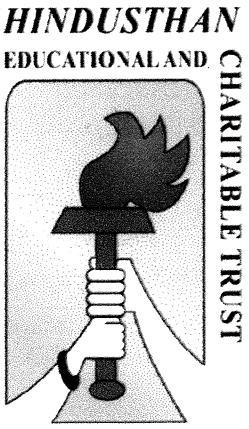

HINDUSTHAN
COLLEGE OF ENGINEERING ANDTECHNOLOGY

(An Autonomous Institution)

Coimbatore– 641032

DEPARTMENT OF CHEMICAL ENGINEERING

CURRICULUM

(UNDER REGULATIONS 2022)

(Academic Council Meeting held on 19.06.2023)

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.	**22HE1072**	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
7.	22HE1073	**INTRODUCTION TO SOFT SKILLS (Common to all branches)**	SEC	1	0	0	0	1	100	0	100
Mandatory Courses											
8.	**22MC1093/ 22MC1094**	**தமிழர்மரபு**/ Heritage of Tamil	MC	2	0	0	0	2	0	0	0
9.	**22HE1095**	Universal Human Values	AEC	2	0	0	2	2	40	60	100
			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.	**22HE2073**	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.	**22MC2094/ 22MC2095**	**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
Mandatory Course											
11.	22MC4191	Indian Constitution	AC	2	0	0	0	2	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.

ECHNOLOGY				
C	TCP	CIA	ESE	TOTAL
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100

ERING				
C	TCP	CIA	ESE	TOTAL
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100

INEERING				
C	TCP	CIA	ESE	TOTAL
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100

TY ENGINEERING				
C	TCP	CIA	ESE	TOTAL
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100

GINEERING				
C	TCP	CIA	ESE	TOTAL
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100
3	3	40	60	100

ESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH.PROGRAMMES							
	Credits per Semester						TotalCredits
	III	IV	V	VI	VII	VIII	
	-	2	-	3	-	-	**11**
	4	3	-	-	-	-	**23**
	3	2	-	-	-	-	**15**
	15	16	11	7	9	-	**61**
	-	-	9	6	3	-	**18**
	-	-	-	6	6	-	**12**
	3	1	1	2	2	10	**25**
	25	**24**	**21**	**24**	**20**	**10**	**165**

TIVE I AND II (EMERGING TECHNOLOGIES)
idents other than CSE, IT, AI&ML, ECE & BIOMEDICAL

urse Title	Category	Periods Per week			Total Contact Periods	Credits
		L	T	P		
gence and Machine nentals	OEC	2	0	2	4	3
nology	OEC	2	0	2	4	3
	OEC	2	0	2	4	3
d Applications	OEC	2	0	2	4	3
l Analytics	OEC	2	0	2	4	3
Virtual Reality	OEC	2	0	2	4	3

OPENELECTIVE I AND II
than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

E TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
		L	T	P		
	OEC	3	0	0	3	3
ustrial	OEC	3	0	0	3	3
id	OEC	3	0	0	3	3
d its	OEC	3	0	0	3	3
ocial Impact	OEC	3	0	0	3	3
System	OEC	3	0	0	3	3
uring	OEC	3	0	0	3	3
ustrial l Control	OEC	3	0	0	3	3
ming using tion	OEC	3	0	0	3	3
utomobile	OEC	3	0	0	3	3
Safety	OEC	3	0	0	3	3

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

Chairman, Board of Studies

Chairman - BoS
CHE - HiCET

Dean (Academics)

Dean (Academics)
HiCET

Principal

PRINCIPAL
Hindusthan College Of Engineering & Tech
COIMBATORE - 641 032.

ACADEMIC COUNCIL ★ HINDUSTHAN COLLEGE OF ENGG & TECH ★ Chairman

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

The learner should be able to

Course Objective

1. Construct the characteristic polynomial of a matrix and use it to identify eigen values and Eigenvectors
2. 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

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

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",9th EditionAddisonWesleyPublishing Company,2016.

T2:ErwinKreyszig,"AdvancedEngineeringMathematics",JohnWiley&Sons,2019.

T3:K.P.UmaandS.Padma,"EngineeringMathematicsI(MatricesandCalculus) ",PearsonLtd,2022.

REFERENCEBOOKS:

R1-JerroldE.Marsden,AnthonyTromba,"VectorCalculus",W.H.Freeman,2003

R2-StraussM.J,G.L.BradleyandK.J.Smith,"Multivariablecalculus",PrenticeHall,2002.

R3-VeerarajanT,"EngineeringMathematics",McGrawHillEducation(India)PvtLtd,NewDelhi,2016.

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ACADEMIC COUNCIL Chairman KARPAGAM COLLEGE OF ENGG & TECH

Dean (Academics)

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	P	C
	2	3

writing.
communication.

	Instructional Hours
question.	
ords on	7+
d answer	2
- Purpose	
Graphs in	
al letters	
il writing	
abulary–	7+
ns based	2
their life	
ts .	
ks giving,	
words on	
ver the	5+
wspapers	4
n pieces.	
suffixes.	
y– words	
ns based	5+
opic with	4
ension - -	
Writing:	
y –words	
listening-	
Preparing	6+
al blogs.	3
Hours	**45**

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Blackswan,2010.

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Name of the Course	L	T	P	C
PHYSICS OF MATERIALS	2	0	2	3

ir applications , become Conversant with principles of optical fiber, types and

wledge about properties of matter
optics
n Physics.
e of thermal physics which is related to the engineering program

Description	Instructional Hours
lated emission –Type of lasers – Nd:YAG laser - Laser Applications – construction of images. Principle and propagation of light through optical aperture and acceptance angle – Classification of optical fibers (based on r optical communication link. **d particle size using Laser**	6
n's ratio – Bending moment – Depression of a cantilever – Deteremination al of the beam by Uniform bending theory and experiment. Twisting couple periment **ilus by uniform bending method** **lus – Torsion pendulum**	6
e –Thickness of thin paper -Testing of thickness of surface- Michelson ht –Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's olving power of grating. **mercury spectrum – spectrometer grating** **thin wire – Air wedge method**	6
ffect: theory and experimental verification – wave particle duality –concept significance – Schrödinger's wave equation – time independent and time one-dimensional rigid box .	6
conduction, convection and radiation – thermal conductivity - Lee's disc conduction through compound media (series and parallel) – applications:	6
Total Instructional Hours	**30**
Total Lab Instructional Hours	**30**

e learner will be able to
chnology of LASER and optical communication in the field of Engineering
roperties of matter
ions of particles
chnology of Quantum Physics in the field of Engineering
hermal physics in engineering field

raw Hill Publishing Company Limited, New Delhi, 2017.
hysics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

Text Book of Engineering physics" S. Chand and Company ltd., New

s – I" VRB publishers Pvt Ltd., 2021

HINDUSTHAN COLLEGE OF ENGG & TECH ACADEMIC COUNCIL Chairman

Dean (Academics)
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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22IT1151	PYTHON PROGRAMMING AND PRACTICES AGRI, CHEM,FT,AERO, AUTO, CIVIL,MECH, MECT,ECE,BME)	2	0	2	3

Course Objective

The learner should be able

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). **Illustrative problems: To find the Greatest Common Divisor (GCD)oftwo numbers, Fahrenheit to Celsius, Perform Matrix addition.**	5+4
II	**DATA, STATEMENTS,CONTROL FLOW** Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if –elif-else); Iteration: state, while, for, break, continue, pass; **Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.**	5+4
III	**FUNCTIONS, STRINGS** Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module. **Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs**	5+4
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, 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.**	5+4
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages **Illustrative programs: Reading writing in a file, word count, Handling Exceptions**	9
	Total Instructional Hours	45

Course Outcome

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

CO1: Develop algorithmic solutions to simple computational problems

CO2: Read, write, execute by hand simple Python programs

CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions

CO4: Represent compound data using Python lists, tuples, dictionaries

CO5: Read and write data from/to files in Python Programs.

TEXT BOOKS:

T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2, Shroff Publishers, First edition (2017).

T2:S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, 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 Pythonl, 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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Dean (Academics)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/	22HE1095	UNIVERSAL HUMAN VALUES (COMMON TO ALL BRANCHES)	2	0	0	0

Course Objectives

The student should be made

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. To highlight plausible implication sofsuchaHolisticunderstanding Interms ofethicalhumanconduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Unit	DESCRIPTION	Instructional Hours
I	**Introduction to Value Education** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations	6
II	**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	6
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 Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasivespace Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence. Vision for the Universal Human Order	6
V	**Implications of the Holistic Understanding – a Look at Professional Ethics** Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical CaseStudiesStrategies for Transition towards Value-based Life and Profession	6
	Total Instructional Hours	**30**

Course Outcome

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

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'ManualforAFoundationCourseinHumanValuesandProfessionalEthics,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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rogramme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22HE1072	**ENTREPRENEURSHIP & INNOVATION (Common for all Branches)**	1	0	0	1

Course Objectives

The student should be made

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

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

Course Outcome

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

CO1: Understandthenatureofbusinessopportunities,resources,andindustriesincriticalandcreative aspects.

CO2: Understand the processes by which innovation is fostered, managed, and commercialized.

CO3:Remember effectively and efficiently the potential of new business opportunities.

CO4:Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness..

CO5:Developabusiness model for a new venture, including revenue. Margins, operations, Working capital, and investment

TEXTBOOKS

T1:AryaKumar"Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization",Pearson,SecondEdition(2012).
T2:EmrahYayici"DesignThinkingMethodology", Artbiztech,FirstEdition(2016).

REFERENCEBOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen &Unwin Publication, Fourth Edition (2007).
R2: ThomasLockWood&EdgerPapke"InnovationbyDesign",Career Press.com,SecondEdition(2017).
R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, FirstEdition(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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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MC1094	**HERITAGE OF TAMIL**	2	0	0	0

Course Objective

The learner should be able to

1. Introduce students to the great History of Tamil literature.
2. Establish the heritage of various forms of Rock art and Sculpture art.
3. To study and understand the various folk and Martial arts of Tamil culture
4. Introduce students to Ancient Tamil concepts to understand the richness of Tamil literature.
5. To learn about the various influences or impacts of Tamil language in Indian culture.

