HINDUSTHAN

COLLEGE OF ENGINEERING ANDTECHNOLOGY

(An Autonomous Institution)

Coimbatore– 641032

DEPARTMENT OF CHEMICAL ENGINEERING

CURRICULUM

(UNDER REGULATIONS 2022)

(Academic Council Meeting held on 03.03.2023)

Hindusthan College of Engineering and Technology

Approved by AICTE, New Delhi, Accredited with 'A' Grade by NAAC
(An Autonomous Institution, Affiliated to Anna University, Chennai)
Coimbatore – 641 032

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**

* 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.

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.

3. The above-mentioned NCC Courses will be offered to theStudents who are going to be admitted in the Academic Year 2021 – 22.

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 andVirtual Reality	OEC	2	0	2	4	3

OPENELECTIVE 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 PERWEEK			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 RefiningTechnology	RenewableEnergy 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 Sheeting	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 Sheeting	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. Analyseanddiscussthemaximaandminimaofthefunctionsofseveralvariables.
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
I	**Matrices** 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.	12
II	**Single Variate Calculus** Rolle's Theorem–Lagrange's Mean Value Theorem-Maxima and Minima–Taylor's and Maclaurin's Series.	12
III	**Functions of Several Variables** Partial derivatives-Total derivative, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.	12
IV	**Integral Calculus** 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.	12
V	**Vector Calculus** Gradient, divergence and curl; Green's theorem, Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
	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.ThomasandR.L.Finney,"CalculusandAnalyticalGeometry",9thEdition Addison Wesley Publishing company,2016.
T2:Erwin Kreyszig,"Advanced Engineering Mathematics",JohnWiley&Sons,2019.
T3:K.P.UmaandS.Padma,"Engineering MathematicsI(MatricesandCalculus) ",PearsonLtd,2022.

REFERENCEBOOKS:

R1-JerroldE.Marsden,AnthonyTromba,"VectorCalculus",W.H.Freeman,2003
R2-StraussM.J,G.L.Bradley and K.J.Smith,"Multivariable calculus",PrenticeHall,2002.
R3-VeerarajanT,"Engineering Mathematics",McGraw Hill Education(India)PvtLtd,NewDelhi,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 eventh appened 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.**PracticalComponent:Listening**-Listentosongsandanswerthequestions **Speaking-** Justaminute	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
	TotalInstructionalHours	**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 UniversityPress,2019.

REFERENCEBOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", OxfordUniversityPress, 2009.

R2-RaymondMurphy, "EnglishGrammarinUse"-4theditionCambridgeUniversityPress,2004.

R3-KamaleshSadanan"AFoundationCourseforTheSpeakersofTamil-Part-I&II",OrientBlackswan,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 EGINEERING	2	0	2	3

Course Objective

The student should be able to

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

Unit	Description	Instructional Hours
I	**LASER AND FIBRE OPTICS** 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.	6
	Determination of Wavelength and particle size using Laser	3
II	**PROPERTIES OF MATTER** 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
III	**WAVE OPTICS** 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.	6
	Determination of wavelength of mercury spectrum – spectrometer grating	3
	Determination of thickness of a thin wire – Air wedge method	3
IV	**QUANTUM PHYSICS** 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
V	**THERMAL PHYSICS** 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

Course Outcome

After completion of the course the learner will be able to

CO1: Understand the advanced technology of LASER and optical communication in the field of Engineering
CO2: Illustrate the fundamentalproperties 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, DhanpatRai 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 Delhi2016
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
Avg	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	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22IT1151	PYTHON PROGRAMMING AND PRACTICES	2	0	2	3

Course Objective

The learner should be able to

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

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).	5
	Illustrative problems: To find the Greatest Common Divisor (GCD)oftwo numbers, Fahrenheit to Celsius, Perform Matrix addition.	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;	5
	Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.	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.	5
	Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs	4
IV	**LISTS, TUPLES, DICTIONARIES**	5
	Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension.	
	Illustrative programs: List Manipulation, Finding Maximum in a List, String processing.	4
V	**FILES, MODULES, PACKAGES**	
	Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages	9
	Illustrative programs: Reading writing in a file, word count, Handling Exceptions	
	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 Pythonprogram 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. Mc-Graw Hill Education (India) Private Ltd. 2019

REFERENCE BOOKS:

R1:CharlesDierbach, —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 complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. TofacilitatethedevelopmentofaHolisticperspectiveamongstudentstowardslifeandprofession 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. TohighlightplausibleimplicationsofsuchaHolisticunderstandingintermsofethicalhuman 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
II6	**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	
III	**Harmony in the Family and Society** 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 RightEvaluation Understanding Harmony in the Society	6
IV	**Harmony in the Nature / Existence** 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 allpervasive spaceRealizing Existence as Co-existence at All LevelsThe 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 ValuesDefinitiveness 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 CaseStudiesStrategies 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'Manualfor*AFoundationCourseinHumanValuesandProfessionalEthics*,RRGaur, R Asthana,G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2

R3.JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, 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

CourseObjective

1. Sensitizationofstudenttowardsself,family(relationship),societyand nature
2. Understanding(ordevelopingclarity)ofnature,societyandlargersystems,onthebasisofhumanr elationshipsandresolvedindividuals
3. Strengtheningof self-reflection
4. Development of commitment and courage to act

Unit	Description	Instructional Hours
I	**BASICFEATURESANDFUNDAMENTALPRINCIPLES** Meaningoftheconstitutionlawandconstitutionalism–Historicalperspectiveoftheconstitutionofl ndia– salient features and characteristics of the constitution of India.	6
II	**FUNDAMENTALRIGHTS** 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	**PARLIAMENTARYFORMOFGOVERNMENT** 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
IV	**LOCALGOVERNANCE** 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
V	**INDIANSOCIETY** 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:Understandand abide the rules of the Indian constitution

TEXTBOOKS:

T1-DurgaDasBasu."Introduction to the Constitution of India",PrenticeHall of India, New Delhi.1997.T2-AgarwalRC.,"Indian Political System", S.Chand and Company, New Delni,1997.
T3-Macive r and Page,"Society:An Introduction Analysis",MacMilan IndiaLtd.,NewDelhi.
T4-SharmaKL., "Social Stratification in India: Issues and Themes", Jawah arlal NehruUniversity, NewDelhi,1997.

REFERENCEBOOKS:

R1-Sharma. Brij Kishore,"Introduction to the Constitution of India:,Prentice Hall of India, NewDelhi.R2-GahaiUR.,"Indian Political System",New Academic Publishing House, Jalaendhar.
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 acquiretheknowledgeandskillsneededtomanagethedevelopmentofinnovation.
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 seplans.
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 incritical 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 lforanewventure,includingcustomerneed,competitors,andindustryattractiveness..
CO5:Develop a business model for a new venture, including revenue. Margins, operations, Working capital, and investment

TEXTBOOKS

T1:AryaKumar"Entrepreneurship–Creating and leading an Entrepreneurial Organization",Pearson, Second Edition(2012).
T2:EmrahYayici"Design Thinking Methodology", Artbiztech,First Edition(2016).

REFERENCEBOOKS

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

WEBRESOURCES

W1:https://blof.forgeforward.in/tagged/startup-lessons
W2:https://blof.forgeforward.in/tagged/entrepreurship
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
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	**BOUNDARY VALUE PROBLEMS** Classification of PDE - Solutions of one-dimensional wave equation-One dimensional equation of heat conduction (excluding insulated edges).	12
III	**FOURIER TRANSFORMS** Fourier Transform Pair - Fourier sine and cosine transform Pair – Properties-Transforms of Simple functions – Convolution Theorem (Statement only).	12
IV	**LAPLACE TRANSFORM** Laplace transform–Basic properties –Transforms of derivatives and integrals of functions-Transform of periodicfunctions - Unit step function - Dirac delta function.	12
V	**INVERSE LAPLACE TRANSFORM** Inverse Laplace transform-Convolution theorem (with out proof) –Solution oflinear 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 GunavathyK.,"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

Course Objective

The student should be able

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
I	**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.	12
II	**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
III	**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
IV	**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
V	**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
	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
I	**CRYSTAL PHYSICS** 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
II	**ELECTRICAL PROPERTIES OF MATERIALS** 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
III	**SEMICONDUCTING MATERIALS** 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
IV	**MAGNETIC MATERIALS** 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
V	**NEW ENGINEERING MATERIALS** Metallic glasses: melt spinning process, Preparation and applications - shape memory alloys: phases, shape memory effect - Characteristics of SMA: Pseudoelastic effect, Super elasticity and Hystersis. 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 DIVERSIVE 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 & OPPORTUNITIUES**: 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
I	**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.	9+6=15
II	**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.**	9+2=11
III	**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.**	9+5=14
IV	**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.	9+2=11
V	**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.	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 ofcorrosion, 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 inengineering 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

Course Objective

The student should be able

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 Willams. "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
I	**DESIGN ABILITY** 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	6
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
IV	**DESIGN EXPERTISE** 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	6
V	**DESIGN THINKING TOOLS AND METHODS** 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 APPTITUDE I	1	0	0	1

Course Objective

The student should be able

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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GE3152 தமிழர் மரபு LTPC
1 0 0 1

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, ஒயிலாட்டம், 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, கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு 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. பொருநை – 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 ofArchaeology & 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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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

Course Objective

The student should be able

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
I	**SOCIAL SERVICES AND COMMUNITY DEVELOPMENT** 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
II	**DISASTER MANAGEMENT** Organization of Disaster management -Types of emergencies - Natural and manmade disasters - fire service and firefighting - prevention of fire.	3
III	**PERSONALITY DEVELOPMENT** Introduction to personality development - public speaking Intra and Inter personal skills -self-awareness - critical thinking - Decision making and problem solving.	3
IV	**MAP READING** 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
V	**PRINCIPLES OF FLIGHT AND AIRMANSHIP** 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	ESSENCEOF INDIAN TRADITIONAL KNOWLEDEGE	1	0	0	1

Course Objective

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.

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 CaseStudies.	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
COLLEGE OF ENGINEERING ANDTECHNOLOGY

(An Autonomous Institution)

Coimbatore– 641032

DEPARTMENT OF CHEMICAL ENGINEERING

CURRICULUM

(UNDER REGULATIONS 2022)

(Academic Council Meeting held on 19.06.2023)

HICET

Hindusthan College of Engineering and Technology

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DEPARTMENT OF CHEMICAL ENGINEERING

R2022

Sl. No	Course Code & Name	Existing Syllabus	Revised Content	Type of Revision (Deletion/Insertion/Modification)	% Revision
R2022					
1	**22CH3201-CHEMICAL PROCESS CALCULATIONS**	**UNIT-V-** Application of energy balances; Unsteady state material and energy balances; Solving material and energy balances using process simulators.	**UNIT-V-** Calorific value of fuels, Flue gas analysis, Orsat analysis, theoretical and excess air requirement for solid, liquid and gaseous fuels	**Insertion**	**20**
2	**22CH3202-FLUID FLOW OPERATIONS**	**UNIT-II-** 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.	**UNIT-II-** Looses in Pipes.	**Insertion**	**20**
		UNIT-III-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.	**UNIT-III-** Buoyancy, Condition of Equilibrium for Submerged and Floating Bodies, Centre of Buoyancy, Metacentre– Determination of Metacentric Height.		

		UNIT-V- 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.	**UNIT-V-** performance of multistage pumps - Cavitation - methods of prevention.		
3	**22CH3203-CHEMICAL ENGINEERING THERMODYNAMICS-I**	**UNIT-II-** PVT behaviour of fluids; Mathematical representation of PVT behavior; generalized compressibility factor correlation; generalized equations of state.	**UNIT-II-** Heat effect accompanying chemical reaction.	**Insertion**	**20**
		UNIT-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.	**UNIT-III-** heat pump, entropy balances for open system, Clausius Inequality		
		UNIT-IV- 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.	**UNIT-IV-** Fugacity and activity		
		UNIT-V- Duct flow of compressible fluids, Compression and expansion processes, steam power plant,internal combustion engines, jet and rocket engines.	**UNIT-V-** Gas-turbine power plant		

4	**22CH3251- MECHANICAL OPERATIONS**	**UNIT-I-** 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 actualscreens: **Sieve analysis.**	**UNIT-I-** Particle Shape, Size, Mixed Particle Sizes and Size Analysis – Cumulative and Differential Analysis.	**Insertion**	**20**
		UNIT-II- 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.**	**UNIT-II-** Principles of Comminution - Energy and Power requirements in Comminution - Mechanical Efficiency		

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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.	[illegible]	[illegible]	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	தமிழர் மரபு/ Heritage of Tamil	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	[illegible]	[illegible]	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	[illegible]	[illegible]	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	தமிழரும் தொழில்நுட்பமும் / TAMILS AND TECHNOLOGY	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											

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 andVirtual Reality	OEC	2	0	2	4	3

OPENELECTIVE 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 PERWEEK			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

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**

* 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.
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.
3. The above-mentioned NCC Courses will be offered to theStudents who are going to be admitted in the Academic Year 2021 – 22.

