COURSE CURRICULUM

B.Tech Chemical Engineering

Batch:2026-2027
Academic Year: 2026-27
Updated on: July, 2026

GSFC University
School of Technology, Vigyan Bhavan, P. O. Fertilizer Nagar, Vadodara - 391750, Gujarat, India

B.Tech
in
Chemical Engineering
Course Curriculum

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W.E.F. July 2026

GSFC UNIVERSITY
EDUCATION RE-ENVISIONED

GSFC University, Vigyan Bhavan, P. O. Fertilizer Nagar, Vadodara - 391750, Gujarat, India

VISION

- GSFCU strives to be the best compact boutique institution with a futuristic approach, encouraging student centric culture and sharpened focus on developing industry ready & employable students with all-round development.

MISSION

- Establish an institution, which promotes creativity and innovation.
- Develop unique quality standards for academic excellence and pedagogical innovations.
- Remain agile through learning ecosystem with flexible processes & systems.
- Holistic growth for industry readiness.

No.	Programme Outcomes (POs)	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	Cognitive domain	Apply
PO2	Problem analysis: Identify, formulate, research literature, and analyse complex engineering	Cognitive domain	Analyse
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	Cognitive domain	Create
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	Cognitive domain	Analyse
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	Cognitive domain	Evaluate

PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	Cognitive domain	Apply
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	Cognitive domain	Understand
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	Cognitive domain	Apply
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	Cognitive domain	Create
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	Cognitive domain	Remember
PO11	Project management and finance: Demonstrate knowledge understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	Cognitive domain	Apply
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	Cognitive domain	Understand

No.	Programme Specific Outcomes (PSOs)	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
PSO1	Graduates will be able to analyze and solve complex chemical engineering problems by integrating principles of material and energy balances, thermodynamics, transport phenomena, chemical reaction engineering, and process control.	Cognitive domain	Apply

PSO2	Graduates will be able to design, model, simulate, and optimize chemical processes and equipment by applying modern engineering tools and techniques, with due consideration to safety, sustainability, and economic feasibility.	Cognitive domain	Create
PSO3	Graduates will be able to apply chemical engineering knowledge in industrial, research, or entrepreneurial settings, including plant operation, process troubleshooting, quality assurance, and compliance with professional and regulatory requirements	Cognitive domain	Analyse

Mapping of POs & PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PSO1	3	3	3	2	3	1	2	2	1	1	2	1
PSO2	2	2	3	3	1	2	1	1	2	2	3	2
PSO3	2	1	2	1	3	1	0	3	2	3	3	1

1: Slight (Low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Definition of Credit:

1 Hour. Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
2 Hours Practical (P) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
3 Hours Experiential learning	1 credit

Course code Definitions:

Lecture	L
Tutorial	T
Practical	P
Basic Science Courses	BSC
Engineering Science Courses	ESC
Humanities and Social Sciences including Management courses	HSMC
Professional core courses /Major (Core)	PCC
Professional Elective courses /Minor Stream	PEC

Open Elective courses	OEC
Laboratory course	LC
Mandatory courses	MC
Non-credit courses	NC
Project (Experiential learning)	PROJ
Experiential learning ex. Internship, Industrial Visit, Field visit, etc,	EL
Multidisciplinary courses	MDC
Ability Enhancement Course	AEC
Skill Enhancement Course	SCE
Value Added Courses	VAC

Structure of Undergraduate Programme:

Sr. No.	Category	Credit Breakup
1	Humanities and Social Sciences courses	12
2	Basic Science courses	28
3	Engineering Science courses	23
4	Professional Core courses	77
5	Professional Elective courses	6
6	Open Elective courses	5
7	Project work, seminar and internship	22
8	Value Added courses	7
	Total	180

Category-wise Courses:

Humanities & Social Sciences Courses

(i) Number of Humanities & Social Science Courses: 6
(ii) Credits: 12

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	AECC111	Fundamentals of English	I	2	0	0	2	2	0	0	2
2	AECC201	Communication Skills in English	II	2	0	0	2	2	0	0	2

3	AECC311	Entrepreneurship Development	III	2	0	0	2	2	0	0	2
4	AECC411	Environmental Studies	IV	2	0	0	2	2	0	0	2
5	AECC501	Disaster Risk Management	V	2	0	0	2	2	0	0	2
6	AECC601	Indian Constitution	VI	2	0	0	2	2	0	0	2
		Total					**12**				**12**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Basic Science Course

