illustrate the process of various logging based on various geological structure CO4 Understand the process of drilling for well completion and different stimulation methods CO5 Sketch the process various off-shore technology oil recovery techniques	

TEXT BOOK:

- T1 Bhagwan Sahay "Petroleum Exploration and Exploitation Practices" Allied Publishers Ltd., Chennai, 1994.
- T2 Richard Dawe, "Modern Petroleum Technology", Vol.I, Upstream, 6th Edition, John and Wiley Sons Ltd, 2000.

REFERENCES:


- R1 Howard B. Bradley, "Petroleum Engineering Handbook", Society of Petroleum Engineers, 1987.
- R2 Norman J. Hyne., "Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production", 2nd Edition, Pennwell Books, 2001.
- R3 Shay B., "Wellsite Geological Techniques for Petroleum Exploration" Allied Publishers Ltd., 1991.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH6302	ENZYME ENGINEERING	3	0	0	3

Course Objectives

- To develop skills of the students in the area of Enzyme Engineering with emphasis on reactor operation and design.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	TYPES OF MICROORGANISM: Structure and function of microbial cells. Fundamentals of microbial growth, batch and continuous culture. Isolation and purification of enzymes from cells. Cell and Enzyme Immobilization.	9
II	FERMENTATION: Types of mechanisms, Continuous fermentation – aeration and agitation, kinetics of fermentation – Processes	9
III	INTRODUCTION OF BIOREACTOR DESIGN: Continuously stirred aerated tank bioreactors. Mixing power correlation. Determination of volumetric mass transfer rate of oxygen from air bubbles and effect of mechanical mixing and aeration on oxygen transfer rate, heat transfer and power.	9
IV	Introduction to Biochemistry, Function and applications. Nature and function of enzyme. Coenzyme / Cofactor. Classification of enzymes. Assay methods and units. Examples of applications of enzymes in industry, analytical technique medicine and Pharmaceuticals.	9
V	Industrial Bioreactors Utilizing Isolated enzymes and biosensors development and applications. Designs of reactor, Batch and continue type; analysis for immobilized enzyme reactors. Sterile and non sterile operations; reactors in series with and without recycle.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the types and structure of different microbial cells, its isolation, purification of enzymes and immobilizing both

CO2- Determine the fermentation operation and its kinetics

CO3- Illustrate the mixing, oxygen transfer methodology into the cells and power requirement for the design of bioreactor

CO4- Estimate the basic biochemistry related to enzymes, its assay techniques and enzyme applications

CO5- Remember the design of bioreactors under batch, continuous mode by the use of isolated enzymes

TEXT BOOKS:

1. Technological Applications of Bio-catalysts, BIOTOL series, Butter worth, 1995.
2. Cornish. A -Bowden, Analysis of Enzyme Kinetic Data, Oxford University Press, 1996.

REFERENCE BOOKS:


1. Wiseman. A and Blakeborough N and Dunnill P, Enzymic and nonenzymic catalysis, Ex. Vol.5 Ellis and Harwood, U.K. (1981).
2. Wiseman A (Ed.), Topics in enzyme and fermentation Bio-technology, Ellis and Harwood, U.K. Vol-5.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme B.Tech	Course Code 19CH6303	Name of the Course FUNDAMENTALS OF NANO SCIENCE	L 3	T 0	P 0	C 3
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Course Objectives • To learn about basis of nano material science, preparation method, types and application

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION: Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms- multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).	9
II	GENERAL METHODS OF PREPARATION: Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.	9
III	NANOMATERIALS: Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO ₂ , MgO, ZrO ₂ , NiO, nanoalumina, CaO, AgTiO ₂ , Ferrites, Nanoclays- functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.	9
IV	CHARACTERIZATION TECHNIQUES: X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.	9
V	APPLICATIONS: NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.	9

Total Instructional Hours 45

Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1- Understand the concept of nanoscience, implications of science and mathematics and the fundamental properties</p> <p>CO2- Determine the process of nanoparticle preparation methods in general</p> <p>CO3- Examine about the various nonmaterial's preparation, its properties and applications</p> <p>CO4- Remember about the various characterization techniques for the identification of nano size and structure</p> <p>CO5- Locate the application of nanotechnology in various fields</p>
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TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS:


1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH6304	Corrosion Science and Engineering	3	0	0	3

Course Objectives

- To provide an understanding of the corrosion principles and engineering methods used to minimize and prevent the corrosion. Basic concepts: Definition and importance, Electrochemical nature and forms of corrosion, Corrosion rate and its determination.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	CORROSION: Corrosion - Definition, classification, forms of corrosion, expressions for corrosion rate, emf and galvanic series, merits and demerits, Pourbaix diagram for iron, magnesium and aluminium - Forms of corrosion, Uniform, pitting, intergranular, stress corrosion - Corrosion fatigue - Dezincification - Erosion corrosion - Crevice corrosion - Cause and remedial measures, Pilling Bedworth ratio, High temperature oxidation.	9
II	BOILERS: Boiler water corrosion by carbon dioxide and unstable salts - Corrosion prevention methods by treatment cooling water, specification, types of scales and causes, use of antiscalant - Water treatments - Maintenance of boilers - Protection of boilers during off loading, high temperature, corrosion, turbine corrosion - Corrosion inhibitors, principles and practice, inhibitors for acidic neutral and other media - Corrosion failure - Inspection and analysis of corrosion damage.	9
III	CORROSION TESTING: Purpose of corrosion testing, classification, susceptibility tests for intergranular corrosion, stress corrosion test, salt spray test, humidity and porosity tests, accelerated weathering tests - ASTM standards for corrosion testing.	9
IV	POLARIZATION: Polarization - Exchange current density, Activation polarization, Tafel Equation, Passivating metals and nonpassivating metals, Effect of oxidizing agents.	9
V	ELECTROLESS PLATING AND ANODISING: Electroless plating and Anodizing - Cathodic protection, metallic, organic and inorganic coatings, corrosion inhibitors - Special surfacing processes - CVD and PVD processes, sputter coating - Laser and ion implantation, arc spray, plasma spray, flame spray, HVOF.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand about corrosion and its forms
CO2- Predict about to Protect boiler against corrosion
CO3-Examine various corrosion test and its ASTM standards
CO4- Sketch the Polarization and Effect of oxidizing agents on corrosion
CO5- Illustrate the Corrosion prevention methods and its applications.

TEXT BOOKS:

- Fontana and Greene., Corrosion Engineering, McGraw Hill Book Co, New York, 1983
- Raj Narayan ., An Introduction to Metallic Corrosion and its prevention, Oxford and IBH, New Delhi, 1983.

