ANNA UNIVERSITY, CHENNAI

NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES

REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

B.TECH. CHEMICAL ENGINEERING

CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3172	அறிவியல் தமிழ் / Scientific Thoughts in Tamil	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10.	GE3172	English Laboratory $	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English – II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3258	Physics of Materials	BSC	3	0	0	3	3
4.	BE3252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.	CH3251	Introduction to Chemical Engineering	PCC	3	0	0	3	3
7.	GE3252	**தமிழர் மரபு / Heritage of Tamils**	HSMC	1	0	0	1	1
8.		NCC Credit Course Level 1#	-	2	0	0	2	2
PRACTICALS								
9.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	2	2
10.	BE3272	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	4	2	2
11.	GE3272	Communication Laboratory / Foreign Language $	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**16**	**30**	**26**

NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3356	Differential Equations	BSC	3	1	0	4	4
2.	CH3301	Basic Mechanical Engineering	ESC	3	0	0	3	3
3.	CH3302	Mechanics of Solids	ESC	3	0	0	3	3
4.	CH3351	Chemical Process Calculations	PCC	3	0	0	3	3
5.	CH3352	Fluid Mechanics for Chemical Engineers	PCC	3	0	0	3	3
6.	CH3303	Chemical Process Industries	PCC	3	0	0	3	3
PRACTICALS								
7.	CH3311	Basic Mechanical Engineering Laboratory	ESC	0	0	3	1.5	1.5
8.	CH3312	Technical Analysis Laboratory	PCC	0	0	3	1.5	1.5
9.	GE33361	Professional Development$	EEC	0	0	2	2	1
			TOTAL	**18**	**1**	**8**	**24**	**23**

$ Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3451	Transform Techniques	BSC	3	1	0	4	4
2.	CH3451	Mass Transfer I	PCC	3	0	0	3	3
3.	PC3352	Mechanical Operations	PCC	3	0	0	3	3
4.	CH3401	Chemical Engineering Thermodynamics – I	PCC	3	0	0	3	3
5.	CH3491	Heat Transfer	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2#		3	0	0	3	3
PRACTICALS								
8.	CH3411	Fluid Mechanics Laboratory	PCC	0	0	3	3	1.5
9.	CH3412	Mechanical Operations Laboratory	PCC	0	0	3	3	1.5
10.	CH3513	Industrial Training/Internship I*	EEC	-	-	-	-	-
			TOTAL	**17**	**1**	**6**	**24**	**21**

 # NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

*Two weeks industrial training/internship carries one credit. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CH3501	Chemical Engineering Thermodynamics – II	PCC	3	0	0	3	3
2.	CH3551	Mass Transfer II	PCC	3	0	0	3	3
3.		Mandatory Course-I&	MC	3	0	0	3	0
4.		Professional Elective I	PEC	3	0	0	3	3
5.		Professional Elective II	PEC	3	0	0	3	3
6.		Professional Elective III	PEC	3	0	0	3	3
PRACTICALS								
7.	CH3511	Computational Chemical Engineering Laboratory	PCC	0	0	3	1.5	1.5
8.	CH3512	Heat Transfer Laboratory	PCC	0	0	3	1.5	1.5
9.	CH3561	Mass Transfer Laboratory	PCC	0	0	3	1.5	1.5
10.	CH3513	Industrial Training/Internship I**	EEC	-	-	-	-	1
			TOTAL	**18**	**0**	**9**	**22.5**	**20.5**

& Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CH3601	Chemical Reaction Engineering – I	PCC	3	0	0	3	3
2.		Open Elective – I*	OEC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	0	3	3
4.		Professional Elective V	PEC	3	0	0	3	3
5.		Professional Elective VI	PEC	3	0	0	3	3
6.	CH3651	Process Dynamics and Control	PCC	3	0	0	3	3
7.		Mandatory Course-II[&]	MC	3	0	0	3	0
8.		NCC Credit Course Level 3[#]		3	0	0	3	3 #
PRACTICALS								
9.	CH3611	Chemical Reaction Engineering Laboratory	PCC	0	0	3	1.5	1.5
10.	CH3612	Process Equipment Design and Drawing	PCC	0	0	3	1.5	1.5
11.	CH3712	Industrial Training/Internship II**	EEC	-	-	-	-	-
			TOTAL	**21**	**0**	**6**	**24**	**21**