		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 RefiningTechnology	RenewableEnergy 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	22CH5601	Introduction to Chemical Process	MDC	3	0	0	3	3
2	22CH6601	Fluid Flow Operations in Chemical Engineering	MDC	3	0	0	3	3
3	22CH6602	Fundamentals of Chemical Thermodynamics	MDC	3	0	0	3	3
4	22CH7601	Process Heat and Mass Transfer	MDC	3	1	0	4	4
5	22CH7602	Reaction Engineering	MDC	3	0	0	3	3
6	22CH8601	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	22MBXXX	Financial Management	MDC	3	0	0	3	3
2	22MBXXX	Fundamentals of Investment	MDC	3	0	0	3	3
3	22MBXXX	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	22MBXXX	Introduction to Block chain and its Applications	MDC	3	0	0	3	3
5	22MBXXX	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	22MBXXX	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	22MBXXX	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	22MBXXX	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	22MBXXX	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	22MBXXX	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	22MBXXX	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	22MBXXX	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	22CEXXX	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	22AGXXX	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	22BMXXX	Sustainable Bio Materials	MDC	3	0	0	3	3
4	22MEXXX	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	22CEXXX	Green Technology	MDC	3	0	0	3	3
6	22CEXXX	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 Sheeting	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	22CH5205	Process Flow Sheeting	MDC	2	0	2	4	3
2	22CH6203	Transport Phenomena	MDC	3	1	0	3	4
3	22CH6204	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	22CH5206	Polymer Chemistry	MDC	3	0	0	3	3
2	22CH6205	Processing Technology	MDC	3	0	0	3	3
3	22CH6206	Rubber Technology	MDC	3	0	0	3	3
4	22CH7205	Polymer Product Design, Blends, and Alloys	MDC	3	0	0	3	3
5	22CH7206	Polymer Structure and property relationships	MDC	3	0	0	3	3
6	22CH8202	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	22CH5207	Petroleum Geology	MDC	3	0	0	3	3
2	22CH6207	Petroleum Exploration	MDC	3	0	0	3	3
3	22CH6208	Drilling Technology	MDC	3	0	0	3	3
4	22CH7207	Petroleum Production Engineering	MDC	3	0	0	3	3
5	22CH7208	Petroleum Reservoir Engineering	MDC	3	0	0	3	3
6	22CH8203	Offshore Engineering	MDC	3	0	0	3	3

B Tech (Hons) Chemical Engineering with Specialization in Instrumental Chemical Analysis

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CH5208	Principles of Mass Spectrometry	MDC	3	0	0	3	3
2	22CH6209	Advanced Analytical Separation Techniques	MDC	3	0	0	3	3
3	22CH6210	Advanced Spectrometry: ICP-MS and LC-MS	MDC	3	0	0	3	4
4	22CH7209	Instruments for Morphology and Structural Characterization	MDC	3	0	0	3	3
5	22CH7210	Statistical Analysis and Data Processing (Lab)	MDC	3	0	0	4	2
6	22CH8204	Troubleshooting Analytical Methods and Instruments	MDC	3	0	0	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
B.E/B.TECH	22MA3107	NUMERICAL METHODS (CHEM, FT)	3	1	0	4

Course Objective

The learner should be able to

1. Solve algebraic, transcendental and system of linear equations by using various techniques.
2. Analyze various methods to find the intermediate values for the given data.
3. Explain concepts of numerical differentiation and numerical integration of the unknown functions.
4. Explain single and multi step methods to solve Ordinary differential equations
5. Describe various methods to solve ordinary differential equations and partial differential equations.

Unit	Description	Instructional Hours
I	**SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** Solution of Algebraic and Transcendental equations: Newton Raphson method . Solution of linear system: Gauss Elimination - Gauss Jordan method -Gauss Seidel method. Matrix inversion by Gauss Jordan method.	12
II	**INTERPOLATION** Interpolation - Newton's forward and backward difference formulae – Newton's divided difference formula and Lagrangian interpolation for unequal intervals.	12
III	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Numerical 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 rule.	12
IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single step methods for solving first order equations: Taylor's series method – Euler and Modified Euler methods – Fourth order Runge-kutta method -Multi step method: Milne's predictor and corrector method.	12
V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Solution of second order ordinary differential equation by Finite difference method – Solution of partial differential equation: one dimensional heat equation by Bender schmidt method – One dimensional Wave equation by Explicit method– Two dimensional heat equation - Laplace Equation and Poisson Equations.	12
	Total Instructional Hours	60

Course Outcome

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

CO1: Solve the system of linear algebraic equations which extends its applications in the field of engineering

CO2: Apply various methods to find the intermediate values for the given data.

CO3: Identify various methods to perfrom numerical differentiation and integration

CO4: Classify and solve ordinary differential equations by using single and multi step methods.

CO5: Illustrate various methods to find the solution of ordinary and partial differential equations.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.

T2 - Grewal.B.S. " Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2012.

REFERENCE BOOKS :

R1 - M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Engineering Computation", Fifth Edition, New Age International publishers 2010.

R2 - Grewal B.S. and Grewal J.S. " Numerical Methods in Engineering and Science ", 6th Edition , Khanna publishers, New Delhi 2015.

R3 - S.K.Gupta, Numerical Methods for Engineers" , New Age International Pvt.Ltd Publishers,2015.

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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	Course Code	Name of the Course	L	T	P	C
B.TECH.	22CH3201	CHEMICAL PROCESS CALCULATIONS	3	1	0	4

Course Objective

The student should be able to

1. Formulate material balances to solve for compositions and flow rates of process streams
2. Incorporate single and multiple reactions into unit operations within chemical processes
3. Perform material and energy balance calculations in various systems

Unit	Description	Instructional Hours
I	**BASIC CHEMICAL CALCULATIONS:** Unit Conversion; Mole concept – Concept of normality, molarity, and molality – Density and specific gravity – Methods of expressing the composition of mixtures and solutions – Weight fraction – Mole fraction-Volumetric composition – Ideal gas law – Dalton"s law – Amagat"s law.	9+3
II	**MATERIAL BALANCE WITHOUT CHEMICAL REACTION:** Law of conservation of mass – Process flow sheet – Material balance calculations involving drying, dissolution, distillation, crystallization, evaporation, absorption and extraction.– Humidity and Saturation – Relative and percentage saturation, Wet bulb and dry bulb temperature, Dew point – Use of humidity chart for engineering calculations	9+3
III	**MATERIAL BALANCE WITH CHEMICAL REACTION:** Stoichiometric equation – stoichiometric ratio – limiting reactant – excess reactant – percent excess – conversion – yield.Bypass, Purging, Recycle operations.	9+3
IV	**ENERGY BALANCE:** Standard heat of formation – Standard heat of combustion – Standard heat of reaction – Hess"s law – Determination of heat of reaction at temperatures other than standard temperature using specific heat relationships – Calculation of theoretical flame temperature.	9+3
V	**COMBUSTION CALCULATIONS:** [redacted]	9+3
	Total Instructional Hours	45+15=60

Course Outcome

CO1	Understand the mole concept and ideal gas equation to express the composition of mixtures
CO2	Apply the method of solving steady state material balances without chemical reactions and usage of psychometric chart
CO3	Estimate the extent of reaction in material balances for systems involving chemical reactions
CO4	Inspect the energy balance and heat capacity calculations.
CO5	Calculate the calorific value of fuels using various methods.

TEXT BOOK:

T1 David M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 8thEdition, Prentice Hall of India, New Delhi, 2012

T2 Bhatt B.I. and Vora S.M., "Stoichiometry", 2nd Edition, Tata McGraw Hill, New Delhi,2004

T3 Narayanan K.V., Lakshmikutty B, Stoichiometry and Process calculations, Prentice Hall India Limited, New Delhi, 2006.

REFERENCES:

R1 Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, 2nd Edition, CBS publishers, 2004.

R2 Venkatramani. V, Anatharaman. N and Meera Shariffa Begam" Process Calculations" Printice Hall of India, New Delhi, 2nd Edn, 2011.

R3 Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes",3rd Edition, John Wiley & Sons, New York, 2005

R4 Reklaitis G. V., "Introduction to Material and Energy Balances", Wiley, New York, (1983).

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Course Code & Name: 22CH3201-CHEMICAL PROCESS CALCULATIONS

) & 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	3		1						2	2	1
CO2	3	3	3	3		1	1		1			2	2	1
CO3	3	3	3	3		1	1		1			2	2	1
CO4	3	3	3	3		1	1		1			2	2	1
CO5	3	3	3	3	1	1						1	1	1
AVG:	3	3	3	3	1	1	1	-	1	-	-	2.2	2.2	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	22CH3202	FLUID FLOW OPERATIONS	3	0	0	3

Course Objective

The student should be able to

1. Develop an understanding of the fundamental properties of fluids and their behavior in static conditions.
2. Familiarize students with the principles of fluid flow, including laminar and turbulent flow, flow equations, and flow measurement techniques.
3. Enable students to understand various flow metering techniques and their applications in fluid transportation.
4. Introduce students to the principles and selection criteria of hydraulic pumps, compressors, and air motors.

Unit	Description	Instructional Hours
I	**Fluid Properties and Statics:** Nature of fluids - properties of fluids; Types offluids- 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; [redacted] - 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. [redacted]	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. [redacted]	9
	Total Instructional Hours	45

Course Outcome

CO1	Demonstrate a comprehensive understanding of the properties and behavior of fluids in static conditions.
CO2	Analyze different types of flow, including laminar and turbulent flow, and apply the equation of continuity and Bernoulli's equation to solve flow-related problems.
CO3	Determine drag coefficients and pressure drops in fluidized and packed beds using appropriate equations and correlations.
CO4	Select and utilize different flow metering techniques for accurately measuring fluid flow rates.
CO5	Understand the principles and characteristics of hydraulic pumps, compressors, and air motors, and apply them in practical applications.

TEXT BOOK:

T1 McCabe W.L., Smith J.C. and Harriot P., — "Unit Operations in Chemical Engineering", 7 th Edition, McGraw Hill International Edition, New York, 2006.

T2 Bansal R.K., "Fluid Mechanics & Hydraulic Machines", Laxmi Publications, 2015.

REFERENCES:

R1 Cengel, Yunus and Cimbala John M, — "Fluid Mechanics Fundamentals and Applications", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2006.

R2 Munson B.R., Young D.F., Okiishi T.H. and Huebsch W.W., — "Fundamentals of Fluid Mechanics", 6th Edition, Wiley India, New Delhi, 2010.

R3 Noel de Nevers, "Fluid Mechanics for Chemical Engineers", 3rd Edition, McGrawHill, New York, 2004.

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Course Code & Name: 22CH3202-FLUID MECHANICS FOR CHEMICAL ENGINEERS

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	2	-	1	-	1	1	-	3	2
CO2	3	2	2	2	1	2	-	1	1	1	-	1	1	1
CO3	3	2	2	2	1	1	-	1	-	1	1	1	3	1
CO4	3	2	3	2	2	2	-	1	-	1	1	2	3	1
CO5	3	2	3	2	2	2	-	1	-	1	2	2	3	1
AVG.	**3**	**2.2**	**2.2**	**2**	**1.6**	**1.8**	**-**	**1**	**1**	**1**	**1.25**	**1.5**	**2.6**	**1.2**

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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 Objective

The student should be able to

1. Calculate and analyse the P-V-T behaviour of the gases using various equation of states and compressibility charts.
2. Determine the first and second law of thermodynamics and will learn to apply these to the solution of chemical engineering problems
3. Assess thermodynamic potential and the concept of Internal energy and enthalpy

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. [redacted]	9
III	**SECOND LAW OF THERMODYNAMICS** : Statements of the second law of thermodynamics, heat engine, [redacted] and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, [redacted] 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. [redacted]	9
V	**COMPRESSIBLE FLUID FLOW& STEAM ENGINES:** Duct flow of compressible fluids, Compression and expansion processes, steam power plant, internal combustion engines, [redacted] jet and rocket engines	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Remember the concepts of heat, work and energy.
CO2	Evaluate thermodynamic properties of pure substances with special emphasis on fluids
CO3	Solve the practical thermodynamic problems by applying first law and steady flow energy equation
CO4	Understand the fundamental thermodynamic properties.
CO5	Apply various methods of evaluating state properties to equipment commonly Encountered in chemical engineering processes, such as turbines, pumps, engines, and refrigeration units

TEXT BOOK:

T1 Smith, J.M., Van Ness, H.C and Abbot M.M "Introduction to Chemical Engineering Thermodynamics ", McGraw Hill Publishers, VI edition, 2003.

T2 Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004.

REFERENCES:

R1 Kyle, B.G., "Chemical and Process Thermodynamics III Edition", Prentice Hall of India Pvt. Ltd., 3rd edition, 2004.

R2 Elliott J.R., Lira, C.T., "Introductory Chemical Engineering Thermodynamics", Prentice Hall,Second Edition, 2011.

R3 Rao, Y.V.C., "Chemical Engineering Thermodynamics" Universities Press, 2005.