(i) Number of Basic Science Course: 7
(ii) Credits: 28

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	BTMA103	Mathematics – I	I	3	0	1	4	3	0	1	4
2	BTPY105	Engineering Physics	I	3	2	0	5	3	1	0	4
3	BTMA203	Mathematics – II	II	3	0	1	4	3	0	1	4
4	BTCY205	Engineering Chemistry	II	3	2	0	5	3	1	0	4
5	BTMA301	Mathematics III	III	3	0	1	4	3	0	1	4
6	BTCH303	Applied Chemistry	III	4	2	0	6	4	1	0	5
7	BTCH410	Numerical Methods for Chemical Engineers	IV	2	2	0	4	2	1	0	3
		Total					**32**				**28**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Engineering Science Course

(i) Number of Engineering Science Course: 8
(ii) Credits: 23

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	BTEC101	Basic of Electrical & Electronics	I	3	2	0	5	3	1	0	4
2	BTME106	Workshop	I	0	2	0	2	0	1	0	1

3	BTFS108	Fundamental in Fire, Environment, health, Safety	I	2	0	0	2	2	0	0	2
4	BTME202	Engineering Graphics	II	0	4	0	4	0	2	0	2
5	BTME209	Engineering Mechanics	II	3	2	0	5	3	1	0	4
6	BTCS206	Python Programming	II	3	2	0	5	3	1	0	4
7	BTCH405	Material Science and Engineering	IV	3	0	0	3	3	0	0	3
8	BTCH702	Plant Design and Economics	VII	3	0	0	3	3	0	0	3
		Total		**17**	**12**	**0**	**29**	**17**	**6**	**0**	**23**

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Professional Core Courses

(i) Number of Professional Core Courses: 18
(ii) Credits: 77

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	BTCH304	Process Calculations	III	3	0	1	4	3	0	1	4
2	BTCH305	Mechanical Operations	III	4	2	0	6	4	1	0	5
3	BTCH310	Fluid Flow Operations	III	3	2	0	5	3	1	0	4
4	BTCH401	Chemical Engineering Thermodynamics - I	IV	3	0	1	4	3	0	1	4
5	BTCH402	Heat Transfer Operations	IV	3	2	1	6	3	1	1	5
6	BTCH403	Process Technology	IV	4	2	0	6	4	1	0	5
7	AECC411	Environmental Studies	IV	2	0	0	2	2	0	0	2
8	BTCH410	Artificial Intelligence in Chemical Engineering	IV	3	0	0	3	3	0	0	3
9	BTCH501	Mass Transfer Operations - I	V	4	2	0	6	4	1	0	5
10	BTCH502	Chemical Reaction Engineering - I	V	3	2	1	6	3	1	1	5
11	BTCH503	Chemical Engineering Thermodynamics - II	V	3	0	1	4	3	0	1	4
12	BTCH504	Instrumentation & Process Control	V	4	2	0	6	4	1	0	5
13	BTCH601	Mass Transfer Operations - II	VI	3	2	1	6	3	1	1	5
14	BTCH602	Chemical Reaction Engineering - II	VI	3	0	0	3	3	0	0	3
15	BTCH603	Process Equipment Design - I	VI	3	2	0	5	3	1	0	4
16	BTCH701	Process Modelling, Simulation and Optimization	VII	4	2	0	6	4	1	0	5
17	BTCH710	Chemical Process Safety	VII	3	0	0	3	3	0	0	3

18	BTCH708	Process Equipment Design - II	VII	2	0	1	3	2	0	1	3
19	BTCH710	Transport Phenomena	VII	3	0	0	3	3	0	0	3
		Total		**57**	**20**	**7**	**84**	**57**	**10**	**7**	**77**

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Professional Elective Courses

(i) Number of Professional Elective Course: 2
(ii) Credits: 6

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	BTCH605A	Petroleum Engineering	VI	3	0	0	3	3	0	0	3
	BTCH605B	Polymer Science & Technology									
	BTCH605E	Green Technology									
	BTCH605F	Industrial Engineering Practices									
	BTCH605G	Advanced Separation Techniques									
	BTCH605H	Carbon Capture and Sequestration									
2	BTCH706A	Petroleum Refining Processes	VII	3	0	0	3	3	0	0	3
	BTCH706B	Polymer Processing									
	BTCH706C	Bioprocess Engineering									
	BTCH706E	Process Intensification									
	BTCH706F	Industrial Management Practices									
		Total		**6**	**0**	**0**	**6**	**6**	**0**	**0**	**6**

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Open Elective Courses:

(i) Number of Open Elective Courses: 2
(ii) Credits: 5

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	NOC01	NPTEL Online Courses	V	0	0	0	0	0	0	0	2
2	BTOE1	Plant Utilities	VI	3	0	0	3	3	0	0	3
	BTOE2	Corrosion Science									
	BTOE8	Energy Technology									
		Total		**3**	**0**	**0**	**3**	**3**	**0**	**0**	**5**

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Project Work, Seminar and Internship in Industry or Elsewhere