REFERENCE BOOKS:


- Budinski, K.G., Surface Engineering for Wear Resistance, Prentice Hall Inc., Engelwood Cliff, New Jersey, USA, 1988
- Uhlig, H.H ., Corrosion and Corrosion Control, John Wiley and Sons, New York, USA, 1985.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme B.Tech	Course Code 19CH6305	Name of the Course PIPING AND INSTRUMENTATION	L 3	T 0	P 0	C 3
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- Course Objectives**
- To impart knowledge on piping technology and instrumentation on pipelines.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	FUNDAMENTALS OF PIPING ENGINEERING: Definitions, Piping Components their introduction, applications. Piping MOC, Budget Codes and Standards, Fabrication and Installations of piping.	9
II	PIPE HYDRAULICS AND SIZING: Pipe sizing based on velocity and pressure drop consideration cost, least annual cost approach, pipe drawing basics, development of piping general arrangement drawing, dimensions and drawing of piping.	9
III	PLOT PLAN: Development of plot plan for different types of fluid storage, equipment layout, process piping layout, utility piping layout. Stress analysis - Different types of stresses and its impact on piping, methods of calculation, dynamic analysis, flexibility analysis.	9
IV	PIPING SUPPORT: Different types of support based on requirement and its calculation.	9
V	INSTRUMENTATION: Final Control Elements; measuring devices, instrumentation symbols introduction to process flow diagram (PFD) and piping & instrumentation diagram (P&ID).	9
Total Instructional Hours		45

- Course Outcomes**
- Upon completion of the course, students can be able to
- CO1- Understand about the basic piping engineering, its standards and installations
 - CO2- Illustrate the drawing, sizing and hydraulics study of pipe
 - CO3- Examine about the development of pipe layout, plot plan and equipment layout and its dynamic analysis
 - CO4- Determine the different types of piping support for various requirements
 - CO5- Remember about the process and instrumentation diagram and cost elements

TEXT BOOKS:

- Piping Handbook, 6 th edition, M.L. Nayyar, P.E., Mc Graw-Hill, Inc.
- Piping Design Handbook edited by Johan J McKetta, CRC Press, 1992.

REFERENCE BOOKS:

- Luyben, W. L., " Process Modeling Simulation and Control for Chemical Engineers, McGraw Hill, 1990.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH6306	SUGAR TECHNOLOGY	3	0	0	3

Course Objective The student should be able to

- 1 To study various technology in sugar production and have knowledge on unit operation in sugar industries

Unit	DESCRIPTION	Instructional Hours
	INTRODUCTION	
I	Sugar industry in India. Chemical and Physical properties of Sucrose and reducing sugars. Source for Sucrose. Formation of sucrose plants. Non sugar compounds of sugar cane. Inorganic constituents of sugar cane juices and sugars. Analytical methods used in Sugar Industry.	9
	PURIFICATION	
II	Chemical technology of the purification processes. Fundamental reactions and physical chemistry aspects of clarification. Liming, sulphitation and carbonation processes. Filtration of sugar juice.	9
	EVAPORATION	
III	Evaporation of sugar juice. Heat transfer in evaporators. Evaporation equipment and auxiliaries. Methods of obtaining steam and quality of steam. Steam economy. Chemistry of the evaporation process. Scale formation and cleaning of evaporators.	9
	CRYSTALLIZATION	
IV	Solubility of sucrose. Solubility of sucrose - nucleation in super saturated solutions - kinetics and growth of crystallization. Chemistry of crystallization. Control methods and equipment in sugar crystallization; Technology of sugar crystallization. Evaporation and circulation in vacuum pans.	9
	CENTRIFUGATION	
V	Theory of the centrifugal processes. Centrifugal operation. Engineering principles of sugar centrifugals and the centrifugal process. Centrifugal equipment and auxiliaries. Production of final molasses and its utilizations. Grading of sugar.	9
	Total Instructional Hours	45
Course Outcome	CO1 Understand about the sugar industries and analytical methods	
	CO2 Examine the purification methods	
	CO3 Determine the evaporation technique in sugar juice processing	
	CO4 Illustrate the crystallization technique in sugar juice processing	
	CO5 Remember the centrifugation technique in sugar juice processing	

TEXT BOOK:

- T1 Honig P., Principles of Sugar Technology, Vol.1,2 and 3, Elsevier Publishing Company, 1953.
T2 Van der Poel P.W., Schwartz T.K., Schiweck H.M., Sugar Technology [Beet and Cane Sugar Manufacture], Beet Sugar

REFERENCES:

- R1 Payne J.H., Sugarcane factory Analytical control, Fifth Edition, Elsevier Publisher, London, 1968.
R2 Jenkins G.H., Introduction to Sugarcane technology, Elsevier Publisher, London, 1966
R3 Hoing P., Principle of Sugar Cane Technology, Elsevier Publisher, London.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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OPEN ELECTIVE

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH6401	WASTE TO ENERGY CONVERSION	3	0	0	3

The student should be able to

- Course Objective**
- To provide students with the production of energy from different types of wastes through thermal, biological and chemical routes
 - It is intended to help the young scientific professionals to keep their knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of wastes for energy production.

Unit	DESCRIPTION	Instructional Hours
I	Introduction: Introduction to waste to energy conversion, characterization of wastes, Energy production from wastes through incineration, energy production through gasification of wastes	9
II	Pyrolysis: Energy production through pyrolysis and gasification of wastes, syngas utilization.	9
III	Densification of biomass and waste plastic blends: Densification of solids, efficiency improvement of power plant and energy production from waste plastics, Energy production from waste Plastic, gas cleanup.	9
IV	Energy production from waste: Energy production from organic wastes through anaerobic digestion and fermentation, introduction to microbial fuel cells	9
V	Cultivation of microalgae for biofuel production: Energy production from wastes through fermentation and trans esterification, Cultivation of algal biomass from wastewater and energy production from algae.	9

Total Instructional Hours 45


Course Outcome	CO1	CO2	CO3	CO4	CO5
	Understand to characterize the waste	Illustrate the pyrolysis and gasification process for energy production.	Examine the process of energy production from plastics	Remember about the energy production from organic waste	Calculate the Energy production from wastes through fermentation and trans esterification

TEXT BOOK:

- T1 Ashok K. Rathoure, Zero Waste: Management Practices for Environmental Sustainability, CRC Press, 2019, 1st Edition.
- T2 M. Habibur Rahman, Abdullah Al-Muyeed, Solid and Hazardous Waste Management, ITN-BUET, 2010

REFERENCES:


- R1 George Tchobanoglous, Frank Kreith Handbook of Solid Waste Management, McGRAW-HILL, 2002.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.TECH. CHEMICAL ENGINEERING (UG)

REGULATION-2019

(For the students admitted during the academic year 2019-2020)

SEMESTER I

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1102	Calculus and Linear Algebra	BS	3	1	0	4	25	75	100
THEORY WITH LAB COMPONENT										
3	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	19CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6	19ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	19HE1001	Language Competency Enhancement Course-I	HS	0	0	2	1	0	100	100
Total :				12	2	12	20	250	450	700
As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course										

SEMESTER II

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	25	75	100
3	19EE2103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
4	19CH2101	Principles of Chemical Engineering	ES	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19PH2151	Material Science	BS	2	0	2	3	50	50	100
6	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices	ES	0	0	4	2	50	50	100
8	19HE2001	Language Competency Enhancement Course-II	HS	0	0	2	1	0	100	100
Total :				15	2	10	22	250	550	800

SEMESTER III

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3103	Fourier Analysis and Numerical Methods	BS	3	1	0	4	25	75	100
2	19CH3201	Chemical Process Calculations	PC	3	1	0	4	25	75	100
3	19CH3202	Fluid Mechanics for Chemical Engineers	PC	3	0	0	3	25	75	100
4	19CH3203	Chemical Engineering Thermodynamics – I	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19CH3251	Analytical Instruments for Analysis	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19CH3001	Fluid Mechanics Lab	PC	0	0	3	1.5	50	50	100
7	19CH3002	Chemical Analysis Lab	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	19AC3191	Indian Constitution	AC	2	0	0	0	100	0	100
Total				16	2	8	20	350	450	800