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Course Code & Name: 22CH3203-CHEMICAL ENGINEERING THERMODYNAMICS-I

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	3	2	3	1	--						1		1	1
CO2	3	2	3	1							1		1	1
CO3	3	2	3	1							1		1	1
CO4	3	2	3	1							1		1	1
CO5	3	2	3	1							1		1	1
AVG	**3**	**2**	**3**	**1**							**1**		**1**	**1**

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	22CH3251	MECHANICAL OPERATIONS	2	0	2	3

Course Objective

The student should be able to

1. Understand the basic information and the systematic diagrams of Unit operations involved in Chemical industries.
2. Apply the concepts of design, operation details and schematic of industrial equipment
3. Choose the right separation technology for easy separation of chemical components

Unit	Description	Instructional Hours
I	**INTRODUCTION TO PARTICULATE SOLIDS:** [redacted] -Various Mean Diameters – Screen Analysis Standard Screens – Various Industrial Screens. **Sieve analysis.**	6+3
II	**SIZE REDUCTION:** [redacted] -Laws of Crushing-Size Reduction Equipment – Crushers- Grinders Cutting Machines – Open and Closed Circuit Operation. **Reduction ratio in Jaw Crusher, Ballmill, Drop Weight Crusher.**	6+4
III	**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.**	6+4
IV	**FILTRATION:** Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipment - 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.**	6+4
V	**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.	6
	Total Instructional Hours	30+15=45

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	Estimating 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.

T3 Patil K.D., Mechanical Operations (Fundamental Principles and Applications), 3 rd ed.,Nirali Prakasam, India, 2012

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.

R4 Narayanan C.M., Bhattacharya B.C., Mechanical Operations for Chemical Engineers, 3rd ed., Khanna Publishers, India, 2011.

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Course Code & Name: 22CH3251-MECHANICAL OPERATIONS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO 1	PSO 2
CO1	3	3	3	3		1			1			2	2	1
CO2	3	3	3	3	1	1		1				2	2	1
CO3	3	3	3	3		1	1		1	1		1	2	1
CO4	3	3	3	3		1						2	1	1
CO5	3	3	3	3	1	1		1	1			1	2	1
AVG:	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**		**1.6**	**1.8**	**1**

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	22AC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

Course Objective

The student should be able to

1. Facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. Make the students understand the traditional knowledge and analyze it and apply it to their day to day life.
3. Impart basic principles of thought process, Itihas and Dharma Shasta and connecting society and nature
4. Uunderstand the concept of Intellectual and intellectual property rights with special Reference.

Unit	Description	Instructional Hours
I	**Introduction to traditional knowledge:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vs indigenous knowledge, traditional knowledge vs western knowledge	6
II	**Protection of traditional knowledge:** The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	6
III	**Itihas and Dharma-Shastra** **Itihas:** The Mahabharata - The Puranas - The Ramayana **Dharma-Shastra**: ***Manu Needhi*** - The Tirukkural– ThiruArutpa	6
IV	**Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	6
V	**Indian philosophy** Jain – Buddhist – Charvaka – Samkhya - Yoga - Nyaya - Vaisheshika- Saiva*Siddhanta*	6
	Total Instructional Hours	30

Course Outcome

CO1	Identify the concept of Traditional knowledge and its importance.
CO2	Explain the need and importance of protecting traditional knowledge.
CO3	Explain the need and importance of Itihas and Dharma Shastra.
CO4	Interpret the concepts of Intellectual property to protect the traditional knowledge.
CO5	Interpret the concepts of indian philosophy to protect the traditional knowledge.

REFERENCES:

R1 Traditional Knowledge System in India, by AmitJha, 2009

R2 Traditional Knowledge System in India by AmitJha Atlantic publishers, 2002.

R3 Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

R4 V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, BharatiyaVidya Bhavan, Mumbai, 5th Edition, 2014.

R5 V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, InernationalChinmay Foundation, Velliarnad, Amaku,am.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CH3001	**FLUID FLOW OPERATIONS LAB**	**0**	**0**	**4**	**2**

Course Objectives

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

S.No.	DESCRIPTION
1.	Determination of coefficient of discharge of the given Venturimeter
2.	Determination of coefficient of discharge of the given Orifice meter
3.	Find the calibration of V-notch
4.	Find the friction factor for the given straight pipe
5.	Determine the pressure drop through annular pipe
6.	Determine the critical Reynolds number and friction factor of a fluid flowing through spiral coil
7.	Determine the critical Reynolds number and friction factor of a fluid flowing through helical coil
8.	Find the performance characteristics of the given centrifugal pump and find the maximum efficiency of the pump
9.	Find the performance characteristics of the given reciprocating pump and find the maximum efficiency of the pump
10.	Determine the Pressure drop studies in packed bed using Ergun equation
11.	Determine the velocity- pressure drop relation from the given fluidized bed
	Total Practical Hours **45**

Upon completion of the course, students can be able to

CO1:Estimate the friction and measure the frictional losses in fluid flow.
CO2:Analyze the flow behavior of fluid flow in pipelines
CO3: Determine the fluid flow pressure drop in various equipment.
CO4:Examine the efficiency of various instruments
CO5:Understand the properties of fluids in different process

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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Course Code & Name: 22CH3001-FLUID MECHANICS LAB

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	-	2	1	1	2	-	3	-	-	2	-	2
CO2	3	-	2	1	2	1	2	-	3	-	-	2	-	2
CO3	3	2	-	2	1	1	2	-	2	2	-	2	1	1
CO4	3	2	-	2	1	1	1	-	3	2	-	2	2	1
CO5	3	2	-	2	1	1	1	-	2	1	-	2	2	1
AVG	3	2	-	2	1	1	1.6	-	2.4	1.8	-	2	1.8	1.4

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CH3002	TECHNICAL ANALYSIS LAB	0	0	4	2

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, Petroleum products and Phenol.

S.No.	DESCRIPTION
1.	Determine the Viscosity of the Given oil (Saybolt Viscometer)
2.	Determine the Viscosity of the Given oil (Redwood Viscometer)
3.	Estimation of Flash and Fire Point of the Given Sample (Pensky Martens Closed Cup Method)
4.	Estimation of Flash and Fire Point of the Given Sample (Cleveland Open Cup Apparatus)
5.	Estimation of Cloud and Pour Point of the Given Sample
6.	Estimation of Acid Value of Given oil Sample (Analysis of Oil)
7.	Estimate the Proximate Analysis of the Given Sample of Coal
8.	Estimation of Total Fatty Matter Content in the given sample
9.	Determination of calorific value of fuels using bomb calorimeter.
10.	Flue gas Analysis – Orsat Apparatus.
11.	Determination of Aromatic Content in the given oil sample.

Total Instructional Hours 45

Course Outcomes

Upon completion of the course, students can be able to

CO1: Acquire knowledge through carry out experiments about physical and chemical characterization of petrochemical products and apply knowledge in industries.
CO2: Analyze the properties of various petroleum products.
CO3: Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.
CO4: Understand the importance and quality of various petroleum products.
CO5: Apply the knowledge of Engineering principles in practice.

REFERENCE BOOKS:

1 Text book of quantitative chemical analysis, J.Mendham, Pearson education 2008.
2 Manual of environmental analysis, N.C Aery, Ane books.2010.
3 Text book of quantitative chemical analysis, J.Mendham, Pearson education 2008.
4 Bhaskar Rao, B.K., "A Text on Petrochemicals", Khanna Publishers, 2000.

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Course Code & Name: 22CH3002-TECHNICAL ANALYSIS LAB

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		2	1	1	2		3	2		2	2	2
CO2	3	2		2	1	1	2		2	2		2	2	2
CO3	3	2		2	1	1	2		2	2		2	1	1
CO4	3	2		2	1	1	1		3	2		2	2	1
CO5	3	2		2	1	1	1		2	1		2	2	1
AVG	3	2		2	1	1	1.6		2.4	1.8		2	1.8	1.4

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Programme	Name of the Course	L	T	P	C	TCP
B.E	22ME3253-BASIC MECHANICAL ENGINEERING	2	0	2	3	4

Course Objective

1. To understand the manufacturing process of metal components.
2. To explore the machine tools and its operation.
3. To understand the mechanisms and relative motions.
4. To learn the thermodynamic process, gas power cycles and Applications.
5. To learn the basic operations and working principles of Hydraulic and pneumatic systems.

Unit	Description	Instructional Hours
I	**Manufacturing Processes** Casting - Sand Mould – Type of patterns - Pattern Materials – Pattern allowances -Moulding machines. Metal Forming Processes: Hot working and cold working of metals - Forging processes. Welding: Basic types and its principles - Sheet Metal Forming Processes-characteristics and operations.	6
II	**Machine Tools** Lathe: Types, Operations, Working Principle; Nomenclature of Cutting Tool – Milling Machines - Types and Working Principle; Drilling machine: Operations and Working Principle - Grinding Machine - Operations, CNC Machines. ***Machining operation using lathe and milling machines.***	6+3
III	**Theory of Machines** Links - Pairs - Chain - Mechanism - Machine structure - Degrees of freedom - Four bar chain. Inversion of mechanisms - Four bar, single slider crank and double slider crank mechanisms. Vibration – Types, Governors and Gyroscopes. ***Understand the concepts on Governors and Gyroscope.***	6+6
IV	**Thermal Engineering** Gas Power Cycles: Otto and Diesel cycles: Internal Combustion Engines: Classification, Components and working principle. Boilers: Classification and working principle; Refrigeration: Vapour Compression and Vapour Absorption system: Types and Applications. ***Performance Test on four stroke Diesel Engine and compressors.***	6+6
V	**Hydraulics & Pneumatics** Fluid power and its Applications - Fluid power systems - Properties and selection of fluids -Accessories and controls. Pneumatics: Properties of air – Fans and Blowers - Compressors – Accessories and controls.	6
	Total Instructional Hours	**30+15=45**

Course Outcome

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

CO1: Understand various manufacturing process.

CO2: Gain knowledge in various machine tools and machining process.

CO3: Classify mechanisms and inversions and determine mobility of a mechanism.

CO4: Learn the basics of thermal power cycles and its Applications.

CO5: understand the basics of Hydraulic and Pneumatic tools and Equipment.

TEXT BOOKS:

T1 - Hajra Choudhary S.K and Hajra Choudhury. AK, "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997.

T2 -Ratan.S.S, "Theory of Machines", Tata McGraw Hill Publishing company Ltd., 2nd Edition, 2005.

T3 -Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000 Third edition, 2015.

REFERENCE BOOKS:

R1 -Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2004.

R2- Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000.

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Programme/sem	Course Code	Name of the Course	L	T	P	C
B.Tech	22MA4151	PROBABILITY, STATISTICS WITH R PROGRAMMING (COMMON TO AERO, CHEM)	2	0	1	3

Course Objective

1. To construct a well-defined knowledge of Probability.
2. To interpret measures of central tendency, dispersion, and association.
3. To introduce Correlation concepts to understand the relation between two random variables.
4. To describe some basic concepts of statistical methods for testing the hypothesis.
5. To educate the design of experiment techniques to solve various engineering problems.

Unit	Description	Instructional Hours
I	**PROBABILITY** Definition – Axioms of Probability – Conditional Probability – Total Probability – Baye's Theorem (without proof). **Introduction to R Studio Programming**	6 +3
II	**DESCRIPTIVE STATISTICS** Measures of Central Tendency - Mean – Median –Mode, Measures of Dispersion - Range – Quartile Deviation – Standard Deviation – Coefficient of Variation. **R Lab: Mean Median Mode, Standard Deviation & Variance**	6 + 3
III	**CORRELATION AND REGRESSION** Correlation – Karl Pearson's correlation coefficient – Spearman's Rank Correlation – Regression lines (problems based on Raw data only). **R Lab: Correlation & Regression**	6 + 3
IV	**HYPOTHESIS TESTING** Large sample test - Test of significance for single mean and difference of means - Small sample test – t test for single mean and difference of mean - F test for variance, Chi – Square test for independence of attributes – Goodness of fit. **R Lab: t - Test, F - Test & Chi Square Test**	6 + 3
V	**ANALYSIS OF VARIANCE** Introduction- Assumptions of Analysis of Variance- Completely Randomized Design- Randomized Block Design - Latin Square Design. **R Lab: Analysis of Variance**	6 + 3
	Total Instructional Hours	**45 + 15=60**

Course Outcome

CO1: Understand the concepts of probability.
CO2: Understand the concepts of Descriptive Statistics
CO3: Compute correlation and predict unknown values using regression.
CO4: Acquire the knowledge of statistical methods for testing the hypothesis.
CO5: Apply Design of Experiment techniques to solve various engineering problems.

TEXT BOOKS:

T1Veerarajan, T., Probability, Statistics and Random Processes, Tata McGraw-Hill, 2nd Edition, New Delhi, April 19, 2017.
T2 Gupta S C and kapoor V.K, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2016.
T3 Medhi J," Stochastic Processes", New Age International Publishers, New Delhi, 2014.