***Open Elective – I shall be chosen from the emerging technologies.**

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

PROGRESS THROUGH KNOWLEDGE

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CH3701	Chemical Reaction Engineering II	PCC	3	0	0	3	3
2.	CH3702	Transport Phenomena	PCC	3	0	0	3	3
3.	GE3791	Human values and Ethics	HSMC	2	0	0	2	2
4.		Elective - Management #	HSMC	3	0	0	3	3
5.		Open Elective – II**	OEC	3	0	0	3	3
6.		Open Elective – III***	OEC	3	0	0	3	3
7.		Open Elective – IV***	OEC	3	0	0	3	3
PRACTICALS								
8.	CH3711	Process Control Laboratory	PCC	0	0	3	1.5	1.5
9.	CH3712	Industrial Training/Internship II##	EEC	-	-	-	-	1
			TOTAL	**20**	**0**	**3**	**21.5**	**22.5**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

****Open Elective – II shall be chosen from the emerging technologies.**

*****Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes**

Elective- Management shall be chosen from the Elective Management courses

##Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

SEMESTER VIII/VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	CH3811	Internship#/ Project Work	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

#15 weeks of continuous Internship in an organization carries 10 credits.

TOTAL CREDITS: 166

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES : VERTICALS

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

Registration of Professional Elective Courses from Verticals:
Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to Regulations 2021 Clause 4.10.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: PETROLEUM PROCESS TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CH3001	Petroleum Chemistry and Refining Fundamentals	PEC	3	0	0	3	3
2.	CH3002	Primary Refining Technology	PEC	3	0	0	3	3
3.	CH3003	Secondary Refining Technology	PEC	3	0	0	3	3
4.	CH3004	Refinery Advancements and Environmental Regulations	PEC	3	0	0	3	3
5.	PE3591	Petroleum Equipment Design	PEC	3	0	0	3	3
6.	CH3005	Petrochemical Technology	PEC	3	0	0	3	3

VERTICAL 2: ENERGY ENGINEERING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CH3006	Bioenergy	PEC	3	0	0	3	3
2.	CH3007	Renewable Energy Resources	PEC	3	0	0	3	3
3.	CH3008	Pinch Technology	PEC	3	0	0	3	3
4.	CH3009	Hydrogen And Fuel Cell Technology	PEC	3	0	0	3	3
5.	CH3010	Power Plant Engineering	PEC	3	0	0	3	3
6.	CH3011	Non-Renewable Energy Sources	PEC	3	0	0	3	3

VERTICAL 3: BIOCHEMICAL ENGINEERING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	BT3392	Biochemistry	PEC	3	0	0	3	3
2.	CH3012	Bioprocess Technology	PEC	3	0	0	3	3
3.	CH3013	Fermentation & Bioprocessing	PEC	3	0	0	3	3
4.	CH3014	Bio separation & Downstream Processing	PEC	3	0	0	3	3
5.	CH3015	Enzyme Immobilisation Technology	PEC	3	0	0	3	3
6.	CH3016	Bioreactor Design	PEC	3	0	0	3	3

VERTICAL 4: ENVIRONMENTAL AND SAFETY ENGINEERING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CH3017	Air Pollution Engineering	PEC	3	0	0	3	3
2.	CH3018	Waste Water Treatment	PEC	3	0	0	3	3
3.	CH3019	Solid waste Management	PEC	3	0	0	3	3
4.	CH3020	Environmental Impact Assessment	PEC	3	0	0	3	3
5.	CH3021	Process Safety Management	PEC	3	0	0	3	3
6.	CH3022	Risk and HAZOP Analysis	PEC	3	0	0	3	3

VERTICAL 5: COMPUTATIONAL CHEMICAL ENGINEERING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CH3023	Computational Techniques	PEC	3	0	0	3	3
2.	CH3024	Optimization of Chemical Processes	PEC	3	0	0	3	3
3.	CH3025	Process Modeling and Simulation	PEC	3	0	0	3	3
4.	CH3026	Pinch Analysis and Heat Exchange Network Design	PEC	3	0	0	3	3
5.	CH3027	Chemical Process Flow sheeting	PEC	3	0	0	3	3
6.	CH3028	Computational Fluid Dynamics	PEC	3	0	0	3	3

VERTICAL 6: CHEMICAL PLANT DESIGN

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CH3029	Chemical Plant Design	PEC	3	0	0	3	3
2.	CH3030	Plant Layout	PEC	3	0	0	3	3
3.	CH3031	Design Safety	PEC	3	0	0	3	3
4.	CH3032	Material Selection	PEC	3	0	0	3	3
5.	CH3033	Statutory Requirements & Customer Care	PEC	3	0	0	3	3
6.	CH3034	Process Plant Utilities	PEC	3	0	0	3	3

OPEN ELECTIVES

Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories.