SEMESTER IV

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH4201	Process Heat Transfer	PC	3	1	0	4	25	75	100
2	19CH4202	Mass Transfer – I	PC	3	0	0	3	25	75	100
3	19CH4203	Chemical Engineering Thermodynamics - II	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
4	19CH4251	Mechanical Operations	PC	3	0	2	4	50	50	100
5	19MA4153	Applied Probability Statistics	BS	3	0	2	4	50	50	100
PRACTICAL										
6	19CH4001	Heat Transfer Lab	PC	0	0	3	1.5	50	50	100
7	19CH4002	Petrochemical Analysis Lab	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	19AC4191	Essence of Indian tradition knowledge/Value Education	AC	2	0	0	0	100	0	100
Total				17	1	10	21	375	425	800

SEMESTER V

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH5201	Chemical Reaction Engineering – I	PC	3	1	0	4	25	75	100
2	19CH5202	Mass Transfer – II	PC	3	1	0	4	25	75	100
3	19CH5203	Process Instrumentation Dynamics and Control	PC	3	1	0	4	25	75	100
4	19CH5204	Safety in Chemical Industries	PC	3	0	0	3	25	75	100
5	19CH53XX	Professional Elective -I	PE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
6	19CH5251	Water Treatment and Solid Waste Management	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19CH5001	Mass Transfer Lab	PC	0	0	3	1.5	50	50	100
8	19CH5002	Process Control Lab	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	19HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
10	19HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
Total				19	3	8	26	475	525	1000

SEMESTER VI

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH6201	Chemical Reaction Engineering– II	PC	3	1	0	4	25	75	100
2	19CH6202	Chemical Process Industries	PC	3	0	0	3	25	75	100
3	19CH6181	Professional Ethics in Engineering	HS	3	0	0	3	25	75	100
4	19CH63XX	Professional Elective - II	PE	3	0	0	3	25	75	100
5	19XX64XX	Open Elective– I	OE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENTS										
6	19CH6251	Fluidization Engineering	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19CH6001	Chemical Reaction Engineering Lab	PC	0	0	4	2	50	50	100
MANDATORY COURSES										
8	19CH6701	Internship/Industrial Training/Skill Development Course (Minimum 3 weeks)	EEC	-	-	-	1	100	0	100
9	19HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	19HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
Total				19	1	6	24	525	475	1000

SEMESTER VII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH7201	Process Economics and Engineering Management	PC	3	0	0	3	25	75	100
2	19CH7202	Process Equipment Design	PC	3	1	0	4	25	75	100
3	19CH73XX	Professional Elective-III	PE	3	0	0	3	25	75	100
4	19XX74XX	Open Elective – II	OE	3	0	0	3	25	75	100
PRACTICALS										
5	19CH7001	Design and Simulation Lab	PC	0	0	3	1.5	50	50	100
6	19CH7002	Rubber Testing Lab	PC	0	0	3	1.5	50	50	100
PROJECT WORK										
7	19CH7901	Project Work – Phase I	EEC	0	0	4	2	50	50	100
Total				12	1	10	18	250	450	700

SEMESTER VIII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19CH83XX	Professional Elective –IV	PE	3	0	0	3	25	75	100
2	19CH83XX	Professional Elective- V	PE	3	0	0	3	25	75	100
PROJECT WORK										
3	19CH8901	Project Work – Phase II	EEC	0	0	16	8	100	100	200
Total				6	0	16	14	150	250	400

TOTAL NO OF CREDITS: 165

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	19CH5301	Energy Technology	PE	3	0	0	3	25	75	100
2	19CH5302	Petroleum Technology	PE	3	0	0	3	25	75	100
3	19CH5303	Electrochemical Engineering	PE	3	0	0	3	25	75	100
4	19CH5304	Polymer Technology	PE	3	0	0	3	25	75	100
5	19CH5305	Food Technology	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE II										
1	19CH6301	Petroleum Exploration and Exploitation Techniques	PE	3	0	0	3	25	75	100
2	19CH6302	Enzyme Engineering	PE	3	0	0	3	25	75	100
3	19CH6303	Fundamentals of Nano Science	PE	3	0	0	3	25	75	100
4	19CH6304	Corrosion Science and Engineering	PE	3	0	0	3	25	75	100
5	19CH6305	Piping and Instrumentation	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE III										
1	19CH7301	Natural Gas Engineering	PE	3	0	0	3	25	75	100
2	19CH7302	Pulp and Paper Technology	PE	3	0	0	3	25	75	100
3	19CH7303	Transport Phenomena	PE	3	0	0	3	25	75	100
4	19CH7304	Multicomponent Distillation	PE	3	0	0	3	25	75	100
5	19CH7305	Chemical Process Optimization	PE	3	0	0	3	25	75	100
6	19CH7306	Fundamentals and Testing of Rubber Compounds	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE IV										
1	19CH8301	Industrial Management	PE	3	0	0	3	25	75	100
2	19CH8302	Sugar Technology	PE	3	0	0	3	25	75	100
3	19CH8303	Total Quality Management	PE	3	0	0	3	25	75	100
4	19CH8304	Foundation Skills in Integrated Product Development	PE	3	0	0	3	25	75	100
5	19CH8305	Supply Chain Management	PE	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE V										
S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	19CH8306	Process Plant Utilities	PE	3	0	0	3	25	75	100
2	19CH8307	Fermentation Technology	PE	3	0	0	3	25	75	100
3	19CH8308	Frontiers of Chemical Technology	PE	3	0	0	3	25	75	100
4	19CH8309	Industrial Nanotechnology	PE	3	0	0	3	25	75	100
5	19CH8310	Drugs and Pharmaceutical Technology	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES

CHEMICAL ENGINEERING										
S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	19CH6401	Waste to Energy Conversion	OE	3	0	0	3	25	75	100
CHEMICAL ENGINEERING										
2	19CH7401	Biomass Conversion and Biorefinery	OE	3	0	0	3	25	75	100
LIFE SKILL COURSES										
3	19LSZ401	General Studies for Competitive Examinations	OE	3	0	0	3	25	75	100
4	19LSZ402	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	25	75	100
5	19LSZ403	Indian Ethos and Human Values	OE	3	0	0	3	25	75	100
6	19LSZ404	Indian Constitution and Political System	OE	3	0	0	3	25	75	100
7	19LSZ405	Yoga for Human Excellence	OE	3	0	0	3	25	75	100

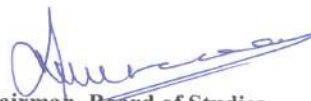
(Note: Z Stands for semester, students can't choose twice the course)


ADDITIONAL CREDIT COURSE FOR CHEMICAL ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1.	19VACH01	Industrial Automation	VA	30 hrs	Internal	1
2.	19VACH02	Bulk Solid Handling for Chemical Engineers	VA	30 hrs	Internal	1
3.	19VACH03	Fundamentals of AI and it's Chemometric Applications	VA	30 hrs	Internal	1
4.	19VACH04	Introduction to Chemical Engineering MATLAB	VA	30 hrs	Internal	1
5.	19VACH05	IOT- Basics and Application in Unit Operations	VA	30 hrs	Internal	1