Unit	Description	Instructional Hours
I	**Language and Literature** Language families in India – Dravidian Languages – Tamil as a classical language – Classical Literature in Tamil- Secular nature of Sangam Literature – Distributive justice in Sangam Literature – Management principles in Thirukural – Tamil epics and impacts of Buddhism & Jainism in Tamil and Bakthi literature of Azhwars and Nayanmars – Forms of minor poetry _ Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidasan.	6
II	**Heritage _ Rock Art Paintings to Modern Art – Sculpture** Hero Stone to Modern Sculpture – Bronze icons – Tribes and their handcrafts - Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar statue at Kanyakumari, Making of musical instruments – Mridangam, Parai, Yazh and Nadhaswaram - Role of Temples in social and economic life of Tamils.	6
III	**Folk and Martial Arts** Therukoothu, Karagattem, Villupattu, Kaniyan koothu, Oyilattam, Leather puppertry, Silambattam., Valari Tiger dance – Sports and Games of Tamils.	6
IV	**Thinai Concept of Tamils** Flora and Fauna of Tamils – Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram concept of Tamils – Education and Literacy during Sangam Age - Ancient cities and ports of Sangam age – Exporot and Import during Sangam age – Overseas conquest of Cholas.	6
V	**Contribution of Tamils to Indian National Movement and Indian Culture** Contribution of Tamils to Indian freedom struggle – The cultural influence of Tamils over the other parts of India – Self respect movement – Role of Siddha Medicine in indigenous systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil books.	6
	Total Instructional Hours	**30**

Course Outcome

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

CO1: Learn about the works pertaining to Sangam age
CO2: Aware of our Heritage in art from Stone sculpture to Modern Sculpture.
CO3Appreciate the role of Folk arts in preserving, sustaining and evolution of Tamil culture.
CO4: Appreciate the intricacies of Tamil literature that had existed in the past.
CO5: Understand the contribution of Tamil Literature to Indian Culture

TEXTBOOKS:

T1: Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
T2: Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
T3: Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).

REFERENCEBOOKS:

R1-The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
R2- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
R3-Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE1073	INTRODUCTION TO SOFT SKILLS	0	0	0	1

Course Objectives:

1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice.
2. To enhance the students 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	2
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 quantitative problems.
CO4: Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity.
CO5: Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar.

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செம்மொழி –
நன்மை – சங்க
கருத்துக்கள் –
நாக்கம் - பக்தி

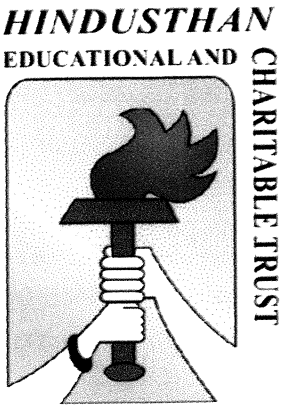
தமிழில்
மற்றும்

3
டியினர்
– தேர்
கள் –
. பறை.
ாழ்வில்

3
லாட்டம்,
ர்களின்

3
சங்க
ாற்றிய
யும் –
மற்றும்

3
கிளில்
வத்தில்,
தமிழ்ப்



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HINDUSTHAN

COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore – 641032

DEPARTMENT OF CHEMICAL ENGINEERING

Revised Curriculum and Syllabus for the Batch 2020-2024

(Academic Council Meeting Held on 19.06.2023)

2019 REGULATIONS

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

R2019

Sl. No	Course Code & Name	Existing Syllabus	Revised Content	Type of Revision (Deletion/Insertion/Modification)	% Revision
1	19CH7202-PROCESS EQUIPMENT DESIGN	UNIT-II -Cooling Tower, Dryers	UNIT-II-Design of single-effect evaporator.	Insertion	25
		UNIT-III- Absorption column, Distillation Column, Extraction Column, Adsorption column.	UNIT-III- Extraction Column		
		Unit-IV- Packed bed Reactors, Pressure Vessel, Storage Vessel.	UNIT-IV- CSTR,PFR		

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ACADEMIC YEAR-2023-2024

CO'S, PO'S & PSO'S MAPPING

Semester – I

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

Course Code & Name : 22ME1201/ ENGINEERING DRAWING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	2	3	2	-	1	-	1	-	-	1	1	1	1	2	-
CO2	3	3	2	1	1	-	1	-	-	1	1	1	1	2	-
CO3	3	3	3	-	1	1	1	-	-	1	1	-	1	1	-
CO4	3	3	3	1	1	2	1	-	-	1	1	1	1	1	-
CO5	3	3	3	1	1	3	1	-	-	1	1	1	1	1	-
Avg	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4	-

Course Code & Name : 22HE1151 / ENGLISH FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					1	2	2	2	3	1	1	1	2
CO2	2	1			1	1	1	2	2	3		2		2
CO3	2	1			1	1	2	3	3	3		1	1	2
CO4	2	1				1	2	2	2	3	1	1		
CO5	2					1	1	2	3	3		1	1	2
Avg	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2

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

Course Code & Name : 22IT1151/PYTHON PROGRMMING PRACTICES

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

HINDUSTHAN
EDUCATIONAL AND CHARITABLE TRUST

HICET

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

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

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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Chairman
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DEAN ACADEMICS
Dean (Academics)
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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.	**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**	**தமிழர்மரபு**/ 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	**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**	**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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COIMBATORE - 641 032.

HINDUSTHAN ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

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.

Chairman, Board of Studies

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COUNCIL OF ENGG & TECH Chairman

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

The student should be able to

Course Objective

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:** Calorific value of fuels, Flue gas analysis, Orsat analysis, theoretical and excess air requirement for solid, liquid and gaseous fuels.	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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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; Losses in pipes - 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. Buoyancy, Condition of Equilibrium for Submerged and Floating Bodies, Centre of Buoyancy, Metacentre–Determination of Metacentric Height.	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. performance of multistage pumps - Cavitation - methods of prevention.	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.

Chairman, Board of Studies

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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. Heat effect accompanying chemical reaction.	9
III	**SECOND LAW OF THERMODYNAMICS** : Statements of the second law of thermodynamics, heat engine, heat pump and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, entropy balances for open system, Clausius Inequality 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. Fugacity and activity	9
V	**COMPRESSIBLE FLUID FLOW& STEAM ENGINES**: Duct flow of compressible fluids, Compression and expansion processes, steam power plant, internal combustion engines, Gas-turbine power plant, 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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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:** Particle Shape, Size, Mixed Particle Sizes and Size Analysis – Cumulative and Differential Analysis –Various Mean Diameters – Screen Analysis Standard Screens – Various Industrial Screens. **Sieve analysis.**	6+3
II	**SIZE REDUCTION:** Principles of Comminution - Energy and Power Requirements in Comminution - Mechanical Efficiency-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), 3rd 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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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	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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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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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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2024-25 ODD

ACADEMIC YEAR-2023-2024

CO'S, PO'S & PSO'S MAPPING

Semester – III

Course Code & Name: 22CH3201-CHEMICAL PROCESS CALCULATIONS

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

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	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	2	-	1	-	1	1	-	3	2	1
CO2	3	2	2	2	1	2	-	1	1	1	-	1	1	1	1
CO3	3	2	2	2	1	1	-	1	-	1	1	1	3	1	2
CO4	3	2	3	2	2	2	-	1	-	1	1	2	3	1	2
CO5	3	2	3	2	2	2	-	1	-	1	2	2	3	1	2
AVG.	3	2.2	2.2	2	1.6	1.8	-	1	1	1	1.25	1.5	2.6	1.2	1.6

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

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

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

Course Code & Name: 22CH3251-MECHANICAL OPERATIONS

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

1-2022 Consolidate

Mapping of Course Outcome and Programme Outcome

Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	I	22MA1101 Matrices & Calculus	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1	-	-
		22ME1201 Engineering Drawing	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1	-	-
		22PH1151 Physics of Materials	3	2.6	2.6	1.6	2.2	1	1	-	1	-	1.6	2.2	2.4	1.4	3
		22HE1151 Englishfor Engineers	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2	2
		22IT1151 Python Programming and Practices	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4	-
II	III	22MA3107 Numerical Methods	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1	-	-
		22CH3201 Chemical Process Calculations	3	3	3	3	1	1	1	-	1	-	-	2.2	2.2	1	3
		22CH3202 Fluid Flow Operations	3	2.2	2.2	2	1.6	1.8	-	1	1	1	1.2	1.5	2.6	1.2	1.6
		22CH3203 Chemical Engineering Thermodynamics – I	3	2	3	1	-	-	-	-	-	-	1	-	1	1	-
		22CH3251 Mechanical Operations	3	3	3	3	1	1	1	1	1	1		1.6	1.8	1	3
		22ME3253 Basic Mechanical Engineering	3	-	3	-	3	-	-	-	1	-	-	-	1	2	-
		22CH3001 Fluid Mechanics Lab	3	2		2	1	1	1.6		2.4	1.8		2	1.8	1.4	3
		22CH3002 Technical Analysis Lab	3	2		2	1	1	1.6		2.4	1.8		2	1.8	1.4	3

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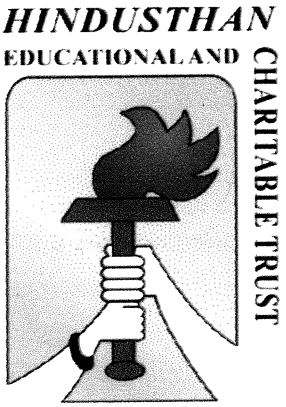

HICET

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 19.06.2023)

2019 REGULATIONS WITH AMENDMENT

HICET

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

R2019 With Amendment

Sl. No	Course Code & Name	Existing Syllabus	Revised Content	Type of Revision (Deletion/Insertion/Modification)	% Revision
1	21CH5301-ENERGY TECHNOLOGY	**UNIT-I** Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.	**UNIT-I-** Roles and responsibility of Ministry of New and Renewable Energy Sources, Consumption as Measure of Prosperity	**Insertion**	**20**
		UNIT-III Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.	**UNIT-III-** Wind rose diagram		
		UNIT-IV- Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.	**UNIT-IV-** Future role of biomass, Biomass programs in India.		

2	**21CH5251-WATER TREATMENT AND SOLID WASTE MANAGEMENT**	**UNIT-I** -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.	**UNIT-I-** Design of facilities for physical and chemical treatment.	**Insertion**	**20**
		UNIT-II- Preliminary/Primary/physical unit operations, Chemical unit processes, Secondary/Biological treatment process, aerobic/anaerobic attached and suspended growth process, Sludge treatment & Disposal.	**UNIT-II-** Disinfection: Basic Principles – Chlorinator – Chemical disinfection – Ozone Treatment. Sludge Processing: Separation, sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic. Nitrification and Denitrification Processes, Phosphorous removal.		

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HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST
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HindusthanCollegeofEngineering andTechnology
(AnAutonomousInstitution, Affiliatedto AnnaUniversity,Chennai
ApprovedbyAICTE,NewDelhi&AccreditedbyNAACwith'A'Grade)
ValleyCampus,PollachiHighways,Coimbatore,Tamilnadu.