OPEN ELECTIVE I AND II
(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
3.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
4.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
5.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
6.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
7.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
8.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
9.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
10.	OAS352	Space Engineering	OEC	3	0	0	3	3
11.	OIM351	Industrial Management	OEC	3	0	0	3	3
12.	OIE354	Quality Engineering	OEC	3	0	0	3	3
13.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
14.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
15.	OMR351	Mechatronics	OEC	3	0	0	3	3
16.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
17.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3

18.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
19.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
23.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
24.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
25.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
26.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
27.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
28.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
29.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
30.	OEC351	Signals and Systems	OEC	3	0	0	3	3
31.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
32.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
33.	OBM352	Assistive Technology	OEC	3	0	0	3	3
34.	OMA352	Operations Research	OEC	3	0	0	3	3
35.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
36.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
3.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
4.	OMA356	Random Processes	OEC	3	0	0	3	3
5.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
6.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
7.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
8.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
9.	OME353	New Product Development	OEC	3	0	0	3	3
10.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
11.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3
12.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
13.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
14.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
15.	OAS353	Space Vehicles	OEC	3	0	0	3	3
16.	OIM352	Management Science	OEC	3	0	0	3	3
17.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
18.	OIE353	Operations Management	OEC	3	0	0	3	3
19.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
20.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
21.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
22.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
25.	ORA353	Concepts in Mobile	OEC	3	0	0	3	3

		Robotics						
26.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
27.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
28.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
29.	OAE353	Drone Technologies	OEC	3	0	0	3	3
30.	OGI352	Geographical Information System	OEC	3	0	0	3	3
31.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
32.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
33.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
34.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
35.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
36.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
37.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
38.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
39.	OTT355	Fibre Science	OEC	3	0	0	3	3
40.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
41.	OPE353	Industrial safety	OEC	3	0	0	3	3
42.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
43.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
44.	OEC353	VLSI Design	OEC	3	0	0	3	3
45.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
46.	OBM353	Wearable devices	OEC	3	0	0	3	3
47.	OBM354	Medical Informatics	OEC	3	0	0	3	3

SUMMARY

B.TECH. CHEMICAL ENGINEERING										
S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1	HSMC	4	3					5		12
2	BSC	12	7	4	6					29
3	ESC	5	11	7.5						23.5
4	PCC		3	10.5	15	10.5	9	7.5		55.5
5	PEC					9	9			18
6	OEC						3	9		12
7	EEC	1	2	1		1		1	10	16
8	Non-Credit /(Mandatory)					√	√			
Total		22	26	23	21	20.5	21	22.5	10	166

PROGRESS THROUGH KNOWLEDGE

Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) 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, Moreover, for minor degree the student can register for courses from any one of the following verticals also.
Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In additions to all the verticals of other programmes)

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Public Administration	Vertical IV Business Data Analytics	Vertical V Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics For Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining For Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Marketing And Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation And Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL I: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneruship	PEC	3	0	0	3	3
2.	CMG338	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL III: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL IV: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics For Management	PEC	3	0	0	3	3
2.	CMG350	Datamining For Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL V: ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

MA3356 **DIFFERENTIAL EQUATIONS** **L T P C**
3 1 0 4

OBJECTIVES :

- To acquaint the students with Differential Equations which are significantly used in engineering problems
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.
- To understand the finite methods for time dependent partial differential equations.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+3

Higher order linear differential equations with constant coefficients – Particular integrals: Operator methods, Method of variation of parameters, Methods of undetermined coefficients– Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients .

UNIT II PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

Explicit Adams-Bashforth Techniques, Implicit Adams-Moulton Techniques, Predictor-Corrector Techniques, Finite difference methods for solving two-point linear boundary value problems, Orthogonal Collocation method.

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 9+3

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes.

UNIT V FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION 9+3

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – First order hyperbolic equations – method of characteristics, different explicit and implicit methods; Wave equation: Explicit scheme- Stability of above schemes.

TOTAL : 60 PERIODS

OUTCOMES:

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

- Apply various methods of solving differential equation which arise in many application problems.
- Understand how to solve the given standard partial differential equations.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
- Familiar with various methods to solve time dependent partial differential equations.