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	26	24	18	14	165

* Student can earn extra credit 35 over and above the total credits


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Hindustan College Of Engineering & Technology
COIMBATORE - 641 032

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH17201	PROCESS ECONOMICS AND ENGINEERING MANAGEMENT	3	0	0	3

Course Objectives

- To enable the students to understand the various concepts of economics, process development, design consideration and cost estimation in chemical industry.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTEREST AND PLANT COST: Time value of money - equivalence, Depreciation, Depletion, estimation of capital cost, Capital requirement for complete plant, cost indices, capital recovery.	9
II	PROJECT PROFITABILITY AND FINANCIAL RATIOS: Estimation of project profitability, Investment alternatives, income statement and financial ratios, balance sheet preparation- problems.	9
III	ECONOMIC BALANCE IN EQUIPMENTS: Essentials of economic balance, economic balance in batch operations, cyclic operations, economic balance for insulation, evaporation, heat transfer equipments.	9
IV	PRINCIPLES OF MANAGEMENT: Principles of management, planning, organizing, staffing, coordinating, directing, controlling and communicating. Types of organizations, Management information systems (MIS).	9
V	PRODUCTION PLANNING CONTROL: Work measurement techniques, motion study, principles of time study, elements of production control, forecasting, planning, routing, scheduling, dispatching, inventory and control, role of control charts in production and quality control.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the capital cost and the value of money for the complete plant
CO2- Understand the profitability of the project and balance sheet preparation
CO3- Understand the economic operation of the equipment
CO4- Understand the planning and management
CO5- Understand the production planning, control chart preparation and quality control

TEXT BOOKS:


- Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 5th Edition, 2004.
- Schweyer, H.E, "Process Engineering Economics", Mc Graw Hill, 1969.

REFERENCE BOOKS:

- F.C. Jelen and J.H. Black, "Cost and Optimization Engineering", McGraw Hill, 3rd Edn., 1992
- Ahuja K.K, Industrial management, Khanna publishers, New Delhi, 1985.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1										3	2
CO2	3	3	3	2	2								3	2
CO3	3	2	3	2	1								3	2
CO4	3	3	3	2	2								3	2
CO5	3	3	3	3	2	2	1	1		1	-	3	3	
AVG.	3	2.6	2.6	2.2	1.7	2	1	1	-	1	-	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7203	PROCESS EQUIPMENT DESIGN	3	1	0	4
Course Objectives	<ul style="list-style-type: none"> Students learn to do in detail process and mechanical design and engineering drawing of different chemical engineering equipments. 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Design of Heat Exchanger: Types of Heat exchanger, Design of Double pipe heat exchanger, Shell and tube heat exchanger, Reboilers and Condensor.	12
II	Design of mass transfer equipments: Dryers, Crystallizers and Evaporators	12
III	Design of Separation processes: Design of Absorption Column, Distillation Column and Extraction Column	12
IV	Design of Reactors & pressure vessels: Design of Packed bed reactors, Storage vessels for solids, liquids and gases	12
V	Standards and Codes: Design of Plant Layout, BIS & ASTM Standards and Codes, Pipe line design, Materials of construction and selection of process equipments.	12
Total Instructional Hours		60

Upon completion of the course, students can be able to

Course Outcomes	CO1- Ability to Design the Heat Exchangers, Condensers.
	CO2- Ability to design the Dryers, crystallizer and Evaporators.
	CO3- Ability to design the Absorption column, Distillation Column, Extraction Column
	CO4- Ability to design the principles of Packed bed Reactors, Pressure Vessel and Storage Vessel
	CO5- Ability to understand the chemical process plant and provide solution for materials of construction.

TEXT BOOKS:

1. N. Anantharaman, K. M. Meera Sheriffa Begum "Mass Transfer- Theory and Practice", 1st Edition, Prentice Hall, New Delhi, 2011.
2. Coulson and Richardson's., "Chemical Engineering Design - Volume 6", Pergamon; 2nd edition, 1993.

REFERENCE BOOKS:


1. Gavahane.K., "Heat Transfer", Nirali Prakasan, Pune, 1996..
2. Green D. W., "Perry's Chemical Engineer's Handbook", 8th Edition McGraw Hill, 2007.
3. Dawande, S. D., "Process Design of Equipment", 4th Edition, Central Techno Publications, Nagpure, 2005.
3. N. Anantharaman, K. M. Meera Sheriffa Begum "Mass Transfer- Theory and Practice", 1st Edition, Prentice Hall, New Delhi, 2011.

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CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AG4702	QUALITY ANALYSIS IN RUBBER INDUSTRY	3	0	0	3

Course Objectives

- To prepare reports and documentations for lab tests, quality checks, identify and escalate the problem associated and to maintain health and safety measures

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	ANALYSIS OF TEST DATA: Outline the importance of test data analysis in Lab testing. Explain the concept of statistical analysis of test Data. Describe various types of errors in test data. Differentiate between accuracy and precision.	12
II	REPORTING AND DOCUMENTATION: Importance of reporting lab testing performance for a lab chemist. Listing the information given in a standard report for rubber lab testing. Documents used during lab testing process. Purpose of using work instructions for rubber lab testing.	9
III	CARRYING OUT QUALITY CHECKS: Importance of quality control in rubber lab. Need of equipment calibration for assuring accurate measurement. Basic concept of AQL (Acceptable Quality Level) for sample drawing process for product testing.	12
IV	PROBLEM IDENTIFICATION AND ESCALATION: Regular problems encountered during rubber lab testing, such as: Equipment maintenance issue, Chemical non-availability, Manpower non-availability, Quality issue in test chemicals, Quality issue in test carried out. Root cause analysis methods available to analyse the problem.	6
V	HEALTH ISSUES: Health and safety requirements for rubber product manufacturing process. Ill-effects of ingredients used in a rubber product manufacturing process.	6
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1: Understand the importance of reporting lab testing results.
 CO2: Understand the quality related concepts in rubber industry.
 CO3: Understand the problem encountered during rubber testing
 CO4: Understand the health issues in rubber product manufacturing process.
 CO5: Understand the handling of personal protective equipments in rubber industry

TEXT BOOKS:

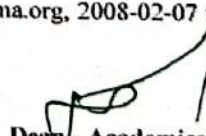
1. John S Dick, "Rubber Technology - Compounding and Testing for Performance", Hanser Publishers, Munich, 2001.
2. Brydson J.A., Rubber Chemistry, Allied science Publishers, London, 1978.
3. Morton.M., Rubber Technology, Chapman Hall, 1995.