TÜVRheinland CERTIFIED

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 Formulation 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 & Catalytic Cracking	PE	3	0	0	3	40	60	100
2	21CH6302	Enzyme Engineering	PE	3	0	0	3	40	60	100
3	21CH6303	Fundamentals of Nano science	PE	3	0	0	3	40	60	100
4	21CH6304	Corrosion Science and Engineering	PE	3	0	0	3	40	60	100
5	21CH6305	Piping and Instrumentation	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE III										
1	21CH7301	Natural Gas Engineering	PE	3	0	0	3	40	60	100
2	21CH7302	Pulp and Paper Technology	PE	3	0	0	3	40	60	100
3	21CH7303	Transport Phenomena	PE	3	0	0	3	40	60	100
4	21CH7304	Multicomponent Distillation	PE	3	0	0	3	40	60	100
5	21CH7305	Chemical Process Optimization	PE	3	0	0	3	40	60	100
6	21CH7306	Fundamentals and Testing of Rubber Compounds	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE IV										
1	21CH8301	Industrial Management	PE	3	0	0	3	40	60	100
2	21CH8302	Sugar Technology	PE	3	0	0	3	40	60	100
3	21CH8303	Total Quality Management	PE	3	0	0	3	40	60	100
4	21CH8304	Foundation Skills in Integrated Product Development	PE	3	0	0	3	40	60	100
5	21CH8305	Supply Chain Management	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE V										
1	21CH8306	Process Plant Utilities	PE	3	0	0	3	40	60	100
2	21CH8307	Fermentation Technology	PE	3	0	0	3	40	60	100
3	21CH8308	Frontiers of Chemical Technology	PE	3	0	0	3	40	60	100
4	21CH8309	Industrial Nanotechnology	PE	3	0	0	3	40	60	100
5	21CH8310	Drugs and Pharmaceutical Technology	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVES										
CHEMICAL ENGINEERING										
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1	21CH6401	Waste to Energy Conversion	OE	3	0	0	3	40	60	100
2	21CH7401	Biomass Conversion and Biorefinery	OE	3	0	0	3	40	60	100
LIFE SKILL COURSES										
3	21LSZ401	General Studies for Competitive Examinations	OE	3	0	0	3	40	60	100
4	21LSZ402	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	40	60	100
5	21LSZ403	Indian Ethos and Human Values	OE	3	0	0	3	40	60	100
6	21LSZ404	Indian Constitution and Political System	OE	3	0	0	3	40	60	100
7	21LSZ405	Yoga for Human Excellence	OE	3	0	0	3	40	60	100
NCC COURSES (Only 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

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	21CH5601	Introduction to Chemical Process	MDC	3	0	0	3	3
2	21CH6601	Fluid Flow Operations in Chemical Engineering	MDC	3	0	0	3	3
3	21CH6602	Fundamentals of Chemical Thermodynamics	MDC	3	0	0	3	3
4	21CH7601	Process Heat and Mass Transfer	MDC	3	1	0	4	4
5	21CH7602	Reaction Engineering	MDC	3	0	0	3	3
6	21CH8601	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	21MBXXX	Financial Management	MDC	3	0	0	3	3
2	21MBXXX	Fundamentals of Investment	MDC	3	0	0	3	3
3	21MBXXX	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	21MBXXX	Introduction to Block chain and its Applications	MDC	3	0	0	3	3
5	21MBXXX	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21MBXXX	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	21MBXXX	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	21MBXXX	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	21MBXXX	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	21MBXXX	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	21MBXXX	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	21MBXXX	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	21CEXXX	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	21AGXXX	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21BMXXX	Sustainable Bio Materials	MDC	3	0	0	3	3
4	21MEXXX	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21CEXXX	Green Technology	MDC	3	0	0	3	3
6	21CEXXX	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	21CH5205	Process Flow Sheeting	MDC	2	0	2	4	3
2	21CH6203	Transport Phenomena	MDC	3	1	0	3	4
3	21CH6204	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	21CH5206	Polymer Chemistry	MDC	3	0	0	3	3
2	21CH6205	Processing Technology	MDC	3	0	0	3	3
3	21CH6206	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	21CH5207	Petroleum Geology	MDC	3	0	0	3	3
2	21CH6207	Petroleum Exploration	MDC	3	0	0	3	3
3	21CH6208	Drilling Technology	MDC	3	0	0	3	3
4	21CH7207	Petroleum Production Engineering	MDC	3	0	0	3	3
5	21CH7208	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	21CH5208	Principles of Mass Spectrometry	MDC	3	0	0	3	3
2	21CH6209	Advanced Analytical Separation Techniques	MDC	3	0	0	3	3
3	21CH6210	Advanced Spectrometry: ICP-MS and LC-MS	MDC	3	0	0	3	4
4	21CH7209	Instruments for Morphology and Structural Characterization	MDC	3	0	0	3	3
5	21CH7210	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

The student should be able

1. Enable the students to gain knowledge on different types of chemical reactors.
2. Apply the students to design the chemical reactors under isothermal conditions.
3. Design the chemical reactors under and non-isothermal conditions

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**INTRODUCTION**: 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	**RESIDENCE TIME DISTRIBUTION**: 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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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	21CH5202	MASS TRANSFER - II	3	0	0	4

Course Objective

The student should be able to

1. Examine the 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.
2. Illustrate the process aspects and equipment used in the operations like ion exchange, extraction and leaching.
3. Analyze the separation of chemical components in distillation columns and adsorbers.

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 Outcome

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	Illustrate 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 BOOK:

T1 Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.

T2 Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.

T3 Geankoplis C.J., "Transport Processes and Separation Process Principles", 4 th Edition, Prentice-Hall of India, New Delhi, 2005.

REFERENCES:

R1 McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.

R2 Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley,2006.

R3 King,C.J.,"SeparationProcesses",2ndEdn.,TataMcGraw-Hill1980.

R4 Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.

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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 Objective

The student should be able to

1. Understand the measurement of different instrumentation measurement techniques
2. Identify the open and closed loop systems and its responses, control loop components and stability of control systems along with instrumentation.
3. Enable the students to compute the response of various control system strategies for different process dynamics and advanced control methods used in industries and research.

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.	9+3
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.	9+3
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.	9+3
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.	9+3
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.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

CO1	Understand the various measuring instruments in process industries.
CO2	Examine the response of first and second order systems
CO3	Analyze the closed loop control systems to determine the transient response, offset and their stability
CO4	Assess the frequency response of closed loop systems and describe the advanced control strategies
CO5	Evaluate the advanced control schemes and to control the equipment in chemical industries.

TEXT BOOK:

T1 Coughnowr, D., " Process Systems Analysis and Control ", 3rd Edn., McGraw Hill, New York, 2008.

T2 Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2003.

T3 C. D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson Education, 2005.

REFERENCES:

R1 Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp , Process dynamics and control I - 2nd ed. John Wiley & Sons, Inc.

R2 Marlin, T. E., " Process Control ", 2nd Edn, McGraw Hill, New York, 2000.

R3 Ogunnaike, B. A., & Ray, W. H. (1994). Process dynamics, modeling, and control (Vol. 1). New York: Oxford University Press.

R4 Seborg, D. E., Mellichamp, D. A., Edgar, T. F., & Doyle III, F. J. (2010). Process dynamics and control. John Wiley & Sons.

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

Course Objective

The student should be able to

1. Understand the fundamental knowledge on need for safety in chemical industries and safe handling of chemicals.
2. Analyze, act and train for emergency in a process industry
3. Apply the various hazards and prevention in commissioning stage of industry

Unit	Description	Instructional Hours
I	**NEED FOR SAFETY IN CHEMICAL INDUSTRIES:** Safety Programmes – components and realization; Types of hazards-chemical, physical, mechanical, ergonomics, biological and noise hazards, toxic chemicals; safe handling.	9
II	**IMPLEMENTATION OF SAFETY PROCEDURES**: Periodic inspection and replacement; Accidents – Causes, Effects, Costs, identification and prevention; Accident Investigation; Accident proneness; Major Accident Case Histories and Loss statistics; 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, Safety Laws - Factories act, ESI act and Workmen 's compensation act.	9
	Total Instructional Hours	45

Course Outcome

CO1	Understand the need for safety in chemical industries and operating conditions
CO2	Demonstrate the awareness of safety and examining inspection
CO3	Formulate emergency planning for chemical industry problems
CO4	Recognize the hazards and implement the effective process control and instrumentation.
CO5	Identify the safe operation of equipment in process industry.

TEXT BOOK:

T1 Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.

T2 Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.

T3 Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.

REFERENCES:

R1 Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969

R2 Heinrich, H.W. Dan Peterson, P.E. and Rood, N., " Industrial Accident Prevention", McGrawHill Book Co., 1980.

R3 Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

R4 Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.

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

Course Objective

The student should be able

1. To evaluate the quality of drinking water and assess its compliance with established standards and guidelines.
2. To evaluate the design concepts and operational considerations for preliminary and biological treatment processes.
3. To assess the challenges and opportunities associated with the application of advanced water treatment technologies associated with industrial sectors
4. To comprehend the material flow in society and explore strategies for reducing raw material usage, waste generation, and promoting the reuse of materials and energy recovery.

Unit	Description	Instructional Hours
I	**Water Resource Management:** 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. Design of facilities for physical and chemical treatment.	9
II	**Water Treatment and Sludge Management:Preliminary/Primary/physical unit operations,** Disinfection: Basic Principles – Chlorinator – Chemical disinfection – Ozone Treatment, Chemical unit processes, Secondary/Biological treatment process, aerobic/anaerobic attached and suspended growth process, Sludge treatment & Disposal. Sludge Processing: Separation, sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic. Nitrification and Denitrification Processes, Phosphorous removal.	9
III	**Advanced Treatment Techniques and its applications:** Ultrafiltration, **Filtration, Adsorption on Activated Carbon,** Ion Exchange, Reverse Osmosis, Electro dialysis cell, Acoustic nanotube, photocatalytic water purification, aquaporin, automatic variable filtration (AVF) technologies. Wastewater treatment in Industries: Paper and Pulp, distillery, Leather, Food processing such dairy and fruit processing and Textile processing.	9
IV	**Electrochemical Processes:** Electro coagulation process in water and wastewater 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 wastewater treatment process. Zero discharge process for wastewater treatment plant.	9
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.	9
	Total Instructional Hours	45

Course Outcome

CO 1	Evaluate water consumption standards and regulations and their significance in ensuring safe and sustainable water supply.
CO 2	Gain knowledge of sludge treatment and disposal methods, including different techniques for sludge handling, thickening, dewatering, conditioning, and ultimate disposal.
CO 3	Evaluate the potential for resource recovery and waste minimization through the application of advanced treatment techniques in industrial wastewater treatment.
CO 4	Understand the integration of electrochemical processes with other treatment technologies for comprehensive water and wastewater treatment.
CO 5	Critically analyze the environmental, social, and economic implications of solid waste management practices and nuclear waste disposal.