(i) Number of Project Work, Seminar and Internship in Industry or Elsewhere: 7
(ii) Credits: 22

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BTCH208	Industrial Internship	II	0	0	0	0	0	0	0	2
2.	BTCH307	Industrial Internship	III	0	0	0	0	0	0	0	2
3.	BTCH407	Industrial Internship	IV	0	0	0	0	0	0	0	2
4.	BTCH506	Industrial Internship	V	0	0	0	0	0	0	0	2
5.	BTCH606	Industrial Internship	VI	0	0	0	0	0	0	0	2
6.	BTCH707	Industrial Internship	VII	0	0	0	0	0	0	0	2
7.	BTCH801	Project	VIII	0	20	0	2	0	10	0	10
		Total									**22**

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Ability Enhancement Courses

(i) Number of Ability Enhancement Courses: 6

(ii) Credits: 12

Sr No	Code	Subject	Semester	L	P	T	Total	L	P	T	Total
1	AECC111	Fundamentals of English	I	2	0	0	2	2	0	0	2
2	AECC201	Communication Skills in English	II	2	0	0	2	2	0	0	2
3	AECC311	Entrepreneurship Development	III	2	0	0	2	2	0	0	2
4	AECC401	Environmental Studies	IV	2	0	0	2	2	0	0	2
5	AECC501	Disaster Risk Management	V	2	0	0	2	2	0	0	2
6	AECC601	Indian Constitu-tion	VI	2	0	0	2	2	0	0	2
		Total									**12**

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Value Added Courses

(i) Number of Value-Added Courses: 2
(ii) Credits: 5

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	VACC101	Foundation Course	I	0	0	0	0	0	0	0	4
2	VACC102	Tinkering & Mentoring	2	0	4	0	4	0	4	0	1
3	VACC*	Indian Knowledge System	2	2	0	0	2	2	0	0	2
		Total									**7**

*Different course codes are there for different courses under IKS

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Research Project / Dissertation

(i) Number of Research Project / Dissertation: 1
(ii) Credits: 10

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1	BTCH801	Project	VIII	0	20	0	2	0	10	0	10
		Total									**10**

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About the Program

Chemical Engineering covers a vast area from producing innovative products in laboratories to implementing them in large scale production in industries by combining the basic principles of Chemistry, mathematics, physics, life sciences and economics. The Chemical Engineering Program at GSFC University focuses to develop Industry ready students for the futuristic areas in modelling and simulation, process control, reaction engineering, transfer operations, thermodynamics, renewable energy and so on. The Program is well equipped with new state of art labs to boost up high quality research & learning activity with the help of several software such as CHEMCAD and MATLAB. Chemical engineering now extends beyond its traditional roots in oil and gas processing to interdisciplinary emerging technologies like recycling and waste management, green technology,

nuclear and biomedical engineering. Apart from this the Gujarat Industrial Policy - 2020 has indicated an increase in demand of Chemical Engineers in near future as major investment is being made in the sector of Petroleum, Chemicals and Petrochemicals in 453 sq. km. at Dahej, Gujarat. The GSFC University in Vadodara, Gujarat is situated at the heart of the chemical belt comprising of major chemical industries like GSFC Limited, IOCL, GACL, Reliance - IPCL, Prakash Chemicals, Deepak Nitrite in the nearby vicinity along-with various chemical industries like ONGC, Reliance Jamnagar Refinery, Atul Chemicals, etc.in other parts of Gujarat.

The great philosopher Aristotle once said, "for the things we have to learn before we can do them, we learn by doing them". Learning by doing or experiential learning is the core belief that we proudly follow at GSFC University! Think about the time when from school we used to go on field trips to a manufacturing industry or a museum, seeing the pages of our books alive in front of us always had a lasting impression. Even after leaving school and joining the Chemical Engineering Program at GSFC University we pledged to go by the same lasting impression through our industrial internships. Internships are undertaken for overall development of student focussing the curriculum application and allied sectors after every semester throughout the course followed by the final six months of industrial project in the last semester. The campus situated within the vicinity of the esteemed organization of GSFC Limited with access to 22 process plants along with internship opportunities in RIL, GACL, L&T, GFL, IOCL, Deepak Nitrate, GNFC etc gives immediate exposure to the students to the real time aspects of Chemical Engineering. To accomplish a holistic development, the hands-on experience is well supported by the chemical engineering program’s cutting-edge curriculum meeting industry demands and fully equipped laboratory facilities for indulging students in the basic knowledge for becoming industry ready. In keeping with the unprecedented time, classroom teaching has also evolved from the traditional ICT tools to Google Classroom and innovative pedagogies like breakout rooms for team building activities, flipped classrooms for making lessons more engaging. Chemical Engineering Program in GSFC University offers a host of courses apart from the core chemical engineering subjects like Petroleum refining Engineering, Plant Utilities, Polymer Science & Technology, Energy

Technology, Industrial Management, Bioprocess Engineering. For soft skill development of students to meet professional goals in terms of presentation and interview a course in Soft Skills and Technical Writing is also offered. Keeping abreast with the latest developments in chemical fields, several courses are offered matching the emerging technologies like Industrial Pollution Control, Chemical Process Safety, Advanced Separation Techniques, Corrosion science, Process Technology and Environmental Science.