REFERENCE BOOKS:


1. James L.White, "Rubber Processing" Hanser Publishers, 1995.
2. Anil K.Bhowmick et al," Rubber Products Manufacturing Technology", Marcel Dekker, 1994.
3. REACH Manual - Rubber Industry - ETRMA-European Tyre www.etrma.org, 2008-02-07 reach-rubber-industry-manual


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7306	Fundamentals and Testing Of Rubber Compounds	3	0	0	3

Course Objectives

- To enable the students to understand the various concepts of economics, process development, design consideration and cost estimation in chemical industry.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION TO RUBBER: Describe various stages of development of rubber. Explain current industrial scenario of rubber and its prospects in future. State the rubber consumption pattern in different sectors. List the source of different types of rubber. Describe usage of rubber for making different products.	12
II	PREPARING FOR LAB TESTING: Outline the importance of identification and traceability in lab testing. Describe tests requirement to carry out to physical properties test, such as: - Specify Gravity, - Volatile loss, - Moisture, - Ash Content, - Softening Point, - pH, etc	12
III	CONDUCTING TESTING OF RUBBER PRODUCTS: Explain testing required for compound ingredients. Describe the process of rubber compound test-Sample preparation. List requirements for sample preparation	12
IV	CHEMICAL ANALYSIS TEST : State formula for ash content calculation. Describe the process of volatile matter- Calculation for a compound. Recall the formula for nitrogen content- calculation.	5
V	PHYSICAL PROPERTIES TEST: Describe the process of testing physical properties of a rubber sample. Explain the importance of visual inspection of the rubber finished products.	4
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

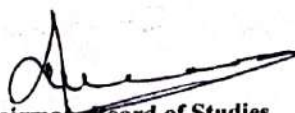
- CO1 Understand the principles of rubber properties
- CO2 Understand the methods of testing
- CO3 Remember the various rubber Compounds
- CO4 Understand the various test procedures
- CO5 Understand the various physical Properties

TEXT BOOKS:

- John S Dick, "Rubber Technology - Compounding and Testing for Performance", Hanser Publishers, Munich, 2001.
- Morton.M., Rubber Technology, Chapman Hall, 1995.

REFERENCE BOOKS:


- James L.White, "Rubber Processing" Hanser Publishers, 1995.
- Anil K.Bhowmick et al, "Rubber Products Manufacturing Technology", Marcel Dekker


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7002	RUBBER AND ITS PRODUCT TESTING LAB	0	0	3	1.5

- Course Objectives**
- The lab makes to
 - Understand various methods of identification analysis in rubber industry
 - 2. Study important methods of test analysis of in rubber industry
 - 3. Introduce rubber testing instruments.
 - 4. Infer the knowledge about pH meters.

S.No.	DESCRIPTION
1.	Identify the rubber products from the given product samples.
2.	Tell the source of rubber for given rubber raw material samples.
3.	Differentiate between the given rubber compounds
4.	Preparation of standard reagents for chemical testing.
5.	Demonstrate dilution of the concentrated solutions.
6.	Demonstrate the process of solution preparation
7.	Demonstrate the steps for specific gravity testing for the given compound sample.
8.	Demonstrate the procedure for viscosity testing of the given compound sample.
9.	Compute mean for the given data set.
10.	Compute standard deviation for the given data set.
11.	Determination of total solids contents in rubber compounds
12.	Determination of volatile matter, dirt, ash content in Rubber
13.	Rubber identification pyrolysis and spot test by specific reagents
14.	Studies on determination of tensile properties of given rubber
15.	Studies on determination of tear strength of given rubber sample.

Total Practical Hours **45**

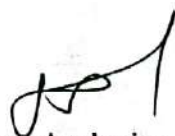
- Course Outcomes** Upon completion of the course, students can be able to
- Understand the common problems related to testing of rubber compounds.

REFERENCE BOOKS:


1. P.R.Freakley and A.R.Payne, Theory and Practice of Engineering with Rubber, Applied Science Publishers, London, 1970
2. P.B.Lindley, Engineering Design with Natural Rubber, Natural Rubber Producers Research Association, London, 1974.


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CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7001	DESIGN AND SIMULATION LAB	0	0	3	1.5

Course Objectives • To give the students an understanding the fundamentals concepts in mathematics, problems solving and computer programming.

S.No.	DESCRIPTION
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1. Equations of state using Newton's method.
2. Regression for parameter estimation using a set of data points.
3. Equilibrium flash distillation (Multicomponent Ideal).
4. Batch Reactor.
5. CSTR in Series Stage wise contacting equipment.
6. Solving a simple flow sheet by simultaneous approach.
7. Simulation of batch Distillation (binary ideal).
8. Gravity Flow Tank.
9. Heat Exchanger.
10. Plug Flow Reactor.
11. Absorber.
12. Drag coefficient of solid particle

Total Practical Hours	45
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Course Outcomes Upon completion of the course, students can be able to

- Understand the design and simulation concepts of various chemical engineering process equipment.

REFERENCE BOOKS:

1. Bequette. B.W, "Process Dynamics": Modelling, Analysis and Simulation," Prentice Hall (1998).
2. Himmelblau. D.M. and Bischoff. K.B, "Process Analysis and Simulation", Wiley, 1988.
3. Strang.G. ,"Introduction to Linear Algebra", Cambridge Press, 4th edition,2009.
4. William. Luyben, "Process Modelling, simulation and control for Chemical Engineers, 2nd Edn., McGraw Hill International Editions, New York, 1990.
5. Chapra.S.C. and Canale.R.P. "Numerical Methods for Engineers", McGraw Hill, 2001.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme B.Tech	Course Code 19CH7302	Name of the Course PULP AND PAPER TECHNOLOGY	L 3	T 0	P 0	C 3
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Course Objectives

- Focused on papermaking science and technology and is intended to be especially valuable to students majoring in programs leading to careers in corporate or government positions which would interface with the paper related industries.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION: Introduction Basic pulp and paper technology – Wood haves dry – Wood as a raw material.	9
II	WOODYARD OPERATION: Woodyard operation - Mechanical pulping – Chemical pulping – Secondary fibre pulp processing.	9
III	PAPER MACHINE: Paper Machine wet and addition paper machine dry and operation – Paper machine - Wet and operation.	9
IV	PAPER AND PAPERBOARD: Paper and paperboard frames and products – Surface treatments – Finishing operation– End uses.	9
V	PROPERTIES AND TESTING OF PULP AND PAPER: Properties and Testing of pulp and paper Process control – Quality assurance – Water and air pollution control.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the basic pulp and paper technology
 CO2- Understand about the mechanical and chemical pulping processes
 CO3- Understand about the wet and dry machines and operations for paper production
 CO4- Understand about the production of paper and paperboard
 CO5- Understand about the various properties and quality testing of pulp and paper and pollution control

TEXT BOOKS:

1. Pulp and paper chemistry and Technology Monica ER Monica, Goran Gellerstedt Gunnar Hennksson De Gneyter 2009.
2. Paper and Pulp Technology, K.P Rao, Oxford and Ibh Publishers 2003

REFERENCE BOOKS:

1. Modern Technology of Pulp, Paper and Paper Conversion Industries [NI104] by NIIR Board of Consultants and Engineers
2. Pulp & Paper - Chemistry & Chemical Technology, Second Edition Revised & Enlarged - Volumes I-iii, Casey, James P., Interscience Publishers, New York (1960)
3. Handbook of Pulp and Paper Technology, Second Edition Revised and Enlarged, Kenneth W. Britt, Van Nostrand Reinhold Co.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme B.Tech	Course Code 19CH7301	Name of the Course NATURAL GAS ENGINEERING	L 3	T 0	P 0	C 3
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Course Objectives