TEXT BOOK:

T1 R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill publishing Co. Ltd., 2 nd edition, 2006

T2 G.W. Ewing, Instrumental Methods of Analysis, Mc Graw Hill, 2004.

T3 Liptak, B.G., Process Measurement and Analysis, CRC Press, 2005.

REFERENCES:

R1 Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005

R2 Patranabis,D., Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.

R3 Eckman D.P., Industrial Instrumentation, Wiley Eastern Limited, 1990

R4 Braun, R.D., Introduction to Instrumental Analysis, Mc Graw – Hill, Singapore, 2006.

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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.	21CH5302	PETROLEUM FORMATION EVALUATION	3	0	0	3

Course Objective	The student should be able to
	1. Acquire knowledge on the concepts of petroleum products involved in day today life.
	2. Understand the overall view of the petroleum formation evaluation and chemical engineering.
	3. Illustrate basic principles involved in analysis of petroleum products.

Unit	Description	Instructional Hours
I	**INTRODUCTION:** Formation evaluation basics, Borehole environment, Invasion and resistivity profile, Basic information needed in log interpretation, Mud Log and Cutting Analysis, Temperature logs, Basic working principle of various logging tools.	9
II	**ROUTINE LOGGING:** Introduction to wireline logging, Coring and Core Analysis, Porosity Logs-Density-neutron – Sonic. Resistivity Logs- Laterologs- Induction logs- Flushed Zone Resistivity log- High frequency measurements. Spontaneous Potential (SP) log- Shale Volume Calculation-Formation water resistivity determination.	9
III	**SPECIAL LOGGING TECHNIQUE:** Magnetic resonance image logging, Dip meter, geochemical log, Cement bond log, variable density log, Types of rocks, Gamma ray log- Shale Volume Calculation-Spectral Gamma ray log.	9
IV	**WELL LOG INTERPRETATION METHOD:** Qualitative methods, Quantitative methods, Petrophysical Techniques- Neutron Density Lithology Plot- Neutron Sonic Lithology Plot- Density Sonic Lithology Plot- MN Lithology Plot- MID Lithology Plot- Alpha Mapping from the SP Log.	9
V	**WELL LOG INTERPRETATION USING PETROPHYSICAL ANALYSIS:** Porosity, permeability, water saturation calculations, rock mineralogy, shaly-sand analysis, log interpretation.	9
	Total Instructional Hours	45

Course Outcome		
	CO1	Acquire knowledge through carry out experiments about physical and chemical characterization of petroleum products and apply knowledge in industries.
	CO2	Illustrate the concept of routine logging.
	CO3	Evaluate the Special Logging Technique.
	CO4	Examine the concept of log interpretation method.
	CO5	Understand the advanced control schemes and to control the equipment in petroleum industries.

TEXT BOOK:

T1	Malcom Rider, Second Edition, 2002: The Geological Interpretation of well logs, Rider-French Consulting limited.
T2	Oeberto Serra & Lorenzo Serra, 2004: Well logging - data acquisition and applications, EditionSerralog, France.
T3	Petroleum Reservoir Engineering Practice, Nnaemeka Ezekwe.

REFERENCES:

R1	Engineering Practice for Petroleum Drilling and Production,Donald W. Dareing
R2	Introduction to MATLAB for Chemical & Petroleum Engineering 2nd Edition Sam Toan, Hertanto Adidharma, Bahareh Nojabaei
R3	Reservoir Engineering in Modern Oilfields Vertical, Deviated, Horizontal and Multilateral Well Systems Wilson Chin
R4	Reservoir Engineering of Conventional and Unconventional Petroleum Resources Nnaemeka Ezekwe

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	21CH5301	ENERGY TECHNOLOGY	3	0	0	3

The student should be able

Course Objective

1. To create awareness about sources of energy and able to estimate how long the available conventional fuel reserves will last.
2. To learn the fundamental concepts about solar energy systems and devices and to design wind turbine blades, hydro systems and geothermal energy system
3. To know about Biomass energy and energy conservation

Unit	Description	Instructional Hours
I	**ENERGY:** Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives. Roles and responsibility of Ministry of New and Renewable Energy Sources, Consumption as Measure of Prosperity	9
II	**CONVENTIONAL ENERGY:** Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.	9
III	**NON-CONVENTIONAL ENERGY:** Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm,Wind rose diagram, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.	9
IV	**BIOMASS ENERGY:** Biomass origin - Resources – Biomass estimation. Thermo-chemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.Future role of biomass , Biomass programs in India.	9
V	**ENERGY CONSERVATION:** Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit - Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Understand of renewable and non-renewable sources of energy
CO2	Remember the applications of different renewable energy sources like ocean thermal, hydro, geothermal energy etc.
CO3	To identify, formulate and solve engineering problems in renewable energy processes.
CO4	Develop capability to do basic design of bio gas plant
CO5	Predict about the energy conservation and management

TEXT BOOK:

T1 Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.

T2 Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.

T3 Energy Management, Paul W.O'Callaghan McGraw – Hill, 1993

REFERENCES:

R1 Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.

R2 El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.

R3 Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

R4 Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008.

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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 equipment.

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

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

REFERENCE BOOKS:

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

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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

Analyze and use the right type of control dynamics for process control under different operative conditions.

REFERENCE BOOKS:

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

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MINOR DEGREE SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	21CH5601	INTRODUCTION TO CHEMICAL PROCESS	3	0	0	3

Course Objective

The student should be able

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 .	9
II	**MATERIAL BALANCE WITHOUT CHEMICAL REACTION:** Humidity and Saturation – Relative and percentage saturation, Wet bulb and dry bulb temperature, Dew point – Use of humidity chart for engineering calculations	9
III	**MATERIAL BALANCE WITH CHEMICAL REACTION:** Stoichiometric equation – stoichiometric ratio – limiting reactant – excess reactant – percent excess – conversion	9
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 –	9
V	**COMBUSTION CALCULATIONS:** Calorific value of fuels, Flue gas analysis, Orsat analysis, theoretical and excess air requirement for solid, liquid and gaseous fuels	9
	Total Instructional Hours	45

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 MeeraShariffaBegam" 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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B.Tech HONOR & HONOR WITH SPECIALIZATION SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	21CH5205	PROCESS FLOW SHEETING	3	0	0	3

Course Objective

The student should be able

1. To introduce about flowsheet simulation
2. To teach solution strategy of steady state and unsteady state systems.
3. To practise the real time flow sheets of chemical process industries

Unit	Description	Instructional Hours
I	**Introduction:** Mathematical models of chemical engineering systems: Introduction; Use of mathematical models; Scope of coverage; Principles of formulation; Fundamental laws; Continuity equation; Energy equation; Equations of motion; Transport equations; Equations of state; Equilibrium; Chemical kinetics.	9
II	**Mathematical Models of Chemical Engineering Systems:** Introduction; Series of isothermal, constant holdup CSTRs; CSTRs with variable hold-ups; Two heated tanks; Gas phase pressurized CSTR; Non-isothermal CSTR; Single component vaporizer; Multicomponent flash drum; Batch reactor; Reactor with mass transfer; Ideal binary distillation column; Batch distillation with holdup; pH systems.	9
III	**Processing Simulation with Software's:** ASPEN PLUS/Hysis/PRO II/Design II/UniSim/OLI Pro/Aspen Custom Modeler/TK-Solve r: Introduction to the Simulation Package; Features of simulation packages; Introduction to the simulation package Graphical User Interface	9
IV	**Design of following equipment using ASPENPLUS software:** Heat Exchanger, Absorption column, Distillation column, Reactor, Evaporator, Flow sheeting of a chemical plant, Simulation of a small size chemical plant.	9
V	**Physical Properties:** Overview of physical property system; Property model specifications; Property data requirements and input; Physical property analysis.	9
	Total Instructional Hours	45

Course Outcome

CO1	Synthesize a flowsheet for the process on paper and implement this in a simulation program.
CO2	Deal with ASPEN PLUS/HYSIS/PRO II/Design II/UniSim/OLI Pro/Aspen Custom Modeler/TK-Solver.
CO3	Use process flowsheet simulations to solve problems in the chemical industry.
CO4	Estimate the thermo-physical properties for the chemical species and identify the correct models to use.
CO5	Design a distillation column, feed height and number of trays in a column.

TEXT BOOK:

T1 William L. Luyben – Process Modeling, Simulation and Control for Chemical Engineers – 2nd edition, McGraw Hill International Edition; 1990

T2 Lorentz T. Biegler, E. Ignacio Grossmann and Arthur W. Westerberg – Systematic Methods of Chemical Process Design – Prentice Hall International – 1997

T3 K.M. Hangos and I. T. Cameron, "Process Modelling and Model Analysis", Academic Press.

REFERENCES:

R1 W. F. Ramirez, "Computational Methods for Process Simulation", 2nd ed., Butterworths. 1997

R2 A.K. Jana " Process Simulation and Control using ASPEN", PHI Learning Pvt Ltd. 2012

R3 Sakari Kaijaluoto "Process Optimization by Flowsheet Simulation", Technical Research Centre of Finland. 1984

R4 A.W. Westerberg, et al, "Process Flow Sheeting", Cambridge University Press. 1990

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	21CH5207	PETROLEUM GEOLOGY	3	0	0	3

Course Objective

The student should be able to

1. Understand the geological practices in the petroleum industry.
2. Illustrate the roles and responsibilities, oil and gas formation, oil and gas traps, porosity and Permeability.
3. Apply the reserve assessment, recovery factors, drill well planning, existing well.

Unit	Description	Instructional Hours
I	**BASIC OVERVIEW** Petroleum Geology – application of geology (study of Earth, materials and processes) to the exploration and production of oil and natural gas	9
II	**OVERVIEW OF SEDIMENTARY ROCKS:** Denudation of the Earth's surface, Weathering - surface processes operating on rock from the earth's crust, Rates of Weathering, Overview of Sedimentary Structures and Sedimentary Environments.	9
III	**PROPERTIES OF RESERVOIR FLUIDS:** Overview Of Reservoir Fluid Content, formation water- Classification – Characterization- Oil Field Brines / Connate Water. Measuring concentrations of solutes in aqueous solutions	9
IV	**GENERATION AND MIGRATION OF PETROLEUM:** Introduction, Modern Organic Processes, Preservation of Organic Matter and Prediction of Source Rocks Petroleum Generation.	9
V	**RESERVOIR SYSTEM AND CHARACTERIZATION:** Material Controls on Primary Porosity, Homogeneity and Heterogeneity of the Reservoir, Reservoir Saturation Conditions,	9
	Total Instructional Hours	45

Course Outcome

CO1	Understand the application of geology and production.
CO2	Apply the method of weathering and overview of sedimentary rocks.
CO3	Estimate the properties of reservoir fluids.
CO4	Inspect the generation and migration of petroleum.
CO5	Calculate the homogeneity of reservoir.