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 44 th Edition, Khanna Publications, New Delhi, 2018.
2. Gupta S.K., "Numerical Methods for Engineers" (Third Edition), New Age Publishers, New Delhi , 2015.
3. M K Jain , S R K Iyengar , R K Jain, "Computational Methods for Partial Differential Equations", New Age Publishers, New Delhi , , 1994.

REFERENCES :

1. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2012.
2. Peter V. O’Neil,” Advanced Engineering Mathematics”, 7th Edition, Cengage learning, 2012.
3. Saumyen Guha and Rajesh Srivastava, “Numerical methods for Engineering and Science”, Oxford Higher Education, New Delhi, 2010.
4. Burden, R.L., and Faires, J.D., “Numerical Analysis – Theory and Applications”, Cengage Learning, India Edition, New Delhi, 2009. Publishers,1993.
5. Morton K.W. and Mayers D.F., “Numerical solution of partial differential equations”, Cambridge University press, Cambridge, 2002.

CH3301 BASIC MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE

- To impart knowledge on thermodynamics and thermal engineering power generating units such as engines and theory of machines

UNIT I LAWS OF THERMODYNAMICS 9

Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation-problems- Second law of Thermodynamics – Kelvin - Plank statement and Clausius statement- problems; Limitations; Heat Engine, Refrigerator and Heat Pump, Available energy, Third law of Thermodynamics - Statement.

UNIT II HEATING AND EXPANSION OF GASES 9

Expressions for work done, Internal energy and heat transfer for Constant Pressure, Constant Volume, Isothermal, Adiabatic and Polytropic processes-Derivations and problems; Free expansion and Throttling process.

UNIT III AIR STANDARD CYCLES 9

Carnot cycle; Stirlings cycle; Joule cycle; Otto cycle; Diesel cycle; Dual combustion Cycle-Derivations and problems.

UNIT IV I.C. ENGINES, STEAM AND ITS PROPERTIES AND TEAM 9

Engine nomenclature and classification; SI Engine; CI Engine; Four Stroke cycle, Two stroke cycle; Performance of I.C.Engine; Brake thermal efficiency; Indicated Thermal Efficiency, Specific fuel consumption.

Steam - Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Dry steam; Superheated steam. Use of steam tables; volume of wet steam, volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle. Steam turbines – Impulse and Reaction types - Principles of operation.

UNIT V SIMPLE MECHANISM, FLY WHEEL, DRIVES AND BALNCING 9

Definition of Kinematic Links, Pairs and Kinematic Chains; Flywheel-Turning moment Diagram; Fluctuation of Energy. Belt and rope drives; Velocity ratio; slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types. Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TOTAL: 45 PERIODS

OUTCOME

- Students should learn thermodynamics and thermal engineering to understand the principles behind the operation of thermal equipments like IC engines and turbines etc., Students should be able to appreciate the theory behind operation of machinery and be able to design simple mechanisms

TEXT BOOKS

1. Nag, P.K., "Engineering Thermodynamics ", IInd Edition, Tata McGraw Hill Publishing Co., Ltd., 1995
2. Rajput, R .K, "Thermal Engineering", Laxmi publications (P) Ltd, 2001.
3. Khurmi R.S., and Gupta J.K, "Theory of Machines", Eurasia Publishing House (P) Ltd., 2004.

REFERENCES

1. Bhaskaran, K.A., and Venkatesh, A., "Engineering Thermodynamics ",Tata McGraw Hill, 1973.
2. Khurmi R.S., and Gupta J.K, "Thermal Engineering", S.Chand & Company (P) Ltd.,2001.
3. Kothandaraman and Dhomkundwar,": A course in Thermal Engineering (SI Units)", Dhanpat Rai and Sons, Delhi (2001)
4. Pandya A. and Shah, " Theory of Machines ", Charatakar Publishers, 1975.
5. Smith, "Chemical Thermodynamics ", Reinhold Publishing Co., 1977.

CH3302 MECHANICS OF SOLIDS

L	T	P	C
3	0	0	3

OBJECTIVE:

- The students will be able to design the support column, beams, pipelines, storage tanks and reaction columns and tanks after undergoing this course. This is precursor or for the study on process equipment design and drawing.

UNIT I STRESS, STRAINAND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – forces on solids and supports – equilibrium and stability – strength and stiffness – tension, compression and shear stresses – Hooke's law and simple problems – compound bars – thermal stresses – elastic constants and poission's ratio.