- Enable the students to learn the basic concept and applications of Natural Gas Engineering.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	NATURAL GAS TECHNOLOGY AND EARTH SCIENCE: Branches of petroleum industry. Sources of information for natural gas engineering and its applications. Geology and earth sciences; Earth sciences-Historical geology, Sedimentation process, Petroleum reservoirs, Origin of petroleum. Earth temperatures & pressure, Earth temperatures, Earth pressure. Petroleum: Natural gas, LP gas, Condensate, & Crude oil.	9
II	PROPERTIES OF NATURAL GASES: Typical compositions. Equations of state: general cubic equations, specific high accuracy equations. Use of equation of state to find residual energy properties, gas measurement gas hydrates, condensate stabilization, acid gas treating, gas dehydrations, compressors, process control deliverability test, gathering and transmission, and natural gas liquefaction.	9
III	GAS COMPRESSION: Positive displacement and centrifugal compressors; fans. Calculation of power requirements. Compressible Flow in Pipes: Fundamental equations of flow: continuity, momentum, energy equations.	9
IV	ISOTHERMAL FLOW IN PIPES: The Weymouth equation. Static and flowing bottom-hole pressures in wells. Fundamentals of Gas flow in porous media: Steady state flow equations. Definition of pseudo-pressure function. Gas flow in cylindrical reservoirs: general equation for radial flow of gases in symmetrical homogeneous reservoirs.	9
V	NON-DIMENSIONAL FORMS OF THE EQUATION: Derivation of coefficients relation dimensionless to real variables. Infinite reservoir solution: Pseudo-steady-state solution. Gas Well Deliverability Tests: Flow-after-flow tests: prediction of IPR curve and AOF for the well. Isochronal tests. Draw down tests: need for data at two flow rates.	9
Total Instructional Hours		45

Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1: Understand about the various sources of information for natural gas engineering and its applications</p> <p>CO2: Understand about the composition and various properties of natural gases</p> <p>CO3: Understand about the compression equipment and its analysis</p> <p>CO4: Understand about the fundamentals of gas flow in various conduits under constant thermodynamic property</p> <p>CO5: Understand about the non-dimensional forms of the equation for gas deliverability</p>
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TEXT BOOKS:

1. Katz D.L. et al., Natural Gas Engineering (Production & storage), McGraw-Hill, Singapore.

REFERENCE BOOKS:

1. Standard Handbook of Petroleum and Natural Gas Engineering. 2nd Edition. William C Lyons, Gary C Plisga. Gulf Professional Publishing.
2. Modern Petroleum Technology Upstream Vol I A.G. Lucas Hurley Edition 2002.

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CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7304	MULTICOMPONENT DISTILLATION	3	0	0	3

Course Objectives

- To understand the concepts of Multicomponent distillation systems.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	THERMODYNAMIC PRINCIPLES: Fundamental Thermodynamic principles involved in the calculation of vapor – liquid equilibria and enthalpies of multi component mixtures – Use of multiple equation of state for the calculation of K values – Estimation of the fugacity coefficients for the vapor phase of polar gas mixtures – calculation of liquid – phase activity coefficients.	9
II	THERMODYNAMIC PROPERTY EVALUATION: Fundamental principles involved in the separation of multi component mixtures – Determination of bubble-point and Dew Point Temperatures for multi component mixtures – equilibrium flash distillation calculations for multi component mixtures – separation of multi component mixtures at total reflux.	9
III	MINIMUM REFLUX RATIO FOR MCD SYSTEM: General considerations in the design of columns – Column sequencing – Heuristics for column sequencing – Key components – Distributed components – Non-Distributed components – Adjacent keys. Definition of minimum reflux ratio – calculation of R_m for multi component distillation Underwood method – Colburn method.	9
IV	VARIOUS METHODS OF MCD COLUMN DESIGN: Theta method of convergence – Kb method and the constant composition method – Application of the Theta method to complex columns and to system of columns – Lewis Matheson method – Stage and reflux requirements – Short cut methods and Simplified graphical procedures.	9
V	VARIOUS TYPES OF MCD COLUMNS: Design of sieve, bubble cap, valve trays and structured packing columns for multi component distillation – computation of plate efficiencies.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Remember and apply the important thermodynamic principles in multi component mixtures

CO2- Understand about the fundamental principles involved in the separation of multi component mixtures

CO3- Understand about Underwood method – Colburn method for the calculation of minimum reflux ratio

CO4- Understand about Theta method to complex columns and to system of columns – Lewis Matheson method for MCD column design

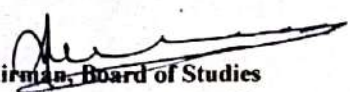
CO5- Understand about the design procedure of sieve, bubble cap, valve tray and packed columns

TEXT BOOKS:

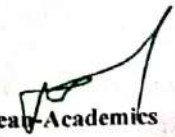
1. Holland, C.D., "Fundamentals of Multi Component Distillation", McGraw Hill Book Company, 1981.
2. Van Winkle, "Distillation Operations", McGraw Hill Publications, 1987.

REFERENCE BOOKS:


1. King, C.J., "Separation Process Principles", Mc Graw Publications, 1986.
2. Treybal, R.E., "Mass Transfer Operations", 5th Edition, Mc Graw Hill publications. 1996.
3. McCabe and Smith, J.C., Harriot, "Unit Operation of Chemical Engineering", 6th Edition, McGraw Hill, 2001.
4. Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley, 2006.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7303	TRANSPORT PHENOMENA	3	0	0	3

Course Objectives

- To develop a fundamental knowledge of the physical principles that govern the transport of momentum, energy and mass, with emphasis on the mathematical formulation of the conservation principles.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	TRANSPORT PHENOMENA BY MOLECULAR MOTION: Vectors/Tensors, Newton's law of viscosity, Newtonian & Non-Newtonian fluids, rheological models, Temperature, pressure and composition dependence of viscosity, Kinetic theory of viscosity, Fourier's law of heat conduction, Temperature, pressure and composition dependence of thermal conductivity, Kinetic theory of thermal conductivity, Fick's law of diffusion, Temperature, pressure and composition dependence of diffusivity, Kinetic theory of diffusivity.	9
II	ONE DIMENSIONAL MOMENTUM TRANSPORT: Shell Momentum balances, boundary conditions, velocity profiles, average velocity, momentum flux at the surfaces, of Newtonian and non-Newtonian for flow of a falling film, flow through circular tube, slits, flow through an Annulus, Adjacent flow of two Immiscible fluids. Equations of Change (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal) their applications in fluid flow problems.	9
III	ONE DIMENSIONAL HEAT TRANSPORT: Shell energy balances, boundary conditions, temperature profiles, average temperature, energy fluxes at surfaces for different types of heat sources such as electrical, nuclear viscous and chemical, Equations of change (non-isothermal), equation of motion for forced and free convection, equation of energy (non-isothermal).	9
IV	ONE DIMENSIONAL MASS TRANSPORT: Shell mass balances, boundary conditions, concentration profiles, average concentration, mass flux at surfaces for Diffusion through stagnant gas film, Diffusion with homogeneous and heterogeneous chemical reaction, Diffusion in to a falling liquid film, Diffusion and chemical reaction in porous catalyst and the effectiveness factor, equation of continuity for binary mixtures, equation of change to set up diffusion problems for simultaneous heat and mass transfer.	9
V	TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW: Turbulence phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. Introduction to macroscopic balances for isothermal flow systems, non-isothermal systems and multicomponent systems.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

- CO1- Understand about the fluid flow and molecular transfer mechanism
- CO2- Understand about the one dimensional momentum transport, its boundary condition and velocity profile
- CO3- Understand about the one dimensional heat transport, its boundary conditions and temperature profiles
- CO4- Understand about the one dimensional mass transport, its boundary conditions, concentration profiles
- CO5- Understand about the transport in turbulent and boundary layer flow

TEXT BOOKS:

1. R. B. Bird, W.E. Stewart, E.W. Lightfoot, Transport Phenomena, 2nd Revised Edition, John Wiley, 2007.
2. Brodkey, R. S., and Hershey, H. C., "Transport Phenomena", McGraw-Hill, 1988.