TEXT BOOK:

T1 Duff,P.M.D.,&Duff,D.(Eds.).(1993).Holmes' principles of physical geology.

T2 Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge University Press.

T3 Trujilo, A. and Thurman, H. (2012) Essentials of Oceanography, 12th Edition, Pearson

REFERENCES:

R1 Deer, W.A., Howie, R.A., & Zussman, J.(1992).An introduction to the rock-forming minerals (Vol. 696). London: Longman.

R2 Hota, R. N. (2017) Practical approach to crystallography and mineralogy, CBS Publishers and Distributors, New Delhi

R3 Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.

R4 Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	21CH5206	POLYMER CHEMISTRY	3	0	0	3

The student should be able to

Course Objective

1. Understand the importance of the chemical approach to polymers.
2. Illustrate the, methods of measuring the molecular weight, polymerization kinetics and Copolymerization and polymer processing technologies.
3. Examine the mechanical properties and applications of polymers.

Unit	Description	Instructional Hours
I	**POLYMER SYNTHESIS AND CHARACTERIZATION:** Methods of Polymer synthesis- Free Radical, cationic, anionic, coordination, condensation Polymerization, metathesis, Atom and Group transfer method (ATRP, RAFT), heterocyclic polymerization	9
II	**PROPERTIES AND APPLICATIONS:** Morphology and order in crystalline polymers-configurations of polymer chains. Polymer structure and physical properties-crystalline melting point Tm-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion	9
III	**MATERIAL BALANCE WITH CHEMICAL REACTION:** Stoichiometric equation – stoichiometric ratio – limiting reactant – excess reactant – percent excess – conversion	9
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 –	9
V	**COMBUSTION CALCULATIONS:** Calorific value of fuels, Flue gas analysis, Orsat analysis, theoretical and excess air requirement for solid, liquid and gaseous fuels	9
	Total Instructional Hours	45

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 reactionsand 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 Textbook of Polymer Chemistry , F.W. Billmeyer Jr., John Wiley (1994)

T2 Principles of Polymer Chemistry , P.J. Flory, Cornell Univ Press (1957)

T3 Introduction to Polymer Chemistry , R.B. Seymour, McGraw Hill (1971)

REFERENCES:

R1 Physical chemistry of Polymer , A Tager, Mir Pub (1978)

R2 Macromolecular Solution : Solvent Property Relationship in Polymers , R. Saymour , Pergamon Press (1982)

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

R4 Plastic Materials, J. A. Brydson, Butterworth Heineman (1982)

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	21CH5208	PRINCIPLES OF MASS SPECTROMETRY	3	0	0	3

Course Objective

The student should be able

1. To gain knowledge on fundamental principles of mass spectrometry instrumentation To provide training in the principles of mass spectrometry
2. To provide training in the different types of mass spectrometry
3. To understand key concepts of mass spectrometry and its application to real-world analytical challenges.

Unit	Description	Instructional Hours
I	**Introduction** Basic principle, Theory, Principle and Instrumentation; Ionisation types and sources - Electron impact, Chemical ionization, Electrospray ionization, Desorption Electro spray ionization, Other sources: Atmospheric pressure Chemical ionization, ICP, etc., Acceleration, Deflection, Detection, Ion formation and types.	9
II	**Mass Analyzer** Magnetic Sector Analyzers, Double-Focusing Spectrometers, Quadrupole Mass Spectrometers, TOF Mass Analyzers, Ion-Trap Analyzers, Fourier Transform Spectrometers, Tandem Mass Spectrometry, Computerized Mass Spectrometers.	9
III	**Fragmentation process** General rules for fragmentation, Stevensons rule, Factors influencing Fragmentation process, General modes of fragmentation; Simple cleavage- Homolytic cleavage, Heterolytic cleavage, Retro Diels-Alder reaction. Rearrangement reactions accompanied by transfer of atoms- Scrambling, Mc Lafferty rearrangement, Elimination.	9
IV	**Fragmentation patterns and fragmentation characteristic relation to parent structure and functional groups:** Saturated Hydrocarbons- Straight chain compounds, Branched Chain Hydro Carbons. Alkenes- Aromatic compounds, Alcohols, Aromatic alcohols, Phenols, Aldehydes, Ketones, Nitro Compounds, Aliphatic acids, Halogen Compounds, Ethers, Aromatic Ethers.	9
V	**Applications** –Omics (proteomics, metabolomics, etc.), Pharmacology/Toxicology, Environmental Monitoring/Analysis Organic chemistry.	9
	Total Instructional Hours	45

Course Outcome

CO1	Discuss the basic principles of operation of a mass spectrometer and the principles of manipulating ions in electric and magnetic field
CO2	Acquire mass spectra using several common mass spectrometry platforms
CO3	Interpret mass spectra for chemical formula determination
CO4	Interpret mass spectra to gain structural information for organic molecules
CO5	Identify the application of mass spectroscopy

TEXT BOOK:

T1 Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler, Daniel A. Crowl, Stanley R. Crouch, Cengage Learning, Seventh Edition, 2018.

T2 Mass Spectrometry Principles and Applications, Edmond de Hoffmann, Vincent Stroobant, Third Edition, John Wiley & Sons Ltd

T3 G.W. Ewing, Instrumental Methods of Analysis, Mc Graw Hill, 2004.

REFERENCES:

R1 Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005

R2 Patranabis,D., Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.

R3 Eckman D.P., Industrial Instrumentation, Wiley Eastern Limited, 1990

R4 Braun, R.D., Introduction to Instrumental Analysis, Mc Graw – Hill, Singapore, 2006

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21CEXXXX	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	3	0	0	3

Course Objective

1. To gain knowledge on concepts and socio-economic policies of sustainable development.
2. To examine the strategies for implementing sustainable development programmes.
3. To learn the various sustainability and performance indicators, their assessment techniques and constraints
4. To explore the different approaches for resource management for a sustainable urban planning.
5. To understand the principles of urban planning and built-in environment.

Unit	Description	Instructional Hours
	INTRODUCTION TO SUSTAINABLE DEVELOPMENT	
I	Definitions and principles of Sustainable Development - History and emergence of the concept of Sustainable Development - Environment and Development linkages- Globalization and environment – Millennium Development Goals: Status (global and Indian) Impacts on approach to development policy and practice in India, future directions.	9
	ENVIRONMENTAL SUSTAINABILITY	
II	Land, Water and Food production - Moving towards sustainability: Energy powering Sustainable Development - Financing the environment and Sustainable Development.	9
	SUSTAINABILITY INDICATORS	
III	Sustainability indicators – Hurdles to Sustainability-Operational Guidelines-Interconnected prerequisites for sustainable development - Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.	9
	URBAN PLANNING AND ENVIRONMENT	
IV	Environment and Resources, Sustainability Assessment, Future Scenarios, Form of Urban Region, Managing the change, Integrated Planning, Sustainable Development.	9
	THE BUILT-IN ENVIRONMENT	
V	Urban Form, Land Use, Compact Development, Principles of street design- complete streets, Transport Integrated Urban land use Planning, Guidelines for Environmentally Sound Transportation.	9
	Total Instructional Hours	**45**

Course Outcome

The students will be able to:
CO1: Describe the concepts and socio-economic policies of sustainable development.
CO2: Recognize and identify the strategies for implementing sustainable development programmes.
CO3: Comprehend the various sustainability and performance indicators, their assessment techniques and constraints
CO4: Identify the different approaches for resource management for a sustainable urban planning
CO5: Illustrate the principles of urban planning and built-in environment.

REFERENCE BOOKS:

R1. Gilg A W and Yarwood R," Rural Change and Sustainability-Agriculture, the Environment and Communities", CABI Edited by S J Essex, September 2005.
R2. Ganesha Somayaji and Sakarama Somayaji, "Environmental Concerns and Sustainable development: Some perspectives from India", Editors: publisher TERI Press, ISBN 8179932249.
R3. James H. Weaver, Michael T. Rock, Kenneth Kustere, "Achieving Broad-Based Sustainable Development: Governance, Environment, and Growth with Equity", Kumarian Press, West Hartford, CT. Publication Year,1997.
R4. Kirkby. J, O'Keefe P. and Timberlake, "Sustainable development" Earth Scan Publication, London,1996.
R5. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press,ISBN:1852930039.
R6. Munier N, "Introduction to Sustainability", Springer2005

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	21CS5602	FINANCIAL MANAGEMENT	3	0	0	3

Course Objective

1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance
3. To describe about capital budgeting and cost of capital
4. To discuss on how to construct a robust capital structure and dividend policy
5. To develop an understanding of tools on Working Capital Management.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO FINANCIAL MANGEMENT** Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value ofmoney- Risk and return concepts	9
II	**SOURCES OF FINANCE** Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, TradeCredit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc	9
III	**INVESTMENT DECISIONS:** Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting — Payback -ARR – NPV – IRR – Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of costof capital - Weighted Average Cost of Capital.	9
IV	**FINANCING AND DIVIDEND DECISION** Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capitalstructure . Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy	9
V	**WORKING CAPITAL DECISION** Working Capital Management: Working Capital Management - concepts - importance - Determinants of Working capital. Cash Management: Motivesfor holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies	9
	Total Instructional Hours	**45**

Course Outcome		
	CO1:	Acquire the knowledge of the decision areas in finance.
	CO2:	learn the various sources of Finance
	CO3:	describe about capital budgeting and cost of capital
	CO4:	construct a robust capital structure and dividend policy
	CO5:	develop an understanding of tools on Working Capital Management.

TEXT BOOKS:

1.M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill

2.M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd

REFERENCE BOOK:

1 James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,.

2. Prasanna Chandra, Financial Management,

3. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011

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Foundations of Entrepreneurship

Course Objective:

CO1: To enable students gain insights on entrepreneurship.
CO2: To make students understand the sources of product & business ideas.
CO3: To provide knowledge on business opportunity identification.
CO4: To enable students to develop business plan
CO5: To enable students to prepare feasibility reports and understand trends in entrepreneurship.

Unit I – Introduction to Entrepreneurship: Entrepreneurial growth in India; sources of entrepreneurship in India. Entrepreneurship process; entrepreneurial mindset: concept and impact; Entrepreneurial growth strategies. Characteristics of an Entrepreneur – Qualities of an Entrepreneur. Entrepreneurial success and failure - reasons and remedies.

Unit II – Product Development: Introduction and Meaning of a Product – Sources of Business or Product Ideas – Criteria for Selecting a Product – Barriers to the successful development of New Products – Why do new products fail. Technology - Considerations in selecting technology.