UNIT II TRANSVERSE LOADING ON BEAMS 9

Beams –support conditions–types of Beams –transverse loading on beams–shear force and bending moment in beams–analysis of can tilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M.Inbeams and their applications– S.F.& B.M. diagrams.

UNIT III DEFLECTIONS OF BEAMS 9

Double integration method – Macaulay's method –Area – moment theorems for computation of slopes and deflections in beams.

UNIT IV STRESSES IN BEAMS 9

Theory of simple bending – assumptions and derivation of bending equation (M/I=F/Y= E/R)– analysisofstressesinbeams–loadscarryingcapacityofbeams–proportioningbeam sections – leaf springs – flitched beams – shear stress distribution in beams – determination of shear stress in flanged beams.

UNIT V TORSIONAND COLUMNS 9

Torsion of circular shafts – derivation of torsion equation (T/J = fs/R = Cθ/L) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts–stepped shafts – shafts fixed at both ends– stresses inhelical springs–deflection of springs–spring constant. Axially loaded short columns–columns of unsymmetrical sections– Euler's theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.

TOTAL: 45 PERIODS

OUTCOME:

- Solve the problems related to the structural components under various loading conditions

TEXT BOOKS:

1. Junarkar, S. B., Mechanics of Structure Vol.1, 21st Edition, Character Publishing House, Anand, Indian, (1995).
2. William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series.
3. McGraw Hill International Editions, Third Edition, 1994.
4. Bansal, R.K, Strength of Materials, Laxmi Publications(P) Ltd., Fourth Edition 2010

REFERENCE:

1. Elangovan A. ,Thinma Visailyal (Mechanics of Solids in Tamil), Anna University, Madras, 1995.

CH3351 CHEMICAL PROCESS CALCULATIONS L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I 9

Base and derived Units - Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II 9

Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT III 9

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT IV 9

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction -Energy balance for systems with and without chemical reaction - Unsteady state energy balances

UNIT V 9

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds - Application of Process simulators in energy and material balance problems.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the fundamentals of units and stoichiometric equations.
- Write material balance for different chemical process.
- Understand the fundamentals of ideal gas behavior and phase equilbria. Write energy balance for different chemical process.

TEXT BOOKS:

1. Bhatt, B.L., Vora, S.M., "Stoichiometry ", 4th Edition, Tata McGraw-Hill (2004)
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Eighth Edition, Prentice Hall Inc., 2012
3. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes",5 th Edn., John Wiley & Sons, New York, 2005.

REFERENCE:

1. Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, CBS publishers ,Second edition,2004.

CH3352 FLUID MECHANICS FOR CHEMICAL ENGINEERS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To acquire a sound knowledge on fluid properties, fluid statics, dynamic characteristics of fluid flow for through pipes and porous medium, flow measurement and fluid machineries

UNIT I **9**

Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT II **9**

Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometer – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III **9**

The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies

UNIT IV **9**

Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the fundamental properties of fluids and its characteristics under static conditions.
- Develop empirical correlation using dimensionless analysis.
- Analyze flow of fluid through pipe and over the of solid,
- Understand and select flow meter(s), characteristics of pumps used in Chemical Process Industries

TEXT BOOKS:

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", Third Edition, McGraw-Hill, (2017).
2. McCabe W.L, Smith, J C and Harriot. P "Unit operations in Chemical Engineering", McGraw Hill, VII Edition, 2017
3. Munson, B. R., Young, D.F., Okiishi, T.H. "Fundamentals of Fluid Mechanics", 9th Edition", John Wiley, 2021

REFERENCES:

1. White, F.M., "Fluid Mechanics ", IV Edition, McGraw-Hill Inc., 1999.
2. James O Wilkes and Stacy G Bike, "Fluid Mechanics for Chemical Engineers' Prentice Hall PTR (International series in Chemical Engineering) (1999)

CH3303 CHEMICAL PROCESS INDUSTRIES L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on various aspects of production engineering and make the student understand the practical methods of production in a chemical factory.

UNIT I SULFUR, SULFURIC ACID AND CEMENT 9

Sulfur, Raw materials Sources, Mining and production of Sulfur – Sulfuric acid, Methods of production of Sulfuric acid – Contact process – Chamber process. Cement – properties of Cement – Methods of production – Overall factors for Cement industry.

UNIT II FERTILIZER INDUSTRY 9

Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries, Phosphoric acid, Single Super Phosphate, DAP, MAP and NPK – Potassium chloride, Potassium Sulphate – Liquid Fertilizers – Bio Fertilizers.