REFERENCE BOOKS:

1. C. J. Geankoplis, Transport Processes and Separation Process Principles, Prentice- Hall Inc., 4th Edition 2003.
2. Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1999.
3. C. O. Bennett, J. O. Myers, Momentum, Heat and Mass Transfer, 2nd International Student Edition McGraw Hill, 1983.
4. R. Welty, R.W. Wilson, and C.W. Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", 5th Edition, John Wiley, New York, 2007.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme B.Tech	Course Code 19CH7305	Name of the Course CHEMICAL PROCESS OPTIMIZATION	L 3	T 0	P 0	C 3
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Course Objectives

- Students will gain knowledge about process modeling and optimization

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION: Introduction to optimization; applications of optimization in chemical engineering; classification of optimization problems.	9
II	SINGLE VARIABLE OPTIMIZATION: Necessary and sufficient conditions for optimum; region elimination methods; interpolation methods; direct root methods.	9
III	MULTIVARIABLE OPTIMIZATION WITHOUT AND WITH CONSTRAINTS: Necessary and sufficient conditions for optimum; direct search methods; indirect search methods.	9
IV	OTHER OPTIMIZATION METHODS: Introduction to geometric, dynamic and integer programming and genetic algorithms.	9
V	APPLICATIONS OF OPTIMIZATION: Formulation of objective functions; fitting models to data; applications in fluid mechanics, heat transfer, mass transfer, reaction engineering, equipment design, resource allocation and inventory control.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the various classification of optimization process in chemical engineering

CO2- Understand the procedure for the determination of necessary and sufficient conditions for optimum

CO3- Understand the process multivariable optimization without and with constraints

CO4- Understand the basic concepts about geometric, dynamic and integer programming and genetic algorithms.

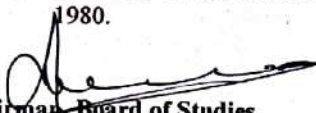
CO5- Understand the optimization application in fluid mechanics, heat transfer, mass transfer, reaction engineering, equipment design, resource allocation and inventory control

TEXT BOOKS:

1. Rao, S. S., Engineering Optimization - Theory and Practice, Third Edition, John Wiley & Sons, New York, 1996.
2. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes ", McGraw-Hill Book Co., New York, 2003.

REFERENCE BOOKS:


1. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimisation ", John Wiley, New York, 1980.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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VIII SEM SYLLABUS
FOR THE BATCH ADMITTED DURING THE
YEAR 2019-2020

**SEMESTER VIII
PROFESSIONAL ELECTIVE IV**

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH8301	INDUSTRIAL MANAGEMENT	3	0	0	3

Course Objective The student should be able to

1. To provide an opportunity to learn basic management concepts essential for business.

Unit	DESCRIPTION	Instructional Hours
I	INTRODUCTION: Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization - Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work - Share Holders - Board of Directors - Committees - Chief Executive -Trade Union.	9
II	FUNCTIONS OF MANAGEMENT: Planning - Nature and Purpose - Objectives - Strategies - Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization - Organizational culture, Staffing - selection and training - Placement - Performance appraisal - Career Strategy - Organizational Development. Leading - Managing human factor - Leadership - Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.	9
III	ORGANIZATIONAL BEHAVIOUR: Definition - Organization - Managerial Role and functions - Organizational approaches, Individual behaviour - causes - Environmental Effect - Behavior and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension - Need Theories - Process Theories - Job Satisfaction, Learning and Behavior - Learning Curves, Work Design and approaches.	9
IV	GROUP DYNAMICS: Group Behavior - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics - Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types - Causes - Conflict Resolution - Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures - Organizational Change and Development - Change Process - Resistance to Change - Culture and Ethics.	9
V	MODERN CONCEPTS: Management by Objectives (MBO), Management by Exception (MBE), Strategic Management - Planning for Future direction - SWOT Analysis - Information technology in management - Decisions support system - Business Process Re-engineering (BPR) - Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (ABM).	9
Total Instructional Hours		45
Course Outcome	CO1 Understand the definition for management, partnership, ownership, etc CO2 Illustrate the functions of management CO3 Determine the behavioral characteristics in the industry CO4 Apply the dynamic conflicts and its solution in a group CO5 Illustrate the various modern industrial management concepts	

TEXT BOOK:

- T1 Herald Knottz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill Education Pvt. Ltd., 2010.
T2 Stephen P. Robbins, "Organization Behaviour", Pearson Education Inc., 13 edition, 2010.

REFERENCES:

- R1 Ties, AF, Stoner and R.Edward Freeman, "Management" Prentice Hall of India Pvt. Ltd. New Delhi 110 011, 1992.
R2 Joseph J, Massie, "Essentials of Management" Prentice Hall of India Pvt. Ltd. 1985.
R3 Tripathi. P.C. & P.N. Reddy, "Principles of Management", Tata McGraw Hill, 2006.
R4 Ahuja K.K, Industrial management, Khanna publishers, New Delhi, 1985.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH8303	TOTAL QUALITY MANAGEMENT	3	0	0	3

Course The student should be able to

Objective 1 To facilitate the understanding of Quality Management principles and process

Unit	DESCRIPTION	Instructional Hours
I	INTRODUCTION: Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.	9
II	TQM PRINCIPLES: Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.	9
III	TQM TOOLS AND TECHNIQUES I: The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.	9
IV	TQM TOOLS AND TECHNIQUES II: Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.	9
V	QUALITY MANAGEMENT SYSTEM: Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001— Benefits of EMS.	9

Total Instructional Hours 45

Course Outcome	
CO1	Understand about quality management towards Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention
CO2	Examine about Quality Statements and principles in detail
CO3	Illustrate about the traditional tools like six sigma in TQM
CO4	Determine the Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function
CO5	Remember the quality management system

TEXT BOOK:

- T1 Dale H.Besterfield, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwarshie and Rashmi Urdhwarshie, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
- T2 Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

REFERENCES:

- R1 Joel.E. Ross, "Total Quality Management – Text and Cases", Routledge., 2017.
- R2 Kiran.D.R., "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
- R3 Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
- R4 Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.