REFERENCE BOOKS :

R1- O.C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, First Indian Reprint, 2010.
R2 - Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 10th Edition, Pearson Education, Asia, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CH4201	**MASS TRANSFER OPERATIONS- I**	3	0	0	3

Course Objectives

i. To Understand the classification of mass transfer operations.
ii. To Apply mass transfer theories to calculate coefficients in various flow conditions.
iii. To Analyze psychrometric charts for designing humidification processes.
iv. To Apply material and energy balance for analyzing drying processes.
v. To Apply crystallization kinetics principles to design batch and continuous crystallizers.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**UNIT - I: Introduction to Mass Transfer Operations** **Introduction:** Scope of Mass Transfer Operations – Classification of Mass Transfer Operations - Choice of Separation method - Methods of conducting Mass Transfer Operations. **Diffusion in Fluids:** Molecular diffusion - The equation of continuity - Steady state molecular diffusion of Fluids at rest and in laminar flow - Diffusivity of gases and liquids - Applications of molecular diffusion.	9
II	**UNIT - II: Mass Transfer Coefficients** Inter Phase Mass Transfer: Equilibrium – Overall mass transfer coefficients – gas phase & liquid phase controlled situations. Eddy Diffusion - Mass transfer coefficients - Mass transfer coefficients in laminar flow and turbulent flow - mass transfer theories - Mass, Heat and Momentum Transfer Analogies. Equipment for gas-liquid contact – Description of continuous and stage wise contact equipment – packing for packed columns liquid distribution – NTU and NTP concepts – comparison of plate and packed columns.	9
III	**UNIT – III: Humidification** Humidification Operations: Vapor - liquid Equilibrium and Enthalpy for a pure substance - vapor gas mixtures, Air-water system - Adiabatic saturation curves, wet bulb temperature – Psychrometric charts – humidification and dehumidification – Operating lines and design of packed humidifiers, dehumidifiers - cooling towers - spray chamber – Evaporative cooling.	9
IV	**UNIT - IV: Drying** 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
V	**UNIT-V: Crystallisation** 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 Outcomes

Upon completion of the course, students can be able to

CO1: Categorize mass transfer operations based on fundamental principles, enhancing their understanding.
CO2: Calculate coefficients in both laminar and turbulent flows, applying mass transfer theories.
CO3: Design packed humidifiers using psychrometric charts, considering adiabatic saturation curves.
CO4: Determine rotary dryer length using rate concepts in continuous drying operations.
CO5: Design continuous crystallizers using the population balance model, incorporating kinetics and balance principles.

TEXT BOOKS:

1. Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill,1981.
2. G.K. Roy, Fundamentals of Heat and Mass Transfer, Khanna Publishers, Sixth Edition, 2017.
3. Mass Transfer: Theory and Practice. By N. Anantharaman, K. M. Meera Sheriffa Begu, PHI Learning Pvt. Ltd., 2017.

REFERENCE BOOKS:

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I and II,4th Edition, Asian Books Pvt. Ltd., India,1998.
2. Foust A.S, "Principles of Unit Operations", 2nd Edition, John Wiley,2008.
3. Seader J.D & Henley E.J, "Separation Process Principles", 2nd Edition, John Wiley,2006.
4. Geankoplis. C.J., "Transport Processes and Separation Process Principles Includes Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey,2003.
5. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7thEdition., McGraw-Hill,2005.

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1			1		1				3	
CO2	3	3	3	1			1		1				3	
CO3	3	3	2	1			1		2		1		3	1
CO4	3	3	3	1			1		1				3	
CO5	3	3	2	1			1		2		1		3	1

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B.Tech **22CH4202 CHEMICAL ENGINEERING THERMODYNAMICS - II** 3 0 0 3

Course Objectives

- Enable the students to understand the terminologies such as chemical potential, fugacity, fugacity coefficient, activity and activity coefficient
- To apply equations of state and activity coefficient models to describe VLE.
- Students will be able to calculations and develop relations to phase equilibrium
- To familiarize students with methods used to describe and predict the chemical reaction equilibrium.
- To acquire knowledge of methods of refrigeration, performance of vapour compression refrigeration system

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**PROPERTIES OF SOLUTIONS** Partial molar properties - ideal and non-ideal solutions - standard states definition and choice – Chemical Potential - fugacity in solution - Henrys law & Dilute solution- activity in solution - Gibbs-Duhem equation - excess properties of mixtures-	9
II	**PHASE EQUILIBRIA** Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity - application of phase rule – duhem's theorem - Consistency test for VLE data - 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.	9
III	**CORRELATION AND PREDICTION OF PHASE EQUILIBRIA** 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
IV	**CHEMICAL REACTIONEQUILIBRIA** Reaction Stoichiometry - Standard free energy change and reaction equilibrium constant - evaluation of reaction equilibrium constant - effect of temperature on equilibrium constant - Vant Hoff equation- prediction of free energy data - equilibria in chemical reactors - calculation of equilibrium compositions for homogeneous chemical reactors - thermodynamic analysis of simultaneous reactions.	9
V	**REFRIGERATION** 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**

Upon completion of the course, students can be able to

Course Outcomes

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

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		1	1			2	1	1	1	1	
CO2	3	2	2	1							1		1	1
CO3	3	3	2	2							1		3	
CO4	3	3	2	1	1				1	2	1		3	1
CO5	3	2	1	1	1	1			1	2	2	2	2	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	22CH4203	PROCESS HEAT TRANSFER	3	0	0	3

The student should be able to

Course Objective

1. Learn various heat transfer methods involved in chemical processes.
2. Study the mechanism of heat transfer in unit operations such as evaporation, drying etc.
3. Apply heat transfer concepts in real industry scenario
4. Understand the concept of radiation and evaporation.
5. Calculate the various dimensionless numbers in heat exchangers.

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 and sphere – Heat conduction through a series of resistances – Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces-Optimum and economic thickness of insulation.	9
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.	9
III	**HEAT TRANSFER WITH PHASE CHANGE:** Heat transfer to fluids with phase change – heat transfer from condensing vapours, drop wise and film wise condensation, Derivation of Nusselt equation for vertical and horizontal tubes, condensation of superheated vapors, Heat transfer to boiling liquids – mechanism of boiling, nucleate boiling and film boiling.	9
IV	**RADIATION** : Radiation heat transfer – Thermal radiation – Laws of radiation – Black body concepts– Emissive power – Radiation shape factor – Gray bodies – Radiation shields. EVAPORATION: Introduction – Types of Evaporators – Capacity – Steam economy – Boiling point elevation (Duhring rule); Material and energy balance of single effect evaporator; Theory of multiple effect evaporators; Design of single and multiple effect evaporators, Vapor recompression method.	9
V	**HEAT EXCHANGERS:** Heat exchangers – Types and practical application – Concept of LMTD & Overall heat transfer coefficient; Effectiveness – NTU method for heat exchanger design; Fouling factor and estimation of Overall heat transfer coefficient; Special type of heat exchangers.	9
	Total Instructional Hours	45

Course Outcome

CO1	Ability to understand and solve conduction problems.
CO2	Ability to analyze and solve problems on convection.
CO3	Ability to apply analogies and correlations to solve industrial problems.
CO4	Ability to analyze and solve problems on radiation and Evaporation.
CO5	Ability to design and analyze the performance of heat exchangers.

TEXT BOOK:

T1 Binay. K Dutta, "Heat Transfer: Principles and Applications", PHI Learning private limited

T2 Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol.I, VI Edition, Asian Books Pvt. Ltd., India, 2006

T3 McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", XII Edition., McGraw-Hill, 2017

REFERENCES:

R1 Kern, D.Q., "Process Heat Transfer", McGraw-Hill, 2001

R2 Holman, J. P., 'Heat Transfer', X Edition., McGraw Hill. 2009.

R3 Ozisik, M. N., "Heat Transfer: A Basic Approach". McGraw-Hill, 1984

R4 Frank Kreith, Raj M Manglik, Principles of Heat Transfer, 8 th ed., Cengage Learning, USA, 2016.

R5 Analysis of heat and mass transfer by Eckert and Drake, McGraw-Hill

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1			1		1				3	
CO2	3	3	3	1			1		1				3	
CO3	3	3	2	1			1		1		1		3	1
CO4	3	3	3	1			1		1				3	1
CO5	3	3	2	1			1		1		2		3	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CH4204	CHEMICAL PROCESS INDUSTRIES	2	0	0	2

Course Objectives

- Identify Industrial Processes for Sulfur, Sulfuric Acid, and Cement.
- Explain the Ecological Aspects of Nitrogen-Based Fertilizer Production.
- Apply Knowledge to Optimize Paper Production Methods.
- Identify Components of Crude Petroleum.
- Explain the Applications of Industries in Hydrogen Production.

UNIT	DESCRIPTION	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 AND ELECTROCHEMICAL INDUSTRIES :** Major Components of Fertilizer Industries –Nitrogen Industries - Ammonia, Nitric acid, Urea – Phosphorus Industries - Phosphorus, Phosphoric acid, Super Phosphate. Electrochemical Industries-Electrolytic Process, Fuel Cells, Arc Process.	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	**PETROCHEMICAL 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.	9
V	**HYDROGEN PRODUCTION INDUSTRIES:** Fundamentals of Hydrogen , Advanced Technologies, Exploration of Emerging Technologies Such as Electrolysis, Steam Methane Reforming and Biomass Conversion for Efficient Hydrogen Production, Practical Applications of Hydrogen in Various Industries and Implementing Safety Protocols for Handling and Storing Hydrogen	9
	Total Instructional Hours	**45**

Course Outcomes:

CO1: List the Applications of Sulfuric Acid in Various Industries.
CO2: Explain the Role of Phosphorus in Fertilizer Production.
CO3: Discuss the Significance of Raw Materials in Paper Production.
CO4: List Common Products Derived from Crude Petroleum.
CO5: Illustrate the Applications of Industries in Hydrogen Production.

TEXT BOOKS:

1.Dryden's Outline of Chemical Technology by M.Gopala Rao Marshall Sittig
2. Shreve's Chemical Process Industries by George T. Austin and Randolph Norris Shreve McGraw-Hill Education
3. Chemical Process Technology and Simulation by S. Pushpavanam.

REFERENCE BOOKS:

1. Chemical Technology: Volume 1 by Anil Kumar & M. Gopala Rao
2. Industrial Chemistry by B. K. Sharma
3. Unit Operations of Chemical Engineering by Warren L. McCabe, Ernest Thiele, Warren L. McCabe
4. Chemical Engineering Design and Analysis: An Introduction by T. Michael Duncan and Jeffrey A. Reimer
5. Chemical Process Equipment: Selection and Design" by James R. Couper, W. Roy Penney, James R. Fair

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	PSO 3
CO1	3	3	2	1			1		1				3		
CO2	3	3	3	1			1		1				3		2
CO3	3	3	2	1			1		2		1		3	1	3
CO4	3	3	3	1			1		1				3		2
CO5	3	3	2	1			1		2		1		3	1	3

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1			1		1				3	
CO2	3	3	3	1			1		1				3	
CO3	3	3	2	1			1		2		1		3	1
CO4	3	3	3	1			1		1				3	
CO5	3	3	2	1			1		2		1		3	1

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / IV	22EE4205	**BASICSOF ELECTRICAL AND ELECTRONICS ENGINEERING (Chemical Engineering)**	2	0	0	2

Course Objective

1. To introduce the basics of electrical quantities.
2. To impart knowledge in the basics of AC fundamentals and circuits
3. To impart knowledge in the Electrical Instrumentation
4. To introduce the basics of power supply and wiring.
5. To impart knowledge in the basics of Electrical Machines.

Unit	Description	Instructional Hours
I	**DC CIRCUITS**–Electrical Quantities-Circuit Components-Types of Electrical Networks - Energy Sources-Electrical Power–Energy -Ohm's Law - Kirchhoff's Laws - Resistors in Series Parallel Circuit – Source Transformation	9
II	**AC CIRCUITS** – Introduction to AC Circuits- Phasor Representation – Relationship Between Voltage And Current in Resistor - Inductor and Capacitor – Simple AC Series &Parallel Circuit circuits – Power – Power factor	9
III	**BASIC ELECTRICAL INSTRUMENTATION**–Introduction - Classification of Instruments - Operating principles - Moving coil - Permanent Magnet (PMMC) Instruments Voltmeter and Ammeter- Moving Iron Ammeters and Voltmeters - Energy meter – Wattmeter.	9
IV	**BASICS OF POWER SUPPLY AND ELECTRICAL WIRING** Introduction to Power supply circuits: Half wave, Full wave Rectifier – SMPS, UPS (online & offline). Wiring types and applications. - Brief discussion on concealed conduit wiring. One way and two way control.	9
V	**ELECTRICAL MACHINES** Squirrel Cage & Slip Ring three phase induction motor (Construction & Working Principles) - Single phase induction motors – types – Capacitor Start & Run – Universal Motor - AC Motor Starters - DOL & Star Delta -. Selection of Motors for Chemical Industries	9
	Total Instructional Hours	**45**

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

Course Outcome

CO1: Analyze basic DC electric circuits.
CO2:Classify the AC circuits waveforms and its quantities
CO3:Familiarize on fundamentals of electrical measurementation
CO4:Ability to analyze basics of power supply and wiring
CO5: Understand the operations of Electrical Machines.