UNIT III PULP, PAPER, SUGAR AND STARCH INDUSTRIES 9

Pulp – Methods of production – Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production. Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivations.

UNIT IV PETROLEUM AND PETRO CHEMICAL INDUSTRIES 9

Petroleum – Chemical Composition, Classification of crude petroleum, Petroleum Refinery products – Petroleum Conversion processes – Pyrolysis and Cracking, Reforming Polymerization, isomerization and Alkylation – petrochemicals – methanol, chloro methanol, Acetylene and ethylene, Isopropanol, Acrylonitrile, Butadiane – Chemicals from Aromatics - Benzene, Toluene and Xylene.

UNIT V FUEL AND INDUSTRIAL GASES 9

Fuel Gases – Natural gas, Liquefied natural gas, Synthesis Gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen – Argon.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the student can classify the chemical process industry into industrial categories of base, intermediate end-products and specialty chemicals manufacturers.

TEXT BOOKS:

1. Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.
2. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley,Second edition 2013.

REFERENCES:

1. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 2017.
2. Srikumar Koyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd

CH3311	BASIC MECHANICALENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVE:

The course is aimed to

Impart practical knowledge in operating IC engines and conduct experiments. To understand test procedures in testing material for engineering applications

LIST OF EXPERIMENTS*

1. Port timing diagram
2. Valve timing diagram
3. Study of 2,4 stroke I C Engines
4. Load test on 4-stroke petrol engine
5. Performance test on 4-stroke single cylinder diesel engine
6. Performance test on 4-stroke twin cylinder diesel engine
7. Heat balance test on diesel engines
8. Tension test
9. Compression test
10. Deflection test
11. Hardness test (Rockwell and Brinell)
12. Spring test
13. Torsion test
14. Impact test

EQUIPMENTS REQUIRED

1. Single cylinder diesel engine coupled with Electrical loading
2. Single cylinder diesel engine coupled with Electrical loading with temperature indicators
3. Single cylinder slow speed diesel engine coupled with Mechanical loading
4. Twin cylinder diesel engine coupled with Electrical loading with Heat balance test setup
5. Single cylinder petrol engine coupled with Electrical loading
6. Two stroke IC Engine model
7. Four stroke IC Engine model
8. Small IC Engine models for study
9. UTM and Hardness test apparatus

*Minimum 10 experiments shall be offered

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Determine Brake power, Indicated power and frictional power of single cylinder diesel engines.

CO2: Determine Brake power, Indicated power and frictional power of twin cylinder diesel engines.

CO3: Determine Brake power, Indicated power and frictional power of single cylinder petrol engines.

CO4: Evaluate the heat distribution from engine and preparing heat balance chart.

CO5: Estimate the engine performance with mechanical loading

CO6: Estimate the PTD and VTD of two and four stroke engines

CH3312	**TECHNICAL ANALYSIS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

OBJECTIVE

- To learn basic principles involved in estimation and characterization of industrially important materials.

I. Soap Analysis

a. Estimation of total fatty acid

b. Estimation of percentage alkali content

II. Oil Analysis

a. Estimation of free acid

b. Determination of Saponification value

c. Determination of iodine value

III. Cement Analysis

a. Estimation of Silica content

b. Estimation of mixed oxide content

c. Estimation of calcium oxide content

d. Estimation of calcium oxide by rapid method

IV. Coal Analysis

a. Estimation of Sulphur present in coal

b. Ultimate analysis of coal

c. Proximate analysis of coal

V. Analysis of Bleaching Powder

a. Estimation of available chlorine

VI. Analysis of Glycerol

Estimation of purity of glycerol

VII. Analysis of fuels

a. Flash point

b. Fire point

c. Cloud point

d. Pour point

e. Aniline point.

MA3451 **TRANSFORM TECHNIQUES** **L T P C**
3 1 0 4

OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and curl - Irrotational and solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and applications in evaluating line, surface and volume integrals.

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value - Parseval's identity – Harmonic analysis.

UNIT III FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT IV LAPLACE TRANSFORMS 9+3

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS

OUTCOMES

Upon successful completion of the course, students should be able to:

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Understand the mathematical principles on Laplace transforms and would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS

1. Grewal B.S., “Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett . L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

CH3451 MASS TRANSFER I

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Learn and determine mass transfer rates under laminar and turbulent conditions and apply these concepts in the design of humidification columns, dryers and crystallisers.