Unit III - Business Opportunity Identification: Need and Importance - Steps in identification of Business Opportunity. Techniques of market Survey – Market Research Procedure.

Unit IV – Business Plan Development: Business modelling: concept, types and functions; Innovation and Entrepreneurship: concept and challenges. The business plan as an entrepreneurial tool, Elements of business planning, Objectives, Market analysis, development of Product/idea, Marketing, Finance, Organization and management, Ownership, Critical risk contingencies of the proposal, Scheduling and milestones.

Unit V- Feasibility Report & trends: Contents of a feasibility report – Considerations while preparing a feasibility report – Proforma of a feasibility report. Technical, Financial, Marketing, Personnel, and management feasibility reports. Trends in entrepreneurship: Rural, Social and women entrepreneurship.

Course Outcome:

CO1: Understand the basics of entrepreneurship and its process.

CO2: Understand the concept of product development and the role of technology.

CO3: Able to understand and identify business opportunity

CO4: Able to develop business plan / business model

CO5: Able to prepare feasibility reports and understand the trends in entrepreneurship.

Text Books:

1. S.Anil Kumar, S.C.Poornima, Mini KAbraham, K.Jayashree "Entrepreneurship Development" , New Age International Publishers.
2. Jasmer singh Sain, Entrepreneurship and small Business" Deep and Deep publication
3. Shankar Raj, "Entrepreneurship Theory and Practice" Vijay Nicole Imprints Pvt ltd.
4. Khanka, S.S, "Entrepreneurship Development", S. Chand & company
5. Vasant Desai, "Fundamentals of Entrepreneurship "Himalaya Publishing House.

Reference Books:

1. Khanna, S. S., Entrepreneurial Development, S. Chand, New Delhi.
2. Hisrich D. Robert, Michael P. Peters, Dean A. Sheperd, Entrepreneurship, McGraw-Hill,6 ed.
3. Zimmerer W. Thomas, Norman M. Scarborough, Essentials of Entrepreneurship and Small Business Management, PHI,4 ed.
4. Holt H. David, Entrepreneurship: New Venture Creation, Prentice- Hall of India, New Delhi, Latest edition.
5. Kuratko, F. Donald, Richard M. Hodgetts, Entrepreneurship: Theory, Process, Practice, Thomson, 7ed.
6. Desai, Vasant, Dynamics of Entrepreneurship: New Venture Creation, Prentice-Hall of India, New Delhi, Latest edition.
7. Patel, V. G., The Seven Business Crises and How to Beat Them, Tata McGraw-Hill, New Delhi, 1995.
8. Roberts, Edward B.(ed.), Innovation: Driving Product, Process, and Market Change, San Francisco: Jossey Bass, 2002.

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CO'S, PO'S & PSO'S MAPPING

Semester – V

Course Code & Name: 21CH5201-CHEMICAL REACTION ENGINEERING-I

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	3							1	1			3	3	1
CO2	3	3	2						1	1			2	3	
CO3	2	3							1	1				3	2
CO4	2	2	3						2	1			2	2	3
CO5		2	2						2	1				3	3
AVG	**2**	**2.6**	**2.3**						**1.4**	**1**			**2.3**	**2.8**	**1.8**

Course Code & Name: 21CH5202-MASS TRANSFER-II

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

Course Code & Name: 21CH5203-PROCESS INSTRUMENTATION DYNAMICS &CONTROL

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	3	1			2				1		1	1	2
CO2	3	2	3	1			1				1		1	1	3
CO3	3	2	3	1			2				1		1	1	3
CO4	2	2	2	1			1				1		1	2	3
CO5	2	2	2	1			2				1		1	2	2
AVG	**2.6**	**2**	**2.6**	**1**			**1.6**				**1**		**1**	**1.4**	**2.6**

Course Code & Name: 21CH5204-SAFETY IN CHEMICAL INDUSTRIES

PO&PSO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO11	PO12	PS O 1	PS O2	PS O3
CO1	2	3							1	1			3	3	1
CO2	3	3	2						1	1			2	3	
CO3	2	3							1	1				3	2
CO4	2	2	3						2	1			2	2	3
CO5		2	2						2	1				3	3
AVG	2.25	2.6	2.33						1.4	1			2.33	2.8	2.25

Course Code & Name: 21CH5251-WATER TREATMENT & SOLID WASTE MANAGEMENT

& PSO →	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PS O2	PSO 3
CO1	2	2	2	2	-	2	3	2	1	1	1	1	2	1	2
CO2	2	2	3	2	1	-	2	1	1	-	3	1	2	1	2
CO3	2	2	3	2	1	-	2	1	1	-	3	1	2	1	2
CO4	1	1	1	1	2	2	2	-	-	-	-	2	1	1	1
CO5	1	1	1	1	2	2	2	-	-	-	-	2	1	1	1
AVG	1.6	1.6	2	1.6	1.5	2	2.2	1.3	1	1	2.3	1.4	1.6	1	1.6

Course Code & Name: 21CH5001-MASS TRANSFER 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	PSO3
CO1	1	2	3	2	1		1		1				3	1	1
CO2	1	2	3	2	1		1		1				3	1	1
CO3	1	2	3	2	1		1		1				3	1	1
CO4	1	2	3	2			1		1				3	1	1
AVG	1	2	3	2	1		1		1				3	1	1

Course Code & Name: 21CH5002-PROCESS CONTROL 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
AVG	3	2		2	1	1	2		3			2		2

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.TECH. CHEMICAL ENGINEERING (UG)

REGULATION-2019

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

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	19CH8303	Total Quality Management	PE	3	0	0	3	25	75	100
3	19CH8304	Foundation Skills in Integrated Product Development	PE	3	0	0	3	25	75	100
4	19CH8305	Supply Chain Management	PE	3	0	0	3	25	75	100
5	19CH8311	Membrane Separation Process	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

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 Objective

The student should be able to

1. Understand the process design development, plant location and layout, cost accounting and estimation, capital investments, taxes and depreciation
2. Acquire awareness about methods of estimating cost of the project profitability, income ratio, balance sheet and inflation.
3. 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+15=60

Course Outcome

CO1	Understand the capital cost and the value of money for the complete plant
CO2	Analyze the project prifitability, balance sheet and inflation in design of process plant.
CO3	Illustrate the economic operation of the equipment
CO4	Evaluating the various principles of management and its organization
CO5	Remember the production planning, control chart preparation and quality control

TEXT BOOK:

T1 Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 5th Edition, 2004.

T2 Schweyer. H.E, "Process Engineering Economics", Mc Graw Hill, 1969.

T3 James R. Cooper, "Process Engineering Economics", Marcel Delkker Inc, New York, 2003

REFERENCES:

R1 F.C. Jelen and J.H. Black, "Cost and Optimization Engineering", McGraw Hill, 3rd Edn., 1992

R2 Ahuja K.K, Industrial management, Khanna publishers, New Delhi, 1985.

R3 Harry Silla, " Chemical Process Engineering: Design and Economics", 1st Edition, CRC press, USA, 2003

R4 Sivasubramanian V, "Process Economics and Industrial Management",1 st Edition, New Delhi, Galcotia Publishers, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19CH7202R	PROCESS EQUIPMENT DESIGN	3	1	0	4

The student should be able to

Course Objective

1. Summarize the concepts of unit operations and unit processes in chemical engineering.
2. Impart knowledge on the concepts of design of major equipment
3. Design the plant layout and pipe line with proper materials.

Unit	Description	Instructional Hours
I	**DESIGN OF HEAT EXCHANGERS:** Design of double pipe heat exchangers, Shell and tube heat exchangers ,Condensers	12
II	**DESIGN OF EVAPORATORS,COOLING TOWERS AND DRYERS:** Design of single-effect evaporator, Cooling Tower, Dryers	12
III	**DESIGN OF MASS TRANSFER EQUIMENT-:** Distillation Column, Absorption column, Extraction Column., Adsorption column.,	12
IV	**DESIGN OF REACTORS:** CSTR,PFR 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 Outcome

CO1	Estimate the overall heat transfer coefficient for heat exchangers.
CO2	Calculate the area of single effect evaporator and drying rate.
CO3	Evaluate the design parameters of distillation,absorption and adsorption columns.
CO4	Choose the appropriate reactor for the desired process.
CO5	Design the layout of chemical process plant and provide solution for materials of construction.

TEXT BOOK:

T1 Green D. W., "Perry's Chemical Engineer's Handbook", 8th Edition McGraw Hill, 2007

T2 Coulsion and Richardson's., "Chemical Engineering Design - Volume 6", Pergamon; 2nd edition, 1993

T3 Process Equipment Design by M. V. Joshi, 3rd edition, Macmillan India Limited 2003.

REFERENCES:

R1 R. K. Sinnott, "Coulson & Richardson's Chemical Engineering", Vol. 6, Butterworth Heinermann, Oxford, 1996.

R2 Dawande, S. D., "Process Design of Equiment", 4th Edition, Central Techno Publications, Nagpure, 2005.

R3 Baranan, C.R., "Rules of Thumb for Chemical Engineers", Gulf Publishing Co, Texas, 1996.

R4 Kern D.Q., Process Heat Transfer, McGraw Hill book Co.Inc., 1982

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19CH7307	CHEMICAL MANUFACTURING PLANT OPERATION	3	0	0	3

Course Objective

The student should be able to

1. Acquire knowledge on the concepts of chemical manufacturing involved in day today life.
2. Understand the overall view of the chemical reactions and chemical engineering.
3. Remember the basic principles involved in analysis of chemical products.

Unit	Description	Instructional Hours
I	**CHEMICAL MANUFACTURING PLANT OPERATION** Monitoring meters, gauges, and electronic instrumentation on one or more chemical or formulation units – mixers – kettles – blenders – dryers – tableting – encapsulation - granulation, and coating machines.	9
II	**COORDINATING AND MAKING EFFECTIVE WORKPLACE:** Procedure and Manual for Maintaining clarity, honesty and transparency while communicating with the seniors and colleagues. Comply with organization's policies and procedures for the work, report status of work as per the schedule. Communicating deviations or anomalies. Procedure to provide information in the desired format and frequency.	9
III	**HOUSEKEEPING, REPORTING AND DOCUMENTATION, HEALTH & SAFETY:** Material requirements for cleaning - inspection, by considering risk, time, efficiency - type of stain - importance activities - importance of team work - work for which protective clothing or identified equipment. Duties in accordance with workplace policy.	9
IV	**MANAGE CHEMICAL HAZARDS IN THE WORKPLACE:** Identify the hazards and risks associated with chemicals with the help of safety data sheet, Identify and analyze the use of appropriate Personal Protective Equipment (PPE) as per work requirements. Guidelines to handle chemicals.	9
V	**ETHICAL AND SUSTAINABLE PRACTICES AT THE WORKPLACE:** Organizational policies for usage of alternate energy sources - solar energy – wind energy- thermal energy-bio energy for the site. Ensure proper usage of fuels - minimize pollution and conserve energy- use resources in a responsible manner.	9
	Total Instructional Hours	45

Course Outcome

CO1	Acquire knowledge through carry out experiments about physical and chemical characterization of chemical products and apply knowledge in industries.
CO2	Understand the concept of organization's policies.
CO3	Evaluate the reporting and documentation.
CO4	Examine the Plant inspection, safe handling of chemicals.
CO5	Illustrate the advanced control schemes and to control the equipment in chemical industries.