TEXT BOOKS:

T1 - D P Kothari and I J Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
T2 - D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010..
T3 - Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

REFERENCE BOOKS:

R1 - . Del Toro V, "Electrical Engineering Fundamentals", Pearson Education.
R2 - T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education
R3 - A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

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CHE - HiCET

ACADEMIC COUNCIL Chairman HICET COLLEGE OF ENGG & TECH

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HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CH4251	CHEMICAL REACTION ENGINEERING - I	2	0	2	3

Course Objectives

- Impart the knowledge of calculus, differential equations, thermodynamics, general chemistry, and material and energy balances to solve reactor design problems.
- Simulate several types of reactors in order to choose the most appropriate reactor for a given need
- Examine the problems related to multiple reactions and evaluate the selectivity, reactivity and yield
- Apply the effect of temperature in reactor design
- Analyze the non-ideal flow and evaluate the conversion in real reactors

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**FUNDAMENTAL CONCEPTS AND DEFINITIONS:** Rate equation, Classification of reactions at equilibrium, theories of reaction rate and prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis. Method of half-life; Analysis of data for Reversible and Irreversible Reactions **Kinetic studies in CSTR (Equimolar)**	6+3
II	**CHEMICAL KINETICS:** 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, Semi batch reactor - Recycle reactor .**Kinetic studies CSTR in series**	6+3
III	**DESIGN FOR MULTIPLE REACTIONS:** Design of reactors for multiple reactions - consecutive, parallel and mixed reactions- factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield. **Kinetic studies in MFR followed by PFR**	6+3
IV	**NON-ISOTHERMAL REACTORS:** 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. **Effect of temperature on reaction rate constant and conversion**	6+3
V	**NON IDEAL REACTORS:** The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; Relationship between C, E and F curves basic models for non-ideal flow; conversion in non-ideal reactors. **RTD Studies in MFR**	6+3
	Total Instructional Hours	**30+15**

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the concept of rate equation and batch reactors.
CO2- Evaluate the choice of right reactor among single, multiple, recycle reactor, etc. with or without multiple reaction
CO3- Analyze the design and working of multiple reactors.
CO4- Determine the non-isothermal effect on reactors.
CO5- Estimate the concept of RTD in analyzing reactor performances.

TEXT BOOKS:

1. Levenspiel O, "Chemical Reaction Engineering", Wiley Eastern Ltd., II Edition, 2000
2. Fogler H.S., Elements of Chemical Reaction Engineering, 5th ed., Prentice Hall India Pvt. Ltd., India, 2016
3. Scott Fogler, H., "Elements of Chemical Reaction Engineering", 4th Edition, Prentice Hall of India.2009

REFERENCES BOOKS:

1. Froment. G.F. & K.B.Bischoff, "Chemical Reactor Analysis and Design", John Wiley and Sons, 1979.
2. Smith J.M., Chemical Engineering Kinetics, 8th ed., McGraw-Hill, USA, 2008
3. Lanny D. Schmidth The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005
4. L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press ,2014

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1						1	1			3	3
CO2	3	3	3	1					1	1			2	3
CO3	2	3	2	1					1	1				3
CO4	2	2	3	1					2	1			2	2
CO5	3	2	2	1					2	1				3

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CH4001	**HEAT TRANSFER LAB**	0	0	3	2

Course Objectives

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

S.No.	DESCRIPTION
1.	Heat Transfer in Agitated Vessel and Helical Coil
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 Vertical Condenser
11.	Heat transfer in a Horizontal Condenser
12.	Heat transfer in Open Pan Evaporator
13.	Stefan Boltzmann experiment
14.	Emissivity measurement

Total Instructional Hours 45

Course Outcomes

Upon completion of the course, students can be able to

- Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipment's
- Estimate the heat transfer rate and heat transfer co-efficient
- Evaluate the performance/calculate the parameters in heat transfer equipments.
- Understand the applications of heat transfer equipment in various operating process plants.
- Evaluate the performance/calculate the parameters in heat transfer equipments.

REFERENCE BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
2. Holman, J. P., 'Heat Transfer ', 8th Edn., Tata McGraw Hill, 1997.
3. Y.A. Cengel and A.J. Ghajar. Heat and Mass Transfer: Fundamentals and Applications. McGraw-Hill, 4/e, 2011.
4. Bergman, Theodore L., Adrienne S. Lavine, Frank P. Incropera, et al. *Introduction to Heat Transfer*. Wiley, 2011
5. Lienhard, John H., and John H. Lienhard. *A Heat Transfer Textbook*. Dover Publications, 2011

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1				1	2		1	3	1
CO2	3	2	2	3	1	2			2	3			3	1
CO3	3	3	3	3	1				2				3	2
CO4	3	3	3	2		2			2	2		1	3	2
CO5	3	3	2	1					1				3	1

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE4071	Soft Skills and Aptitude III	0	0	0	1

Course Objectives:

1. Solve Logical Reasoning questions of easy to intermediate level
2. Solve Quantitative Aptitude questions of easy to intermediate level
3. Solve Verbal Ability questions of easy to intermediate level
4. Display good writing skills while dealing with essays

Unit	Description	Instructional Hours
	Logical Reasoning	
I	Clocks - Calendars - Direction Sense - Cubes - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency - Syllogism	10
	Quantitative Aptitude	
II	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 Permutation, Combination: Fundamental Counting Principle, Permutation and Combination, Computation of Permutation, Circular Permutations, Computation of Combination - Probability	12
	Verbal Ability	
III	Sentence Correction: Subject-Verb Agreement, Modifiers, Parallelism, Pronoun-Antecedent Agreement, Verb Time Sequences, Comparisons, - Sentence Completion and Para-jumbles- Critical Reasoning: Argument – Identifying the Different Parts (Premise, assumption, conclusion), Strengthening statement, Weakening statement, Mimic the pattern	6
	Recruitment Essentials	
IV	Cracking interviews - demonstration through a few mocks - Sample mock interviews to demonstrate how to crack the: HR interview, MR interview, Technical interview - Cracking other kinds of interviews: Skype/ Telephonic interviews, Panel interviews, Stress interviews - Resume building – workshop: A workshop to make students write an accurate resume- Essay Writing	2
	Total Instructional Hours	30

Course Outcome:

CO1: Students will avoid the various fallacies that can arise through the misuse of logic.

CO2: Students would opt for alternate methods to solve the problems rather than conventional methods.

CO3: Students will heighten their awareness of correct usage of English grammar in writing and speaking

CO4: Students will be concise and clear, using professional language for placements.

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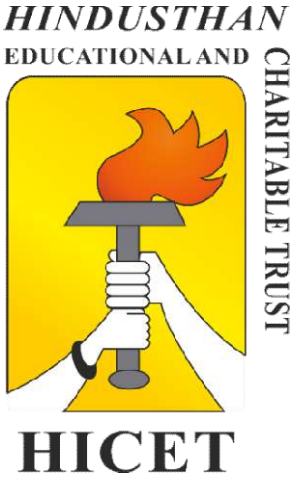

HINDUSTHAN

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)

2019 REGULATIONS WITH AMENDMENT

HindusthanCollegeofEngineering andTechnology

(AnAutonomousInstitution, Affiliatedto AnnaUniversity,Chennai
ApprovedbyAICTE,NewDelhi&AccreditedbyNAACwith'A'Grade)
ValleyCampus,PollachiHighways,Coimbatore,Tamilnadu.

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.TECH. CHEMICAL ENGINEERING (UG)

REGULATION-2019 WITH AMENDMENT

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

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	Computational Fluid Dynamics 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 Formation Evaluation	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	Blue Economy Entrepreneurship	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	Process Plant Utilities	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	Fermentation Technology	PE	3	0	0	3	40	60	100
2	21CH8307	Frontiers of Chemical Technology	PE	3	0	0	3	40	60	100
3	21CH8308	Industrial Nanotechnology	PE	3	0	0	3	40	60	100
4	21CH8309	Drugs and Pharmaceutical Technology	PE	3	0	0	3	40	60	100
5	21CH8310	Membrane Separation Process	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 forthe 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 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

CREDIT DISTRIBUTION

B.E. / B.TECH.PROGRAMMES										
S.No.	**Course Area**	**Credits per Semester**								**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	HSC	4	4	-	-	-	3	-	-	**11**
2	BSC	10	10	4	4	-	-	-	-	**28**
3	ESC	6	8	-	-	-	-	-	-	**14**
4	PCC	-	-	16	17	21	12	10	-	**76**
5	PEC	-	-	-	-	3	3	3	6	**15**
6	OEC	-	-	-	-	-	3	3	-	**6**
7	EEC	-	-	-	-	2	3	2	8	**15**
8	MC	-	-	-	-	-	-	-	-	-
Total		**20**	**22**	**20**	**21**	**26**	**24**	**18**	**14**	**165**

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	0	0	3	3
3	21CH6232	Fundamentals of Chemical Thermodynamics	MDC	3	0	0	3	3
4	21CH7231	Process Heat and Mass Transfer	MDC	3	1	0	4	4
5	21CH7232	Reaction Engineering	MDC	3	0	0	3	3
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	21MB5231	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								
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	Vertical IV Instrumental Chemical Analysis
Process Flow Sheeting	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	21CH5203	Process Flow Sheeting	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	21CH5204	Polymer Chemistry	MDC	3	0	0	3	3
2	21CH6204	Processing Technology	MDC	3	0	0	3	3
3	21CH6205	Rubber Technology	MDC	3	0	0	3	3
4	21CH7205	Polymer Product Design, Blends, and Alloys	MDC	3	0	0	3	3
5	21CH7206	Polymer Structure and property relationships	MDC	3	0	0	3	3
6	21CH8202	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	21CH5205	Petroleum Geology	MDC	3	0	0	3	3
2	21CH6206	Petroleum Exploration	MDC	3	0	0	3	3
3	21CH6207	Drilling Technology	MDC	3	0	0	3	3
4	21CH7205	Petroleum Production Engineering	MDC	3	0	0	3	3
5	21CH7206	Petroleum Reservoir Engineering	MDC	3	0	0	3	3
6	21CH8203	Offshore Engineering	MDC	3	0	0	3	3

B Tech (Hons) Chemical Engineering with Specialization in Instrumental Chemical Analysis

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CH5206	Principles of Mass Spectrometry	MDC	3	0	0	3	3
2	21CH6208	Advanced Analytical Separation Techniques	MDC	3	0	0	3	3
3	21CH6209	Advanced Spectrometry: ICP-MS and LC-MS	MDC	3	0	0	3	4
4	21CH7207	Instruments for Morphology and Structural Characterization	MDC	3	0	0	3	3
5	21CH7208	Statistical Analysis and Data Processing (Lab)	MDC	3	0	0	4	2
6	21CH8204	Troubleshooting Analytical Methods and Instruments	MDC	3	0	0	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH5201	**CHEMICAL REACTION ENGINEERING - I**	**3**	**1**	**0**	**4**

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- Illustrate the working of CSTR and PFR.
CO3-Explain the design and working of multiple reactors.
CO4- Determine the non-isothermal effect on reactors.
CO5- Demonstrate the concept of RTD in analyzing reactor performances.

TEXT BOOKS:

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

REFERENCES BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2.0	3.0	-	-	-	-	-	-	1.0	1.0	-	-	3.0	3.0
CO2	3.0	3.0	2.0	-	-	-	-	-	1.0	1.0	-	-	2.0	3.0
CO3	2.0	3.0	-	-	-	-	-	-	1.0	1.0	-	-	1.0	2.0
CO4	2.0	2.0	3.0	-	-	-	-	-	2.0	1.0	-	-	2.0	2.0
CO5	-	2.0	2.0	-	-	-	-	-	2.0	1.0	-	-	3.0	3.0
AVG	**2.25**	**2.6**	**2.33**	**-**	**-**	**-**	**-**	**-**	**1.4**	**1.0**	**-**	**-**	**2.2**	**2.6**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH5202	MASS TRANSFER - II	3	1	0	4

Course Objectives

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

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**ABSORPTION:** Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages, tray efficiency, tower diameter; packed tower absorber – rate based approach; determination of height of packing using HTU and NTU calculations.	12
II	**DISTILLATION:** Vapour liquid equilibria - Raoult's law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Introduction to multi-component distillation, azeotropic and extractive distillation.	12
III	**LIQUID-LIQUID EXTRACTION:** Liquid - liquid extraction - solvent characteristics- equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors- Supercritical extraction.	12
IV	**LEACHING:** Solid-liquid equilibria- leaching equipment for batch and continuous operations- calculation of number of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.	12
V	**ADSORPTION AND ION EXCHANGE & MEMBRANE SEPARATION PROCESS:** Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers, break through curves. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.	12
	Total Instructional Hours	**60**

Course Outcomes

Upon completion of the course, students can be able to

CO1- Evaluate the theoretical stages, number of transfer units and height requirements for a gas absorption process

CO2- Apply the number of trays for stage wise contact and determine the height of the packed tower.

CO3- Evaluate the equilibrium stages and understand the working of extractor.

CO4- Evaluate the number of stages and the working of leaching equipment.

CO5- Understand the concept of adsorption, ion exchange & membrane separation processes.

TEXT BOOKS:

1. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981..
2. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.

REFERENCES BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
2. Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley,2006.
3. King,C.J.,"SeparationProcesses",2ndEdn.,TataMcGraw-Hill1980
4. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	3.0	-	-	2.0	2.0	2.0	2.0	2.0	-	3.0	3.0	3.0
CO2	3.0	3.0	3.0	-	-	2.0	2.0	2.0	2.0	2.0	-	3.0	3.0	3.0
CO3	3.0	3.0	3.0	-	-	2.0	2.0	2.0	2.0	2.0	-	3.0	3.0	3.0
CO4	3.0	3.0	3.0	-	-	2.0	2.0	2.0	2.0	2.0	-	3.0	3.0	3.0
CO5	3.0	3.0	3.0	-	-	2.0	2.0	2.0	2.0	2.0	-	3.0	3.0	3.0
AVG	**3.0**	**3.0**	**3.0**	**-**	**-**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**-**	**3.0**	**3.0**	**3.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH5203	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- Relate the classification of various process instruments.
CO2-Examine the open loop systems in process control.
CO3- Illustrate the closed loop systems in process control.
CO4- Determine the Frequency response of control systems and tune the PID controllers
CO5- Examine the advanced control schemes and to control the equipment in chemical industries.