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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH8307	FERMENTATION TECHNOLOGY	3	0	0	3

The student should be able to

Course Objective	1	To enable the students to understand the role of fermentation microorganisms and (bio) chemical activities and conversions that take place during fermentations, and their impact on quality
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Unit	DESCRIPTION	Instructional Hours
I	INTRODUCTION TO FERMENTATION PROCESSES: Microbial biomass – Microbial Enzymes – Microbial metabolites – Recombinant products – Transformation Process – Microbial growth kinetics – Isolation and preservation and improvement of industrially important micro organism.	9
II	INSTRUMENTATION AND CONTROL: Measurement of process variables – Temperature and its control – Flow measurement and control – Gases and Liquids – Pressure measurement and control – Online analysis – Control System – Combination of Control Systems – Computer application in fermentation technology.	9
III	RECOVERY AND PURIFICATION OF FERMENTATION PRODUCTS : Removal of Microbial cells – Foam Separation – Precipitation Filtration – Different Filtration process - Centrifugation – Different centrifuge cell description – Different methods – Solvent recovery – Superfluid extraction – Chromatography – Membrane processes – Drying – Crystallization – Whole growth processing.	9
IV	EFFLUENT TREATMENT: Strength of fermentation effluent – Treatment and disposal – Treatment Processes – Physical, chemical and biological – Aerobic process – Anaerobic treatment.	9
V	FERMENTATION ECONOMICS: Introduction – Isolation of micro organisms of industrial interest – Strain improvement – Market potential – Plant and equipment – Media – Air sterilization – Heating and cooling – Recovery costs.	9
Total Instructional Hours		45


Course Outcome	CO1	Remember the basic fundamental of microbial cells, enzymes and recombinant technology in fermentation processes
	CO2	Determine the various instrumental control techniques in fermentation operations
	CO3	Examine the various downstream operations in the fermentation process
	CO4	Understand the treatment of fermentation effluent use of physical, chemical and biological methods and its strength
	CO5	Calculate the economic production of fermented products and operation starts from upstream to downstream

TEXT BOOK:

- T1 Fermentation and Biochemical Engineering Handbook – C.C Haber. William Andrew II Edition 2007.
T2 Principles of fermentation Technology P.Stanbury Butterworth Hanman – 1999.

REFERENCES:

- R1 Bioprocess Engineering Hyderson B.K Nancy A.de la K.L.Nelsen Wiley Interscience, 1994.
R2 Bioprocess engineering principles, Pauline M. Doran, Academic Press.
R3 Biochemical Engineering, H.W. Blanch and D.S. Clark, Marcel Dekker, 1997.
R4 Shigeo Katoh, Jun-ichi Horiuchi and Fumitake Yoshida, "Biochemical Engineering", Wiley, 2015



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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH8304	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	3	0	0	3

Course Objective	The student should be able to
1	To get an idea about the global trends and the requirement of skills for integrated product development

Unit	DESCRIPTION	Instructional Hours
I	FUNDAMENTALS OF PRODUCT DEVELOPMENT: Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.	9
II	REQUIREMENTS AND SYSTEM DESIGN: Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.	9
III	DESIGN AND TESTING: Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation.	9
IV	SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT : Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal.	9
V	BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY: The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.	9
Total Instructional Hours		45
Course Outcome	CO1 Understand the global trends and development methodologies of various types of products and services	
	CO2 Determine the system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics	
	CO3 Illustrate the requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification	
	CO4 Examine the process of documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer	
	CO5 Remember the process of conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.	

TEXT BOOK:

- T1 John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.
T2 Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.

REFERENCES:

- R1 Hiriappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
R2 Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
R3 Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
R4 Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH8305	SUPPLY CHAIN MANAGEMENT	3	0	0	3

Course Objective	The student should be able to
1	To provide an insight on the fundamentals of supply chain networks, tools and techniques

Unit	DESCRIPTION	Instructional Hours
I	INTRODUCTION: Role of Logistics and Supply chain Management; Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.	9
II	SUPPLY CHAIN NETWORK DESIGN: Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.	9
III	LOGISTICS IN SUPPLY CHAIN: Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.	9
IV	SOURCING AND COORDINATION IN SUPPLY CHAIN: Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co- ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.	9
V	SUPPLY CHAIN AND INFORMATION TECHNOLOGY: The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain - E-Business in supply chain.	9

Total Instructional Hours 45

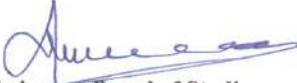
Course Outcome	
CO1	Understand about the role, scope, importance and evolution of supply chain
CO2	Examine the supply chain network design for network decisions
CO3	Illustrate the logistics in supply chain
CO4	Determine the sourcing and coordination in supply chain
CO5	Remember about the information technology in supply chain management and future

TEXT BOOK:

- T1 Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and operation", Pearson Education, 2010.
T2 Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI, 2010.

REFERENCES:

- R1 David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
R2 James B.Ayers, "Handbook of Supply chain management", St.Lucle press, 2000.
R3 Jeremy F.Shapiro, "Modeling the supply chain", Thomson Duxbury, 2002.



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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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PROFESSIONAL ELECTIVE V

Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19CH8306	PROCESS PLANT UTILITIES	3	0	0	3

Course Objective The student should be able to

- To enable the students to understand the process plant utilities and optimization techniques to optimize various parameters in chemical industries

Unit	DESCRIPTION	Instructional Hours
I	IMPORTANT OF UTILITIES: 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.	9
II	STEAM AND STEAM GENERATION: 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.	9
III	REFRIGERATION: Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluoro Methane, Chlorofluoro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.	9
IV	COMPRESSED AIR: 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.	9
V	FUEL AND WASTE DISPOSAL: Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas, Liquid Petroleum Fuels, Coal and Coke. Internal Combustion Engine, Petrol and Diesel Engine. Waste Disposal.	9

Total Instructional Hours 45

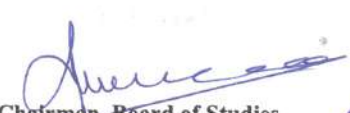
Course Outcome	CO1	Understand the importance of various utility operations such as Chemical Softening and Demineralization, Water Softening and Reverse Osmosis etc.,
	CO2	Determine the importance of steam and its generation, properties and steam production equipment
	CO3	Examine the various Refrigeration Cycles, different methods of Refrigeration used in Industry
	CO4	Remember the air compression, equipment used for Humidification, Dehumidification and Cooling Towers in the industries
	CO5	Calculate the types of Fuel used in Chemical Process Industries and the proper disposal of fuel waste

TEXT BOOKS:

- T1 Industrial Chemistry by Shashi Chawla, Dhanpat Rai and Sons Publication.
T2 P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi, 1986.
T3 Heat Transfer by D.S. Kumar.
T4 Fuel Furances and Refractories by O.P. Gupta, Khanna Publishers.

REFERENCES:

- R1 Perry R. H. Green D. W. "Perry's chemical Engineer's Handbook", McGraw Hill, New York, 2007.
R2 P. N. Ananthanarayan, "Basic Refrigeration & Air conditioning", Tata McGraw Hill, New Delhi, 2007.
R3 Plant Utilities by D.B. Dhone, NiraliPrakshan Publication.



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PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-		-	2	-	-	3	3	-
CO2	3	3	2	2	-	-		-	2	-	-	3	3	-
CO3	3	3	3	3	-	-		-	2	-	2	3	3	2
CO4	3	3	2	3	-	-	2	-	2	-	3	3	3	2
CO5	3	3	2	2	-	-	2	-	2	-	3	3	3	2
AVG.	3	3	2.2	2.4	-	-	2	-	2	-	2.7	3	3	2


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