UNIT I MOLECULAR DIFFUSION 9

Introduction to mass transfer operations. Molecular diffusion in gases, liquids and solids. Diffusivity measurement and prediction; multi-component diffusion.

UNIT II CONVECTIVE TRANSFER AND INTERPHASE MASS TRANSFER 9

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT III HUMIDIFICATION OPERATIONS 9

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV DRYING 9

Drying – Equilibrium. Classification of dryers, batch drying – Mechanism and time of cross through circulation drying, theoretical estimation of drying rate and time. Continuous dryers – material and energy balance. Advance drying techniques such as freeze drying, microwave drying

UNIT V CRYSTALLIZATION 9

Crystal geometry. Equilibrium, yield and purity of products, theory of super saturation, nucleation and crystal growth, classification of crystallizers, design of batch crystallizers and continuous crystallizers.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamentals, types and mechanism of mass transfer operations

CO2: Understand the theories of mass transfer and the concept of inter-phase mass transfer

CO3: Understand the basics of humidification process and its application

CO4: Understand the concept and mechanism of drying operations

CO5: Understand the concept of crystallization process and identification of suitable crystallizer

CO6: Formulate and solve material balances for unit operations such as humidification, drying and crystallization operations.

TEXT BOOKS:

1. Treybal, R. E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill,2017.
2. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., NewJersey, 2003.
3. Narayanan K.V. and Lakshmikutty, B "Mass Transfer – Theory and Applications", 1st Edition, CBS Publishers & Distributors Pvt Ltd, New Delhi, 2014.

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition., McGraw-Hill, 2005.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I and II, 5th Edition, Asian Books Pvt. Ltd., India, 2002.
3. Seader J.D. and Henley E.J., "Separation Process Principles", 4th Ed., John Wiley, 2016

PC3352 MECHANICAL OPERATIONS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impact knowledge in the field of particle size reduction and also deals with the detail construction and working of equipment's used for mechanical operations.

UNIT I PARTICLE CHARACTERIZATION AND MEASUREMENT 9

General characteristics of solids, different techniques of size analysis- Static - Image analysis and Dynamic analysis - Light scattering techniques, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques. Screening methods and equipment, screen efficiency, ideal and actual screens.

UNIT II PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT 9

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 - Nano particle fabrication - Top-down approach - Bottom-up approach. Size enlargement - Importance of size enlargement, principle of granulation, briquetting, palletization, and flocculation. Fundamentals of particle generation.

UNIT III PARTICLE SEPARATION (GAS-SOLID AND LIQUID-SOLID SYSTEM) 9

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

UNIT IV FILTRATION AND FILTRATION EQUIPMENTS 9

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.

UNIT V MIXING AND PARTICLE HANDLING 9

Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, Powder hazards, conveyer selection, different types of conveyers and their performance characteristics.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students will be able to understand the overview of equipment used to perform various mechanical operations and problems associated during the implementation and applications.

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.
3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", 2nd Edn., John Wiley & Sons, 1994.
4. Hiroaki Masuda , KoHigashitani and Hideto Yoshida, Powder Technology Handbook, 3rd Edition.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
2. Christie J. Geankoplis, Transport processes and unit operations.
3. Sunggyu Lee, Kimberly H. Henthorn, Particle Technology and Applications.
4. Martin Rhodes, Introduction to Particle Technology, Second Edition.

CH3401 CHEMICAL ENGINEERING THERMODYNAMICS - I L T P C

3 0 0 3

OBJECTIVE:

The course is aimed to

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

UNIT I **9**

Terminologies of thermodynamics, the variables and quantities of thermodynamics, characteristics of systems and processes, energy classifications, point and path functions, energy in transition work and heat. Zeroth law; temperature scales

UNIT II **9**

The first law of thermodynamics, statements of first law for the flow and non-flow processes. PVT behaviour of fluids; Mathematical representation of PVT behaviour; generalized compressibility factor correlation; generalized equations of state

UNIT III **9**

Joule's experiment, energy balance for closed systems, mass and energy balance for open systems, 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 IV **9**

Thermodynamic properties – 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 V **9**

Thermodynamic aspects of compression, expansion processes and duct flow of compressible fluids, steam power plant.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamental concepts of thermodynamics and its related functions

CO2: Relate PVT behaviour of fluids and understand the real gas behavior

CO3: Apply second law and analyse the feasibility of system/devices

CO4: Analyse the thermodynamic property relations and their application to fluid flow