TEXT BOOKS:

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

REFERENCES BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	1.0	-	-	-	-	-	-	-	-	-	3.0	1.0
CO2	3.0	3.0	1.0	1.0	-	-	-	-	-	-	-	-	3.0	1.0
CO3	3.0	3.0	2.0	2.0	-	-	-	-	-	-	-	-	3.0	1.0
CO4	3.0	3.0	2.0	2.0	-	-	-	-	-	-	-	-	3.0	1.0
CO5	3.0	3.0	2.0	-	2.0	-	-	-	-	-	-	-	3.0	1.0
AVG	**3.0**	**3.0**	**1.6**	**1.67**	**2.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.0**	**1.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH5204	SAFETY IN CHEMICAL INDUSTRIES	3	0	0	3

Course Objectives

- 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; Potential hazards – extreme operating conditions, 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- Examine the Plant inspection, safe handling of chemicals
CO3- Implement on risk management iso 14000, ems
CO4- Determine the hazard identification safety audits, checklist, what if analysis
CO5- Illustrate 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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	2.0	2.0	-	2.0	2.0	-	2.0	-	-	2.0	3.0	3.0
CO2	3.0	3.0	2.0	2.0	-	2.0	2.0	-	2.0	-	-	2.0	3.0	3.0
CO3	3.0	3.0	2.0	1.0	-	2.0	2.0	-	-	-	-	3.0	3.0	3.0
CO4	3.0	3.0	2.0	2.0	-	2.0	2.0	-	-	-	-	3.0	3.0	2.0
CO5	3.0	3.0	2.0	2.0	-	2.0	2.0	-	-	-	-	3.0	3.0	2.0
AVG	**3.0**	**3.0**	**2.0**	**1.8**	**-**	**2.0**	**2.0**	**-**	**2.0**	**-**	**-**	**2.6**	**3.0**	**2.6**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH5251	WATER TRAETMENT AND SOLID WASTE MANAGEMENT	2	0	2	3

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. Electro ionization process for silica removal in water and waste water treatment process. Zero discharge process for waste water treatment plant.	6
V	**SOLID WASTE MANAGEMENT:** Definitions, Characteristics and perspectives, Types of solid wastes, Sources of Solid waste, Properties of solid waste, Solid waste Management – An Overview:- Material flow in society, Reduction in raw material usage, Solid waste generation, and reuse with materials, energy recovery.	6
	Total Instructional Hours	**45**

Course Outcomes

Upon completion of the course, students can be able to

CO1- Remember the types of water pollutants and sources.
CO2- Examine the Primary/ Secondary/Biological treatment process of waste water.
CO3- Determine the tertiary/advanced treatment process of waste water.
CO4- Examine the sources of air and noise pollution and control techniques.
CO5- Distinguish the types of solid waste, sources and solid waste management techniques.

TEXT BOOKS:

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

REFERENCES BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	2.0	2.0	-	2.0	3.0	3.0	-	-	2.0	3.0	3.0	3.0
CO2	3.0	3.0	3.0	3.0	-	2.0	2.0	-		-	3.0	3.0	3.0	3.0
CO3	3.0	2.0	3.0	3.0	-	2.0	2.0	-	2.0	-	3.0	3.0	3.0	3.0
CO4	3.0	2.0	3.0	3.0	-	2.0	2.0	-	2.0	-	3.0	3.0	3.0	3.0
CO5	3.0	3.0	3.0	3.0	-	2.0	3.0	-		-	2.0	3.0	3.0	3.0
AVG	**3.0**	**2.6**	**2.8**	**2.8**	**-**	**2.0**	**2.4**	**3.0**	**2.0**	**-**	**2.6**	**3.0**	**3.0**	**3.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH5001	MASS TRANSFER LAB	0	0	3	1.5

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

Course Outcomes

Upon completion of the course, students can be able to

- Perform steam and packed column distillation for binary mixture separation
- Measure diffusivity and investigate mass transfer in rotating disc contactors
- Study drying characteristics of tray and rotary dryers for efficient moisture removal.
- Conduct liquid: liquid extraction, leaching, and adsorption studies for component separation.
- Analyze vapour - liquid equilibrium and perform evaporation and gas-liquid absorption studies

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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	3.0	2.0	-	-	-	-	-	-	-	3.0	3.0	3.0
CO2	3.0	3.0	3.0	2.0	-	-	1.0	-	-	-	-	3.0	3.0	3.0
CO3	3.0	3.0	3.0	2.0	-	1.0	1.0	-	-	-	-	3.0	3.0	3.0
CO4	3.0	3.0	3.0	2.0	-	1.0	1.0	-	-	1.0	-	3.0	3.0	3.0
CO5	3.0	3.0	3.0	2.0	-	1.0	1.0	-	-	1.0	-	3.0	3.0	3.0
AVG	**3.0**	**3.0**	**3.0**	**2.0**	**-**	**1.0**	**1.0**	**-**	**-**	**1.0**	**-**	**3.0**	**3.0**	**3.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH5002	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

- Evaluate responses of first: order, second: order, interacting, and non- interacting systems.
- Perform open and closed: loop studies on level, flow, thermal, and pressure systems
- Tune control systems for level, pressure, and thermal processes for optimal performance.
- Determine flow coefficients and analyze characteristics of various control valve types.
- Analyze closed: loop response of cascade control systems for improved process stability.

REFERENCE BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	2.0	3.0	3.0	-	1.0	1.0	1.0	1.0	-	1.0	2.0	3.0
CO2	3.0	3.0	2.0	3.0	3.0	-	1.0	1.0	1.0	1.0	-	1.0	2.0	3.0
CO3	3.0	3.0	2.0	3.0	3.0	-	1.0	1.0	1.0	1.0	-	1.0	2.0	3.0
CO4	3.0	3.0	2.0	3.0	3.0	-	1.0	1.0	1.0	1.0	-	1.0	2.0	3.0
CO5	3.0	3.0	2.0	3.0	3.0	-	1.0	1.0	1.0	1.0	-	1.0	2.0	3.0
AVG	**3.0**	**3.0**	**2.0**	**3.0**	**3.0**	**-**	**1.0**	**1.0**	**1.0**	**1.0**	**-**	**1.0**	**2.0**	**3.0**

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	21HE5071	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.	21HE5072	DESIGN THINKING	1	0	0	1

Course Objective

OBJECTIVES:

- 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
I	**DESIGN ABILITY** 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**
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	**4**
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	**4**
IV	**DESIGN EXPERTISE** 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

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	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH6201	CHEMICAL REACTION ENGINEERING– II	3	1	0	4

Course Objectives

- 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 Outcomes

Upon completion of the course, students can be able to

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- Understand the mass transfer effects on gas-liquid reactors**.**

TEXT BOOKS:

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

REFERENCES BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	3.0	2.0	-	2.0	2.0	2.0	1.0	1.0	-	2.0	3.0	2.0
CO2	3.0	3.0	2.0	2.0	-	2.0	3.0	2.0	1.0	1.0	-	2.0	3.0	2.0
CO3	3.0	3.0	3.0	3.0	-	2.0	2.0	2.0	1.0	1.0	-	2.0	3.0	2.0
CO4	3.0	3.0	3.0	3.0	-	2.0	2.0	2.0	2.0	1.0	-	2.0	3.0	2.0
CO5	3.0	3.0	3.0	3.0	-	2.0	2.0	2.0	2.0	1.0	-	2.0	3.0	3.0
AVG	**3.0**	**3.0**	**2.8**	**2.6**	**-**	**2.0**	**2.2**	**2.0**	**1.4**	**1.0**	**-**	**2.0**	**3.0**	**2.2**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH6202	CHEMICAL PROCESS INDUSTRIES	3	0	0	3

Course Objectives

- 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, Butadiane – 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 Outcomes

Upon completion of the course, students can be able to

CO1- Interpret 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 BOOKS:

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

REFERENCES BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH6181	PROFESSIONAL ETHICS IN ENGINEERING	3	0	0	3

Course Objectives

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill 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 Outcomes

Upon completion of the course, students can be able to

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 BOOKS:

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

REFERENCES BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2.0	2.0	3.0	2.0	2.0	-	3.0	-	-
CO2	-	-	2.0	-	-	2.0	2.0	3.0	2.0	2.0	-	3.0	-	2.0
CO3	-	3.0	3.0	3.0	-	3.0	3.0	3.0	3.0	2.0	-	3.0	-	3.0
CO4	3.0	3.0	2.0	3.0	-	3.0	3.0	3.0	2.0	-	-	3.0	-	3.0
CO5	-	2.0	2.0	-	-	3.0	3.0	3.0	3.0	-	-	3.0	-	3.0
AVG	**3.0**	**2.67**	**2.25**	**3.0**	**-**	**2.6**	**2.6**	**3.0**	**2.4**	**2.0**	**-**	**3.0**	**-**	**2.75**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH6251	FLUIDIZATION ENGINEERING	2	0	2	3

Course Objectives

- To enable the students 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, Kozneykarman – 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.	9
V	**OTHER TYPES OF FLUIDIZATION:** Single stage and multistage fluidization – Collection of fines – Use of cyclones.	9
	Total Instructional Hours	**45**

Course Outcomes

Upon completion of the course, students can be able to

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 BOOKS:

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

REFERENCES BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	1.0	-	3.0	2.0	-	-	-	-	-	-	1.0	-	1.0
CO2	2.0	1.0	-	3.0	2.0	-	-	-	-	-	-	1.0	-	1.0
CO3	2.0	1.0	-	3.0	2.0	-	-	-	-	-	-	1.0	-	1.0
CO4	2.0	1.0	-	3.0	2.0	-	-	-	-	-	-	1.0	-	1.0
CO5	1.0	1.0	-	3.0	2.0	-	-	-	-	-	-	1.0	-	1.0
AVG	**2.0**	**1.0**	**-**	**3.0**	**2.0**	**-**	**-**	**-**	**-**	**-**	**-**	**1.0**	**-**	**1.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21CH6001	CHEMICAL REACTION ENGINEERING LAB	0	0	4	2

Course Objectives

- To impart knowledge on design of reactors.

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

- Conduct kinetic studies in batch, semi: batch, CSTR, PFR, and packed bed reactors
- Perform combined reactor studies in PFR and CSTR for enhanced process efficiency.
- Analyze residence time distribution in PFR, CSTR, and packed bed reactors for mixing characterization.
- Study micellar catalysis, heterogeneous catalysis, and gas: liquid reactions for improved reaction rates.
- Investigate temperature dependence, sono: chemical, and photochemical reaction kinetics for innovative applications.

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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	3.0	2.0	-	-	-	-	-	-	-	3.0	3.0	3.0
CO2	3.0	3.0	3.0	2.0	-	-	1.0	-	-	-	-	3.0	3.0	3.0
CO3	3.0	3.0	3.0	2.0	-	1.0	1.0	-	-	-	-	3.0	3.0	3.0
CO4	3.0	3.0	3.0	2.0	-	1.0	1.0	-	-	1.0	-	3.0	3.0	3.0
CO5	3.0	3.0	3.0	2.0	-	1.0	1.0	-	-	1.0	-	3.0	3.0	3.0
AVG	**3.0**	**3.0**	**3.0**	**2.0**	**-**	**1.0**	**1.0**	**-**	**-**	**1.0**	**-**	**3.0**	**3.0**	**3.0**

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	21HE6071	Soft Skill-II	1	0	0	1

Course Objectives:

1. To make the students aware of the importance, the role and the content of softskills 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	4
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	3
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.	3
IV	**Quantitative Aptitude:** Permutation, Combination - Probability - Logarithm - Quadratic Equations - Algebra - Progression - Geometry - Mensuration.	3
V	**Logical Reasoning:** Logical Connectives - Syllogisms - Venn Diagrams – Cubes - Coded inequalities - Conditions and Grouping	2

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.

REFERENCE BOOKS:

R1: Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays 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	Course Title	L	T	P	C
BE/BTECH	21HE6072	Intellectual Property Rights (IPR)	1	0	0	1

Course Objectives:

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
I	**INTRODUCTION TO INTELLECTUAL PROPERTY** Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.	3
II	**PATENTS** 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
III	**COPYRIGHTS** Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.	3
IV	**TRADEMARKS** 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
V	**DESIGN AND GEOGRAPHICAL INDICATION** Design: meaning and concept of novel and original -Procedure for registration. Geographical indication: meaning, and difference between GI and trademarks -Procedure for registration.	3

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 BOOKS:

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.