TEXT BOOK:

T1 Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.

T2 Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969.

T3 Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press,2004

REFERENCES:

R1 Chemical Operator's Portable Handbook 1st Edition by Jack T. Ballinger.

R2 Attendant Operator Chemical Plant AOCP Book by Rajkot, Sunrise Publications.

R3 Chemical Plant and Its Operation Including Safety and Health Aspects T. M. Cook, D. J. Cullen.

R4 Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19CH7308	CHEMICAL STORAGE & HANDLING OPERATION	3	0	0	3

Course Objective

The student should be able to

1. Implement the proper procedures for responding to spills, emergencies, or injuries.
2. Demonstrate ways to assess and manage the hazards associated with chemicals.
3. Illustrate an accurate chemical inventory.

Unit	Description	Instructional Hours
I	**GENERAL SAFETY AND OPERATIONAL RULES:** Introduction to common rules relates to laboratory. Safety policies - First aid - Fire safety and types of fire extinguisher. Operation, application and use of laboratory hood. PPE Policies and Consequences for violating PPE policy.	9
II	**HAZARDOUS CHEMICALS**: Introduction to hazardous chemicals. List and classification of common hazardous chemicals in chemical industries. Procedure and rules for handling chemicals, Essential practices for handling hazardous chemicals, Laboratory waste management.	9
III	**CHEMICAL STORAGE:** General requirements - Segregation of incompatible chemicals - Specifications for chemical storerooms, Guildlines and procedure for Chemical storage in laboratories (outside of chemical storerooms) - Additional storage requirements and recommendations for specific hazard chemical.	9
IV	**LABELLING:** Labeling of chemicals- Requirements, Pictograms – introduction-types of charts-symbols, Identification of the Hazards of Materials for Emergency Response - NFPA Diamond, Secondary Containers, Safety Data Sheets (SDS)-Storage – need- maintain .	9
V	**HANDLING AND TRANSPORTATION:** Personal protective equipment (PPE) for chemical handling. Safe handling techniques for different types of chemicals, Procedures for transferring and dispensing chemicals, Transportation methods and equipment for chemicals, Hazard communication during chemical transportation.	9
	Total Instructional Hours	45

Course Outcome

CO1	Develop awareness on the methods for safety, load protection basics.
CO2	Understand the need for safety in chemical industries and operating conditions.
CO3	Acquire knowledge through carry out experiments about physical and chemical characterization of chemical products and apply knowledge in industries.
CO4	Illustrate the properties and basics of labelling.
CO5	Evaluate the Personal protective equipments.

TEXT BOOK:

T1 Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.

T2 Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969.

T3 Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press,2004

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R4 Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19CH7309	CHEMICAL EFFLUENT TREATMENT PLANT OPERATION	3	0	0	3

Course Objective

The student should be able to

1. Comprehend the significance of machinery inspection and the importance of consistently monitoring operating conditions, gauges, and meters.
2. Understand the significance of timely documentation, ensuring the confidentiality of recorded information, and effectively reporting it to the relevant authority.
3. Illustrate a comprehensive understanding of the risk assessment process and the hierarchical approach to risk control.

Unit	Description	Instructional Hours
I	**PROCESSES, MONITORING, AND MAINTENANCE:** Disinfect and deodorize water - sand filters and UV disinfection to process- disposal of wastes - chlorinating/dechlorinating units - inspect pumps and motors, machinery - maintain surveillance on operating conditions, gauges and meters - control equipment and monitor processes - determine the quality of the water - maintenance of records	9
II	**COMPLIANCE, AND FEEDBACK:** Supportive departments - preventive and corrective maintenance - stakeholders compliance - health and safety team - requirements of employee - communication with employee - organization's policies and procedures - feedback	9
III	**SURFACE CLEANING AND SAFETY:** Types of surfaces - material requirements - time, risk, efficiency and type of stain - cleaning equipment: types, operating condition - SOP - usage of signage - ventilation - personal protective equipment.	9
IV	**OCCUPATIONAL HAZARDS MANAGEMENT:** Safety checks - report hazards - minimum environmental damage - designated storage - operate emergency equipment - procedures for dealing with accidents, fires and emergencies - first aid equipment - first aid techniques - standard safety procedures while handling heavy/hazardous material, chemicals, machine, equipment	9
V	**CHEMICAL HANDLING AND SAFETY:** Guidelines to handle chemicals - safety data sheet - types of chemicals hazards and levels of risks - PPE like overalls and aprons, gloves, chemical resistant glasses, respiratory protection, boots - types of labels, like dangerous to the environment, explosive, toxic, flammable,corrosive - chemical storage areas - safe disposal of chemical wastes - chemical storage - procedures in cases of breaches or hazards, accidents, and emergency situations.	9
	Total Instructional Hours	45

Course Outcome

CO1	Recognizes the significance of maintaining cleanliness and organization in the workplace.
CO2	Capable of comprehending workplace hazards and implementing appropriate measures to mitigate health and safety risks effectively.
CO3	Competent in adhering to applicable health, safety, and environmental guidelines, legislation, and regulations.
CO4	Proficient in adhering to protocols for analysing and comprehending process-related documents, as well as understanding the necessary processes and equipment involved in chemical effluent treatment.
CO5	Analyze the various categories of chemical hazards and evaluating the corresponding levels of associated risks.

TEXT BOOK:

T1 Weber W.J., (1975) "Physico - Chemical Processes for Water Quality Control".

T2 Quantitative Risk Assessment in Chemical Process Industries American Institute of Chemical Industries, Centre for Chemical Process safety.

T3 Handbook of Environmental Health and Safety – principle and practices , Vol. II.

REFERENCES:

R1 APHA, (2002), "Standard Methods for Examination of Water and Wastewater"; 21st Edition.

R2 Accident Prevention Manual for Industrial Operations NSC, Chicago, 1982.

R3 Sawyer C.N. and McCarty, P.L ., (2003), "Chemistry for Environmental Engineering and Science", 5th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

R4 Daniel A. Crowl and J. F. Louvar, Chemical Process Safety, Fundamentals with Applications, 3rd ed., Prentice Hall, 2011. 723 pages. ISBN-13: 978-0-13-138226-8

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7002	COMPUTATIONAL FLUID DYNAMICS LAB	0	0	3	1.5

Course Objectives

- The lab involved the numerical solution of some common problems of chemical engineering and aim to visualize the effect of various factors on the flow of heat and mass transfer.

S.No.	DESCRIPTION
1.	Study of fluid flow and heat transfer in mixing tee.
2.	Study of flow mal distribution in different shapes of headers.
3.	Velocity boundary layer analysis of flow of fluid over a flat plate in laminar flow.
4.	Study of laminar and turbulent flow in pipe line.
5.	Modeling of forced convection in pipe line flows.
6.	Study of flow of fluid over air foil and effect of angle of attack.
7.	Modeling steady flow past cylinder and other geometries.
8.	Study of fluid flow and heat transfer in mixing elbow.
9.	Study the effect of roughness in turbulent flow through pipe line.
10.	Study of flow of fluid through a nozzle.
11.	Study of fluid flow in a rotating disk.
12.	Modeling motion of sphere in cylinder falling under gravity.

Total Practical Hours 45

Course Outcomes

Upon completion of the course, students can be able to

- Analyze the common problems related to fluid behaviour and the numerical solution for that.

REFERENCE BOOKS:

1. P.S. Ghosdastidar, Computer Simulation of Flow and Heat Transfer, Tata McGraw-Hill (1998).
2. Muralidhar, K.,and Sundararajan,T. Computational Fluid Flow and Heat Transfer, Narosa Publishing. House (1995).
3. Ranade, V.V., Computational flow modeling for chemical reactor engineering, Academic Press (2002).
4. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19CH7401	**BIOMASS CONVERSION AND BIO-REFINERY**	**3**	**0**	**0**	**3**

Course Objectives

The student should be able to

- Understand the basics of biomass and various conversion technologies.
- Identify the different types of products that can be obtained upon successful conversion
- Explain the process of production of Chemicals from Biomass, Integrated Biorefinery

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	**Introduction:** World energy scenario, consumption pattern, fossil fuel depletion and environmental issues. Availability and abundance of biomass, photosynthesis, composition and energy potential, virgin biomass production and selection, waste biomass availability, abundance and potential, biomass as energy resources, short rotation woody crops, oil crops and their bio refinery potential, microalgae as feedstock for biofuels and biochemical, enhancing biomass properties for biofuels, challenges in conversion. Basic concept of bio refinery, types of bio refineries, bio refinery feedstock's and properties.	9
II	**Biomass Pretreatment:** Barriers in lignocellulosic biomass conversion, pretreatment technologies. Physical and Thermal Conversion Processes,Microbial Conversion Process: Types, fundamentals, equipment's and applications; thermal conversion products.	9
III	**Production of biofuels:** Diesel from vegetable oils, microalgae and syngas; trans esterification; FT process, catalysts; biodiesel purification, fuel properties. Factors affecting bio oil, bio chars production, fuel properties, bio oil up gradation. Corn ethanol, lignocellulosie ethanol, microorganisms for fermentation, current industrial ethanol production technology, cellulases and their role in hydrolysis, concepts of SSF and CBP, advanced fermentation technologies, ABE fermentation pathway and kinetics, product recovery technologies.	9
IV	**Hydrogen, Methane and Methanol:**Bio-hydrogen generation, metabolic basics, feedstock's, dark fermentation by strict anaerobes, facultative anaerobes, thermophilic microorganisms, integration of bio hydrogen with fuel cell; fundamentals of biogas technology, fermenter designs, biogas purification, methanol production and utilization.	9
V	**Organic Commodity Chemicals from Biomass, Integrated Biorefinery:** Biomass as feedstock for synthetic organic chemicals, lactic acid, polylactic acid, succinic acid, propionic acid, acetic acid, butyric acid, 1,3-propanediol, 2,3-butanedioil, PHA. Concept of biorefinery, corn/soybean/sugarcane biorefinery, lignocellulosic biorefinery, aquaculture and algal biorefinery, waste biorefinery, hybrid chemical and biological conversion processes, techno- economic evaluation, life-cycle assessment.	9
	Total Instructional Hours	**45**

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand about the Biomass and Biorefinary
CO2- Examine the various pretreatment and conservation process
CO3- Illustrate the various production process of biofuel
CO4- Analyze the different biomass feedstock's from wastes
CO5- Explain the process of integrated biorefinery and its techno- economic evaluation.