CO5: Develop the significance of thermodynamic potentials and their use in the analysis of processes

CO6: Formulate thermodynamic formulations and the working of compressors and expanders

TEXT BOOKS:

1. Smith J.M., VanNess,H.C., &Abbot M.C," Introduction to Chemical Engineering Thermodynamics",McGraw Hill VII Edition 2009
2. Kyle B.G.,"Chemical and Process Thermodynamics", Pearson International third Edition.
3. Rao Y.V.C.,"Chemical Engineering Thermodynamics"Universities Press, 2005
4. Koretsky.,Engineering and Chemical thermodynamics,Wiley,2011

REFERENCES:

1. Sandler,S.I.,"Chemical and Engineering Thermodynamics",IV Edition,Wiley,2006.
2. Narayanan K.V"A Text Book of Chemical Engineering Thermodynamics"Prentice Hall of India Pvt.Ltd,2 nd edition,2013.
3. Kevin Douglas, Fundamentals of Chemical Engineering Thermodynamics, Timothy Anderson,2015

CH3491 **HEAT TRANSFER** **L T P C**
3 0 0 3

OBJECTIVE:

The course is aimed to

- Teach the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation and its application to the students

UNIT I **9**

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer ; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres - Thermal conductivity measurement-effect of temperature on thermal conductivity; Heat transfer in extended surfaces; Transient heat conduction

UNIT II **11**

Concepts of heat transfer by convection - Natural and forced convection, Hydrodynamic and thermal Boundary layers; analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Colburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate.

UNIT III **9**

Heat Exchangers – classification and design, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger, NTU and efficiency of Heat exchangers

UNIT IV **8**

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling

UNIT V **8**

Evaporation- single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring's rule. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: To familiarize the students with the fundamental concepts of Heat Transfer. Provide the student with knowledge about heat transfer by conduction in solids for steady state

CO2: Students will understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows

CO3: The course gives the student insight about boundary layer flow, laminar and turbulent flows

CO4: Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers

CO5: The course provides the student with knowledge about heat transfer with phase change (Boiling and condensation) and evaporation

CO6: Students will understand radiative heat transfer including blackbody radiation and Kirchoff'slaw, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems

TEXT BOOKS:

1. Holman, J. P., 'Heat Transfer ', 10th Edn., McGraw Hill,2010.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.
4. B.K. Dutta, Heat transfer principles and applications, PHI Learning PVT Ltd, 2016

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering",6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

L	T	P	C
2	0	0	2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCE BOOKS :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CH3411 FLUID MECHANICS LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVE:

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

LIST OF EXPERIMENTS

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

***Minimum 10 experiments shall be offered**

EQUIPMENT REQUIRED

1.	Viscometer	1 No.
2.	Venturi meter	1 No.
3.	Orifice meter	1 No.
4.	Rotameter	1 No.
5.	Weir and Notches	1 No.
6.	Open drum with orifice	1 No.
7.	Pipes and fittings	1 No.
8.	Helical and spiral coils	1 No.
9.	Centrifugal pump / Gear pump / Reciprocating	1 No
10.	Packed column	1 No.
11.	Fluidized bed	1 No.

Minimum 10 equipment

TOTAL: 45 PERIODS

OUTCOMES:

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

CH3412 MECHANICAL OPERATIONS LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVE:

The course is aimed to

- Develop sound practical knowledge for students on different types of mechanical operations equipments.

LIST OF EXPERIMENTS*

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher
6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator

8. Reduction ratio of Roll Crusher
9. Separation characteristics of Elutriator
10. Reduction ratio of Drop weight crusher
11. Size separation using Sub-Sieving

EQUIPMENTS REQUIRED

1. Sieve shaker
2. Leaf filter
3. Plate and Frame Filter Press
4. Sedimentation Jar
5. Jaw Crusher
6. Ball Mill
7. Cyclone Separator
8. Roll Crusher
9. Elutriator
10. Drop Weight Crusher
11. Sieves.

*Minimum 10 experiments shall be offered

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Determine the size analysis in solid- solid separation systems
CO2: Capability to select different solid - fluid separation equipments.
CO3: Evaluate the size reduction and various crushing parameters
CO4: Estimate the separation characteristics
CO5: Understand the technical methods related to unit operations in process plant
CO6: Apply and understand fluid particle systems and equipment

PROGRESS THROUGH KNOWLEDGE