REFERENCE BOOKS:

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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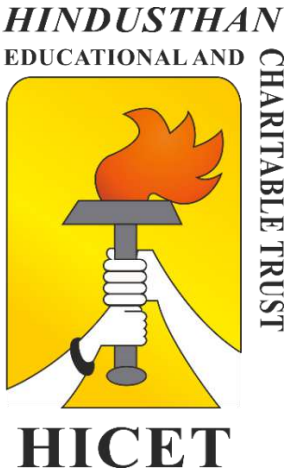

HINDUSTHAN

COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore – 641032

DEPARTMENT OF CHEMICAL ENGINEERING

2019 REGULATIONS

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.TECH. CHEMICAL ENGINEERING (UG)

REGULATION-2019

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	19CH7003	Computational Fluid Dynamics 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
6	19CH7306	Fundamentals of rubber testing compounds	PE	3	0	0	3	25	75	100
7	19CH7307	Chemical Manufacturing Plant Operation	PE	3	0	0	3	25	75	100
8	19CH7308	Chemical storage and Handling Operation	PE	3	0	0	3	25	75	100
9	19CH7309	Chemical Effluent treatment plant Operation	PE	3	0	0	3	25	75	100
10	19CH7310	Analytical Instruments Operation	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										
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

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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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7201	**PROCESS ECONOMICS AND ENGINEERING MANAGEMENT**	**3**	**0**	**0**	**3**

Course Objectives

The student should be able to

- Understand the process design development, plant location and layout, cost accounting and estimation, capital investments, taxes and depreciation
- Acquire awareness about methods of estimating cost of the project profitability, income ratio, balance sheet and inflation.
- Illustrate the economic design consideration in chemical industry and methods of principles of management, organization, production planning and its inventory.

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 PROFITABILTY 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- Calculate the capital cost and the value of money for the complete plant
CO2- Illustrate the profitability of the project and balance sheet preparation
CO3- Estimate the economic operation of the equipment
CO4- Identify the planning and management
CO5- Examine the production planning, control chart preparation and quality control

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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19CH7201 - Process Economics and Engineering Management

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	-	2.0	-	-	-	-	-	2.0	-	3.0	3.0	-
CO2	3.0	3.0	-	2.0	-	-	-	-	-	-	-	3.0	3.0	2.0
CO3	3.0	3.0	-	2.0	2.0	-	-	-	-	-	-	3.0	3.0	-
CO4	3.0	3.0	-	2.0	2.0	-	-	-	-	-	-	3.0	3.0	-
CO5	3.0	3.0	-	2.0	2.0	-	-	-	-	2.0	-	3.0	3.0	2.0
AVG	**3.0**	**3.0**	**-**	**2.0**	**2.0**	**-**	**-**	**-**	**-**	**2.0**	**-**	**3.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7202	**PROCESS EQUIPMENT DESIGN**	**3**	**1**	**0**	**4**

Course Objectives

The student should be able to

Summarize the concepts of unit operations and unit processes in chemical engineering.

Impart knowledge on the concepts of design of major equipment

Design the plant layout and pipe line with proper materials.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Heat Exchangers, Condensers, Evaporators	12
II	Cooling Tower, Dryers	12
III	Absorption column, Distillation Column, Extraction Column, Adsorption column	12
IV	Packed bed Reactors, Pressure Vessel, Storage Vessel	12
V	Design of Plant Layout, Pipe Lines and Pipe Layouts, Schematics and Presentation Materials of Construction and Selection of process equipments	12
	Total Instructional Hours	60

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the principles and apply design procedures for thermal equipment such as heat exchangers, condensers, and evaporators

CO2- Analyze and design mechanical and thermal aspects of cooling towers and industrial dryers

CO3- Evaluate and design mass transfer equipment including absorption, distillation, extraction, and adsorption columns.

CO4- Design pressure vessels, packed bed reactors, and storage vessels considering safety, mechanical integrity, and process requirements

CO5- Develop comprehensive plant layouts including pipelines and piping systems, and prepare schematic presentations with appropriate selection of materials of construction

TEXT BOOKS:

1. Green D. W., "Perry's Chemical Engineer's Handbook", 8th Edition McGraw Hill, 2007
2. Coulsion and Richardson's., "Chemical Engineering Design - Volume 6", Pergamon; 2nd edition, 1993.

REFERENCE BOOKS:

1. R. K. Sinnott, "Coulson & Richardson's Chemical Engineering", Vol. 6, Butterworth Heinermann, Oxford, 1996.
2. Green D. W., "Perry's Chemical Engineer's Handbook", 8th Edition McGraw Hill, 2007.
3. Dawande, S. D., "Process Design of Equiment", 4th Edition, Central Techno Publications, Nagpure, 2005.
4. Baranan, C.R., "Rules of Thumb for Chemical Engineers", Gulf Publishing Co, Texas, 1996.

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19CH7202 - Process Equipment Design

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	1.0	-	-	-	-	-	-	-	-	-	3.0	2.0
CO2	3.0	3.0	3.0	2.0	2.0	-	-	-	-	-	-	-	3.0	2.0
CO3	3.0	2.0	3.0	2.0	1.0	-	-	-	-	-	-	-	3.0	2.0
CO4	3.0	3.0	3.0	2.0	2.0	-	-	-	-	-	-	-	3.0	2.0
CO5	3.0	3.0	3.0	3.0	2.0	2.0	1.0	1.0	-	1.0	-	3.0	3.0	-
AVG	**3.0**	**2.6**	**2.6**	**2.25**	**1.75**	**2.0**	**1.0**	**1.0**	**-**	**1.0**	**-**	**3.0**	**3.0**	**2.0**

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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
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

Course Outcomes

Upon completion of the course, students can be able to

- Solve equations of state using Newton's method for accurate thermodynamic calculations.
- Perform regression analysis to estimate model parameters from experimental data
- Model batch reactors, CSTRs in series, and plug flow reactors for optimal performance
- Calculate equilibrium and simulate flash distillation and gas absorption for multicomponent systems.
- Simulate heat exchangers and gravity flow tanks for efficient energy and fluid dynamics control

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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19CH7001 - Design and Simulation Lab

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	3.0	3.0	2.0	2.0	1.0	-	-	-	-	-	-	3.0	2.0
CO2	3.0	3.0	3.0	2.0	2.0	1.0	-	-	-	-	-	-	3.0	2.0
CO3	3.0	3.0	3.0	2.0	2.0	1.0	-	-	-	-	-	-	3.0	2.0
CO4	3.0	3.0	3.0	2.0	2.0	1.0	-	-	-	-	-	-	3.0	2.0
CO5	3.0	3.0	3.0	2.0	2.0	1.0	-	-	-	-	-	-	3.0	2.0
AVG	**3.0**	**3.0**	**3.0**	**2.0**	**2.0**	**1.0**	**-**	**-**	**-**	**-**	**-**	**-**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7002	**RUBBER TESTING LAB**	**0**	**0**	**3**	**2**

Course Objectives

- To enable the students to carry out test related to identification of rubber and properties of rubber.

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

Total Instructional Hours 45

Course Outcomes

Upon completion of the course, students can be able to

- Identify various rubber products using physical and chemical testing methods
- Prepare standard reagents and solutions for chemical analysis of rubber samples
- Perform specific gravity and viscosity testing on rubber compounds accurately.
- Determine total solids, volatile matter, dirt, and ash content in rubber compounds.
- Evaluate tensile properties, tear strength, and perform pyrolysis and spot tests for rubber identification.

REFERENCE BOOKS:

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

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

Course Objectives

The student should be able to

- Remember the basic concept and applications of Natural Gas Engineering
- Categorize the Typical compositions of Natural gases.
- Derive the coefficients relation dimensionless to real variables.

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 poser requirements. Compressible Flow in Pipes: Fundamental equations of flow: continuity, momentum, elegy 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

Upon completion of the course, students can be able to

CO1: Understand about the various sources of information for natural gas engineering and its applications

CO2: Illustrate about the composition and various properties of natural gases

CO3: Structure the compression equipment and its analysis

CO4: Remember the fundamentals of gas flow in various conduits under constant thermodynamic property

CO5: Examine about the non-dimensional forms of the equation for gas deliverability

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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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

Course Objectives

The student should be able to

- Defend the papermaking science and technology leading to careers in corporate or government positions which would interface with the paper related industries
- Discover the different types of operation in Paper industry.
- Extract the Properties and Testing of pulp and paper Process control

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- Examine the mechanical and chemical pulping processes

CO3-Implement the wet and dry machines and operations for paper production

CO4- Illustrate the production of paper and paperboard

CO5- Remember 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 Gellerstcdt 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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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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

The student should be able 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.
- Derive the one dimensional heat, mass and momentum transport of two Immiscible fluids
- Apply the phenomenological relations for transfer fluxes

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- Illustrate the fluid flow and molecular transfer mechanism

CO2- Organize the one dimensional momentum transport, its boundary condition and velocity profile

CO3- Examine the one dimensional heat transport, its boundary conditions and temperature profiles

CO4- Demonstrate 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 Mc-Graw 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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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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

The student should be able to

- Understand the concepts of Multicomponent distillation systems.
- Apply the thermodynamic principles in VLE.
- Categorize the various methods of designing the MCD column.

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 Rm 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- Apply the fundamental principles involved in the separation of multi component mixtures

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

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

CO5- Illustrate 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 Ttransfer Operations", 5th Edition, Mc Graw Hill publications. 1996.
3. Mc Cabe 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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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

Course Objectives

The student should be able to

- Understand about process modeling and optimization
- Develop the Necessary and sufficient conditions for optimum.
- Formulate the objective functions and fitting the models to data.

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- Apply the procedure for the determination of necessary and sufficient conditions for optimum

CO3- Illustrate the process multivariable optimization without and with constraints

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

CO5- Examine 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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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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

The student should be able to

- Illustrate the fundamentals of rubber and various methods of testing the rubber compounds
- Analyze the testing methods of rubber products.
- Examine the Importance of identification and traceability in lab testing.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**INTRODUCTION:** Various stages of development of rubber. Current industrial scenario of rubber and its prospects in future. Rubber consumption pattern in different sectors. Source of different types of rubber. Usage of rubber for making different products.	9
II	**RUBBER COMPOUNDS:** Ingredient of the rubber compound. Common rubber compound used in rubber industry. Equipment used for rubber lab testing. Classification of testing equipment based on their usage in different rubber testing.	6
III	**PREPARING FOR LAB TESTING:** Outline the importance of identification and traceability in lab testing. Tests requirement to carry out to physical properties test, such as: - Specify Gravity, - Volatile loss, - Moisture, - Ash Content, - Softening Point, - pH, etc.	12
IV	**CONDUCTING TESTING OF RUBBER PRODUCTS:** Testing required for compound ingredients. Process of rubber compound test sample preparation. List requirements for sample preparation. Formula for ash content calculation. Process of volatile matter calculation for a compound. Formula for nitrogen content calculation. Process of testing physical properties of a rubber sample.	12
V	**ANALYSIS OF TEST DATA:** 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. Recall basic mathematic rules. Define the importance of quality management system in rubber testing lab.	6
	Total Instructional Hours	**45**

Course Outcomes

Upon completion of the course, students can be able to

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

CO2- Apply the procedure for the determination of rubber compounds.

CO3- Illustrate the process for preparatory of lab testing.

CO4- Understand the basic concepts about conducting test of rubber compounds.

CO5- Examine the optimization application for analysis of test data.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH8301	**INDUSTRIAL MANAGEMENT**	**3**	**0**	**0**	**3**

Course Objectives

The student should be able to

- Provide an opportunity to learn basic management concepts essential for business
- Categorize the functions of management.
- Extract the group dynamics and modern concepts.

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	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 .	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 Outcomes

Upon completion of the course, students can be able to

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 BOOKS:

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

REFERENCE BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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

The student should be able to

Course Objective

Examine the various technology in sugar production and have knowledge on unit operation in sugar industries

Identify the various unit operation in sugar industries

Analyze the various Analytical methods used in Sugar Industry.

Unit	DESCRIPTION	Instructional Hours
I	**INTRODUCTION** 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
II	**PURIFICATION** Chemical technology of the purification processes. Fundamental reactions and physical chemistry aspects of clarification. Liming, sulphitation and carbonation processes. Filtration of sugar juice.	9
III	**EVAPORATION** 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
IV	**CRYSTALLIZATION** 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
V	**CENTRIFUGATION** 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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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Dean (Academics)
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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 Objectives

The student should be able to

- Facilitate the understanding of Quality Management principles and process.
- Recognize the tools and techniques in TQM.
- Understand the TQM management system.

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 Outcomes

Upon completion of the course, students can be able to

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- Understand about the quality management system

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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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 Objectives

The student should be able to

- Examine the global trends and the requirement of skills for integrated product development
- Understand the concept screening and techniques.
- Illustrate the business dynamics in engineering service industry.

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 Outcomes

Upon completion of the course, students can be able to

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: Understand 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 BOOKS:

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

REFERENCE BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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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 Objectives

The student should be able to

- Emphases on the fundamentals of supply chain networks, tools and techniques
- Summarize the supply chain and information technology methods.
- Illustrate the Role of transportation in supply chain.

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 Outcomes

Upon completion of the course, students can be able to

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- Relate the information technology in supply chain management and future

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH8306	**PROCESS PLANT UTILITIES**	**3**	**0**	**0**	**3**

Course Objectives

The student should be able to

- Understand the process plant utilities and optimization techniques to optimize various parameters in chemical industries.
- Conclude the refrigerant to be processed in the particular refrigeration cycle.
- Use the different types of fuels in the process industry and identify the disposal method.