TEXT BOOKS:

1. Shibu Jose, Thallada Bhaskar, Biomass and Biofuels:Advanced Biorefineries for Sustainable Production and Distribution, 2015, CRC Press.
2. Donald L. Klass, Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, Elsevier, 2006

REFERENCES BOOKS:

1. Thallada Bhaskar Ashok Pandey S.Venkata Mohan Duu-Jong Lee Samir Kumar Khanal, Waste Biorefinery, 2018, Elsevier, 2018.
2. **Bo Zhang, Yong Wang,** Biomass Processing, Conversion and Biorefinery, Nova Science Publishers, 2013.

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CO'S, PO'S & PSO'S MAPPING

Semester – VII

Course Code & Name: 19CH7201-PROCESS ECONOMICS AND ENGINEERING MANAGEMENT

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	1	-	1	-	3	2
CO2	2	2	-	-	-	-	-	-	1	-	-	-	3	2
CO3	-	-	-	-	-	-	-	-	1	-	-	-	-	3
CO4	3	2	3	-	-	-	-	-	2	1	1	-	-	3
CO5	-	-	2	-	-	-	-	-	2	1	1	-	-	3
AVG	**2.3**	**2**	**2.5**	-	-	-	-	-	**1.4**	**1**	**1**	-	**3**	**2.6**

Course Code & Name: 19CH7202-PROCESS EQUIPMENT DESIGN

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	1	-	1	-	3	3
CO2	3	3	3	2	2	-	-	-	1	-	-	-	3	3
CO3	3	3	3	2	1	-	-	-	1	-	-	-	3	3
CO4	3	3	3	2	1	-	-	-	1	-	1	-	3	3
CO5	2	2	2	2	1	-	-	-	1	-	1	-	3	3
AVG	**2.8**	**2.8**	**2.8**	**2**	**1.4**	-	-	-	**1**	-	**1**	-	**3**	**3**

Course Code & Name: 19CH7001-DESIGN &SIMULATION 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**	**PSO3**
CO1	2	2	3	2	2		2		2				3	2	2
AVG	**2**	**2**	**3**	**2**	**2**		**2**		**2**				**3**	**2**	**2**

Course Code & Name: 19CH7002-COMPUTATIONAL FLUID DYNAMICS 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**	**PSO3**
CO1	3	2	3	2	3	3							2	2	3
AVG	**3**	**2**	**3**	**2**	**3**	**3**							**2**	**2**	**3**

Mapping of Course Outcome and Programme Outcome

Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	I	19HE1101 Technical English	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	1	-	-
		19MA1102Calculus and Linear Algebra	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1	-	-
		19PH1151Applied Physics	3	2.2	2	1.6	2	1.33	-	-	-	-	-	1	1	-	-
		19CY1151 Chemistry for Engineers	3	2	2	2	2	1	1	-	-	-	-	1	1	1	-
		19CS1151 Python Programming and Practices	2	3	3	-	2	-	-	-	2	-	-	2	2	2	-
		19ME1152 Engineering Drawing	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4	-
I	II	19HE2101 Business English for Engineers	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1	-
		19MA2101Differential Equations and Complex Variables	3	3	3	2.4	2.4	-	-	-	-	-	-	2	2	2	-
		19EE2103 Basics of Electrical and Electronics Engineering	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
		19CH2101 Principles of Chemical Engineering	2	2.5	1.2	3	1	1	1				2	1	1	1	-
		19PH2151 Material Science	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2	-
		19CY2151 Environmental Studies	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-	-
		19ME2001 Engineering Practices	3	-	3	-	3	-	-	-	1	-	-	-	1	2	-
		19MA3103 Fourier Analysis and Numerical Methods	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1	-	-
		19CH3201 Chemical Process Calculations	3	3	3	3	1	1	1	-	1	-	-	2.2	2.2	1	3
		19CH3202 Fluid Mechanics for Chemical Engineers	3	2.2	2.2	2	1.6	1.8	-	1	1	1	1.2	1.5	2.6	1.2	1.6
		19CH3203	3	2	3	1	-	-	-	-	-	-	1	-	1	1	-

II	III	Chemical Engineering Thermodynamics – I															
		19CH3251 Analytical Instruments for Analysis	3	3	3	3	1	1	1	1	1	1	-	1.6	1.5	1	2.8
		19CH3001 Fluid Mechanics Lab	3	2	2	1.5	1.5	1	2	-	3	-	-	2	-	2	-
		19CH3002 Chemical Analysis Lab	3	2	2	1.5	1.5	1	2	-	3	-	-	2	-	2	-
II	IV	19CH4201-Process Heat Transfer	3	3	3	3	10	-	-	-	1		1.6		3	3	2.2
		19CH4202-Mass Transfer – I	3	3	3	3	1	1	1	1	1	1	-	1.6	1.5	1	2.8
		19CH4203-Chemical Engineering Thermodynamics - II	3	3	1	1	-	-	-	-	-	-	-	-	3	1	1
II	IV	19CH4251Mechanical Operations	3	3	3	3	1	1	1	1	1	1		1.6	1.8	1	3
		19MA4153Applied Probability Statistics	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1	-	
		19CH4001 Heat Transfer Lab	1	2	3	2	1		1		1	-	-		3	1	1
		19CH4002 Petrochemical Analysis Lab	3	2	2	1.5	1.5	1	2	-	3	-	-	2	-	2	-
III	V	19CH5201 Chemical Reaction Engineering – I	2	2.6	2.3	-	-	-	-	-	1.4	1			2.3	2.8	1.8
		19CH5202Mass Transfer – II	3	1	2	1	1	-	-	-	-	-	-	1.6	3	2	2
		19CH5203 Process Instrumentation Dynamics and Control	2.6	2	2.6	1	-	-	1.6		-	-	1	-	1	1.4	2.6
		19CH5204 Safety in Chemical Industries	2.25	2.6	2.33	-	-	-	-	-	1.4	1	-	-	2.33	2.8	2.25
		19CH5251Water Treatment and Solid Waste Management	1.6	1.6	2	1.6	1.5	2	2.2	1.3	1	1	2.3	1.4	1.6	1	1.6
		19CH5001Mass Transfer Lab	1	2	3	2	1	-	1	-	1	-	-	-	3	1	1
		19CH5002 Process Control Lab	3	2	-	2	1	1	2	-	3	-	-	2		2	-
III	VI	19CH6201 Chemical Reaction Engineering– II	1	1.8	2.2	2		1	1	-	-	-	-	-	3	1.6	3
		19CH6202 Chemical Process Industries	3	3	2	2.4	1	-	1	-	-	-	-	-	3	2.6	3
		19CH6181 Professional Ethics in Engineering	-	1.7	1	2	1	1.7	2.3	2.8	2.2	2.2	1	1	2.3	2.3	2

		19CH6251 Fluidization Engineering	3	1	1	1	-	1	-	-	-	-	1	-	2.4	3	1
		19CH6001 Chemical Reaction Engineering Lab	1	2	3	2	1	-	1	-	1	-	-	-	3	1	1
IV	VII	19CH7201 Process Economics and Engineering Management	2.3	2	2.5	-	-	-	-	-	1.4	1	1	-	3	2.6	-
		19CH7202 Process Equipment Design	2.8	2.8	2.8	2	1.4	-	-	-	1	-	1	-	3	3	-
		19CH7001 Design and Simulation Lab	2	2	3	2	2	-	2	-	2	-	-	-	3	2	2
		19CH7002-Rubber Testing Lab	3	2	3	2	3	3	-	-	-	-	-	-	2	2	3
PE		19CH5301Energy Technology	2.2	1	1	-	-	2.4	2	1	-	-	-	-	1	2	-
		19CH5302Petroleum Technology	3	2	1	-	-	2.8	2	1	-	-	-	-	1	2	-
		19CH5303Electrochemical Engineering	2.2	1	1	-	-	2.4	2	1	-	-	-	-	1	2	-
		19CH5304Polymer Technology	2.2	1	1	-	-	2.4	2	1	-	-	-	-	1	2	-
		19CH5305Food Technology	3	2	1	-	-	2.8	2	1	-	-	-	-	1	2	-
		19CH6301Petroleum Exploration and Exploitation Techniques	3	2	1	-	-	2.8	2	1	-	-	-	-	1	2	-
		19CH6302Enzyme Engineering	1	2	2	1.4	-		1.2	-	-	-	-	1	1	1.2	-
		19CH6303Fundamentals of Nano Science	3	2	1	-	-	2.8	2	1	-	-	-	-	1	2	-
		19CH6304Corrosion Science and Engineering	1	2	2	1.4	-		1.2	-	-	-	-	1	1	1.2	-
		19CH6305Piping and Instrumentation	3	2	1	-	-	2.8	2	1	-	-	-	-	1	2	-
		19CH7301Natural Gas Engineering	3	2	1	-	-	2.8	2	1	-	-	-	-	1	2	-
		19CH7302Pulp and Paper Technology	1	2	2	1.4	-	-	1.2	-	-	-	-	1	1	1.2	-
		19CH7303Transport Phenomena	1	2	2	1.4	-	-	1.2	-	-	-	-	1	1	1.2	-
		19CH7304Multicomponent Distillation	3	3	3	3	-	-	1	-	-	-	-	1	3	2	-
		19CH7305Chemical Process Optimization	3	3	3	3	-	-	1	-	-	-	-	1	3	2	-
		19CH7306Fundamentals and Testing of Rubber Compounds	3	2	1	3	-	2.8	2	1	-	-	-	-	1	2	-

PE		19CH8301Industrial Management	3	2	1	2	-	2.8	2	1	-	-	-	-	1	2	-
		19CH8302Sugar Technology	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8303Total Quality Management	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8304Foundation Skills in Integrated Product Development	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8305Supply Chain Management	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8306Process Plant Utilities	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8307Fermentation Technology	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8308Frontiers of Chemical Technology	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8309 Industrial Nanotechnology	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
		19CH8310Drugs and Pharmaceutical Technology	3	3	3	2	-	-	1	-	-	-	-	1	3	2	-
OE		19CH6401Waste to Energy Conversion	3	3	3	-	-	-	2	-	-	-	-	-	2	3	3
		19CH7401Biomass Conversion and Biorefinery	2.2	2	-	-	-	1	1.3	-	1.4	1	-	-	1.3	2.8	2.7

CHAIRMAN-BOS

DEAN -ACADEMICS

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