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 Mono chloro difluro Methane, Chloro fluro 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 Outcomes

Upon completion of the course, students can be able to

CO1- Infer 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- Compare and contrast 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:

1. Industrial Chemistry by Shashi Chawla, Dhanpat Rai and Sons Publication.
2. P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi, 1986.
3. Heat Transfer by D.S. Kumar.
4. Fuel Furances and Refractories by O.P. Gupta, Khanna Publishers.

REFERENCE BOOKS:

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

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH8307	**FERMENTATION TECHNOLOGY**	**3**	**0**	**0**	**3**

Course Objectives **The student should be able to**

- Understand the role of fermentation microorganisms and (bio) chemical activities and conversions that take place during fermentations, and their impact on quality.
- Categorize the different parameters to be controlled in the fermentation process and its control methods
- Judge the optimal recovery and related purification technique in the fermentation process.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**INTRODUCTION TO FERMENTATION PROCESSES:** Microbial biomass – Microbial Enzymes – Microbial metabolites – Recombinant products – Transformation Process – Microbial growth binetus – 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 – Cenline analysis – Control System – Combination of Control Systems – Computer application in termentation technology.	9
III	**RECOVERY AND PURIFICATION OF FERMENTATION PRODUCTS :** Removal of Microbial cells – Foam Separation – Precipitation Filtration – Different Filtration process - Centifugation – 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 – Anareobic 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 Outcomes

Upon completion of the course, students can be able to

CO1- Understand 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- Remember 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 BOOKS:

1. Fermentation and Biochemical Engineering Handbook – C.C Haber. William Andrew II Edition 2007.
2. Principles of fermentation Technology P.Stanbury Buttuworth Hanman – 1999.

REFERENCE BOOKS:

1. Bioprocess Engineering Hydersen B.K Nancy A.delaK.L.Nelsen Wiley Interscience,1994.
2. Bioprocess engineering principles, Pauline M. Doran, Academic Press.
3. Biochemical Engineering, H.W. Blanch and D.S. Clark, Marcel Dekker, 1997.
4. Shigeo Katoh, Jun-ichiHoriuchi and Fumitake Yoshida, "Biochemical Engineering", Wiley, 2015.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH8308	**FRONTIERS OF CHEMICAL TECHNOLOGY**	**3**	**0**	**0**	**3**

Course Objectives

The student should be able to

- Identify the latest trends to be followed in the process industries
- Correlate the materials technology, bio-engineering with chemical technology and its processing.
- Categorize the renewable energy technologies and apply into the chemical process industries.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**PROCESS INTENSIFICATION:** Novel reactor configurations; combination of reaction and separation; use of different energy fields, lab on a chip.	9
II	**CHEMICAL PRODUCT DESIGN:** Scope and importance; identification of needs and specifications; sources of ideas and screening ideas; selection of product idea; process development for product manufacture; specialty chemical manufacture; economic aspects.	9
III	**RENEWABLE ENERGY:** Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cells and bio-hydrogen, solar energy	9
IV	**MATERIALS ENGINEERING:** Polymers and composites, ceramics and glasses, colloidal dispersions and nanoparticles, thin films and electronic materials	9
V	**BIOENGINEERING:** Biomechanics, biotransport and biomaterials, biomolecular and cellular engineering, drug discovery and development.	9
	Total Instructional Hours	**45**

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand about the application of various unit operations, unit processes, chemical reaction principles for the design of advanced reactors and lab

CO2- Remember the fundamentals and chemical engineering principle for the design of chemical products with economic aspects

CO3- Apply the chemical technologies in the field of renewable energy production

CO4- Determine the various materials in the advancement of chemical engineering

CO5- Examine the various development in bioengineering

TEXT BOOKS:

1. Keil, F. J., Modeling of Process Intensification Wiley-VCH Verlag GmbH & Co. KGaA2007.
2. Cussler, E.l. and Moggridge, G.D., "Chemical product design" Cambridge University Press, Cambridge, 2001.

REFERENCE BOOKS:

1. Hoffmann,P, Tomorrow's energy: hydrogen, fuel cells, and the prospects for a cleaner planet, MIT Press, Sabon, 2002.
2. Mitchell, B.S., An introduction to materials engineering and science for chemical and materials engineers, John Wiley and Sons Inc., New Jersey, 2004.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH8309	**INDUSTRIAL NANOTECHNOLOGY**	**3**	**0**	**0**	**3**

Course Objectives

The student should be able to

- Explain on advantages of nanotechnology based applications in each industry.
- List the instances of contemporary industrial applications of nanotechnology.
- Provide an overview and compose the future technological advancements and increasing role of nanotechnology in each industry.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**NANO ELECTRONICS:** Advantages of nano electrical and electronic devices – Electronic circuit chips – Lasers - Micro and NanoElectromechanical systems – Sensors, Actuators, Optical switches, Bio-MEMS –Diodes and Nano-wire Transistors - Data memory –Lighting and Displays – Filters (IR blocking) –	9
II	**BIONANOTECHNOLOGY:** Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis - Reconstructive Intervention and Surgery – Nanorobotics in Surgery – Photodynamic Therapy - Nanosensors in Diagnosis– Neuro-electronic Interfaces – Protein Engineering – Drug delivery – Therapeutic applications.	9
III	**NANOTECHNOLOGY IN CHEMICAL INDUSTRY :** Nanocatalyts – Smart materials – Heterogenous nanostructures and composites – Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes) – Molecular Encapsulation and its applications – Nanoporous zeolites	9
IV	**NANOTECHNOLOGY IN AGRICULTURE AND FOOD TECHNOLOGY** : Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology – Potential of nano-fertilizers - Nanotechnology in Food industry - Packaging, Food processing - Food safety and biosecurity – Contaminant detection – Smart packaging.	9
V	**NANOTECHNOLOGY IN TEXTILES AND COSMETICS:** Nanofibre production - Electrospinning – Controlling morphologies of nanofibers – Tissue engineering application– Polymer nanofibers - Nylon-6 nanocomposites from polymerization - Nano-filled polypropylene fibers - Bionics– Swim-suits with shark-skin-effect,Soil repellence, Lotus effect	9
	Total Instructional Hours	**45**

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand about nanotechnology in electronic industries and various products
CO2- Illustrate about nanotechnology in biotechnology sectors and applications
CO3- Determine nanotechnology in chemical industries and various applications
CO4- Examine nanotechnology in agriculture and food technology sectors and various applications
CO5- Analyze the application of nanotechnology in textiles and cosmetics sectors.

TEXT BOOKS:

1. Neelina H. Malsch (Ed.),Biomedical Nanotechnology, CRC Press (2005).
2. Udo H. Brinker, Jean-Luc Mieusset (Eds.), Molecular Encapsulation: Organic Reactions in Constrained Systems,Wiley Publishers (2010).
3. Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, (2006).

REFERENCE BOOKS:

1. Lynn J. Frewer, WillehmNorde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri- food sector, Wiley-VCH Verlag, (2011).
2. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).
3. Y-W. Mai,Polymer Nano composites, Woodhead publishing, (2006).
4. W.N. Chang,Nanofibres fabrication, performance and applications, Nova Science Publishers Inc, (2009).

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH8310	**DRUGS AND PHARMACEUTICAL TECHNOLOGY**	**3**	**0**	**0**	**3**

Course Objectives

The student should be able to

- Understand the polytechnical nature of engineering and drug discovery in the pharmaceutical industry involving Chemical Engineering.
- Decide the manufacturing principles and quality control techniques in pharmaceutical industries.
- Remember the analytical methods to be used in analysis of pharmaceutical products.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**INTRODUCTION:** Development of drugs and pharmaceutical industry; organic therapeutic agents uses and economics.	9
II	**DRUG METABOLISM AND PHARMACO KINETICS & MICROBIOLOGICAL AND ANIMAL PRODUCTS:** Drug metabolism; physico chemical principles; pharma kinetics-action of drugs on human bodies. Antibiotics- gram positive, gram negative and broad spectrum antibiotics; hormones.	9
III	**IMPORTANT UNIT PROCESSES AND THEIR APPLICATION :** Chemical conversion processes; alkylation; carboxylation; condensation and cyclisation; dehydration, esterification, halogenation, oxidation, sulfonation; complex chemical conversions fermentation.	9
IV	**MANUFACTURING PRINCIPLES & PACKING AND QUALITY CONTROL**: Compressed tablets; wet granulation; dry granulation or slugging; advancement in granulation; direct compression, tablet presses formulation; coating pills; capsules sustained action dosage forms; parential solutions, oral liquids; injections; ointments; standard of hygiene and manufacturing practice. Packing; packing techniques; quality control.	9
V	**PHARMACEUTICAL PRODUCTS & PHARMACEUTICAL ANALYSIS:** Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives; external antiseptics; antacids and others. Analytical methods and tests for various drugs and pharmaceuticals – spectroscopy, chromatography, fluorimetry, polarimetry, refractometry, pH metry.	9
	Total Instructional Hours	**45**

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand in general about development of drugs and pharmaceutical industry.

CO2-Determine the drug metabolism and pharma co kinetics & microbiological and animal products in general.

CO3- Examine the important unit processes and their application in drug manufacturing.

CO4- Understand about the various drug manufacturing principles & packing and quality control.

CO5- Illustrate the various pharmaceutical products and its analysis.

TEXT BOOKS:

1. Rawlines, E.A.; "Bentleys Text book of Pharmaceutics , III Edition, Bailliere Tindall, London, 1977.
2. Shayne Cox Gad. Pharmaceutical Manufacturing Handbook, Published by John Wiley & Sons, Inc., 2008.

REFERENCES BOOKS:

1. Yalkonsky, S.H.; Swarbick. J.; "Drug and Pharamaceutical Sciences", Vol. I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.
2. "Remingtons Pharmaceutical Sciences ", Mack Publishing Co., 1975.
3. Bernd Meibohm. Pharmacokinetics and Pharmacodynamics of biotech drugs, Published by Wiley-VCH, 2006.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO2	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO3	3.0	2.0	3.0	2.0	2.0	-	2.0	-	2.0	-	2.0	2.0	3.0	2.0
CO4	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
CO5	3.0	2.0	2.0	2.0	2.0	-	2.0	-	2.0	-	3.0	2.0	3.0	2.0
AVG	**3.0**	**2.0**	**2.2**	**2.0**	**2.0**	**-**	**2.0**	**-**	**2.0**	**-**	**2.4**	**2.0**	**3.0**	**2.0**

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19CH8311	MEMBRANE SEPARATION PROCESS	3	0	0	3

Course Objective

The student should be able to

1. Understand the principle and technical concept of advanced separation processes.
2. Describe the process of Reverse Osmosis, Nanofiltration.
3. Summarize the Types and choice of Adsorbents.

Unit	Description	Instructional Hours
I	**BASICS OF SEPARATION PROCESS :** Overview and membrane materials, Material properties and preparation of phase-inversion membranes, Review of Conventional Processes, Process concept, Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid separations involving a second liquid, Dual functional Filter.	9
II	**MEMBRANE SEPARATIONS:** Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollow fiber Membrane , Porous and non-porous membrane transport and Osmosis concepts , Reverse Osmosis, Nanofiltration, Ultra filtration and Micro filtration, Preparation of composite, inorganic membranes , MF and UF characterization and membrane transport , Problems and solutions based on RO, MF.	9
III	**SEPARATION BY ADSORPTION:** Types and choice of Adsorbents, Affinity Chromatography, Ion Exchange Chromatography and Immuno Chromatography, Recent Trends in Adsorption.	9
IV	**INORGANIC SEPARATIONS:** Electrophoresis, Dielectrophoresis, , Electro dialysis, Evaporation, Problems and solutions based on ED, PV, Facilitated Transport, Membrane contactors and other membrane processes.	9
V	**OTHER TECHNIQUES:** Separation involving Lyophilisation, Liquid Membranes, Gas separation, Membrane Distillation, zone melting, Adductive Crystallization, Supercritical fluid Extraction.	9
	Total Instructional Hours	45

On completion of the course, the students will be able to

Course Outcome

CO1	Understand the Concept of Separation Process.
CO2	Analyze key concepts of separation processes including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects.
CO3	Illustrate the concept of adsorption and its application.
CO4	Acquire Knowledge in inorganic separations for the reaction.
CO5	Differentiate and determine various processes by performing the specific tests.

TEXT BOOK:

T1 Schoen, H.M., "New Chemical Engineering Separation Techniques", Interscience Publishers,1972.

T2 Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw Hill Book Co., 1980.

T3 B. K. Dutta, Mass Transfer and Separation Processes, PHI,2007.

REFERENCES:

R1 King, C. J., "Separation Processes", Tata McGraw Hill, 1982.

R2 M. H. Mulder, Basic Principles of Membrane Technology,Springer, 2004

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	2	2	2	2	2	2	2	2	2
CO2	2	3	2	2	3	2	2	2	2	2	2	1	2	2
CO3	2	3	2	2	3	2	2	2	2	2	2	1	2	2
CO4	2	3	2	2	3	2	2	2	2	2	2	1	2	2
CO5	2	3	3	2	3	2	2	2	2	2	2	1	2	2

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