Along with the course curriculum, the students of chemical engineering also participate in various co-curricular and extra-curricular activities through different student managed clubs and AIChE GSFCU student chapter. AIChE student chapters are a great way for chemical engineering students to connect both locally and globally with other students and experts in the field of chemical engineering for net-working, scholarships, career placement, education opportunities etc. AIChE GSFC University Student Chapter won consecutive two times the global recognition of the Outstanding Student Chapter Award in the year 2021 and 2022 respectively!

Students also have exposure to the incubation and innovation center at GSFC University named GSFC University Incubation, Innovation, and Technology & Applied Research Centre (GUIITAR); which helps them orient, develop, tinker and create their own business platforms as a career path option.

Teaching Scheme Semester – I

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semes

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1	BTEC101	Basics of Electrical & Electronics	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2	BTMA103	Mathematics – I	3	0	1	4	3	0	1	4	20	40	40	100	0	100
3	BTPY115	Engineering Physics	3	2	0	5	3	1	0	4	20	40	40	100	50	150
4	BTME106	Workshop	0	2	0	2	0	1	0	1	0	0	0	0	50	50
5	BTFS108	Fundamentals in Fire & Environment, Health, Safety	2	0	0	2	2	0	0	2	20	40	40	100	0	100
6	AECC111	Fundamentals of English	2	0	0	2	2	0	0	2	20	40	40	100	0	100
7	VACC101	Foundation Course	0	0	0	0	0	0	0	4	0	0	0	0	100	100
		Total	**13**	**6**	**1**	**20**	**13**	**3**	**1**	**21**						**750**

Teaching Scheme Semester – II

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1	BTME202	Engineering Graphics	0	4	0	4	0	2	0	2	-	-	-	-	50	50
2	BTMA203	Mathematics - II	3	0	1	4	3	0	1	4	20	40	40	100	-	100
3	BTME209	Engineering Mechanics	3	2	0	5	3	1	0	4	20	40	40	100	50	150
4	BTCY205	Engineering Chemistry	3	2	0	5	3	1	0	4	20	40	40	100	50	150
5	BTCS206	Python Programming	3	2	0	5	3	1	0	4	20	40	40	100	50	150
7	AECC201	Communication Skills in English	2	0	0	2	2	0	0	2	20	40	40	100	-	100
8	BTCH208	Industrial Internship	0	0	0	0	0	0	0	2	-	-	-	-	-	100
9	VACC201*	Tinkering & Mentoring	0	2	0	1	0	2	0	1	-	-	-	-	50	50
10	VACC#	Indian Knowledge System	2	0	0	2	2	0	0	2	100	40	60	100	-	100
		Total	**16**	**14**	**1**	**28**	**16**	**7**	**1**	**25**						**950**

***syllabus of VACC201 attached after semester 8**

#Different course codes are there for different courses under IKS

Teaching Scheme
Semester – III

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1.	BTMA301	Mathematics-III	3	0	1	4	3	0	1	4	20	40	40	100	-	100
2.	BTCH310	Fluid Flow Operations	3	2	0	5	3	1	0	4	20	40	40	100	50	150
3.	BTCH303	Applied Chemistry	4	2	0	6	4	1	0	5	20	40	40	100	50	150
4.	BTCH304	Process Calculations	3	0	1	4	3	0	1	4	20	40	40	100	-	100
5.	BTCH305	Mechanical Operations	4	2	0	6	4	1	0	5	20	40	40	100	50	150
7.	AECC311	Entrepreneurship Development	2	0	0	2	2	0	0	2	20	40	40	100	-	100
8.	BTCH307	Industrial Internship	0	0	0	-	0	0	0	2	-	-	-	-	-	100
		Total	**19**	**6**	**2**	**27**				**26**						**850**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Teaching Scheme
Semester – IV

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1	BTCH401	Chemical Engineering Thermodynamics - I	3	0	1	4	3	0	1	4	20	40	40	100	0	100
2	BTCH402	Heat Transfer Operations	3	2	1	5	3	2	1	5	20	40	40	100	50	150
3	BTCH403	Process Technology	4	2	0	6	4	2	0	5	20	40	40	100	50	150
4	BTCH409	Numerical Methods in Chemical Engineering	2	2	0	4	2	2	0	3	20	40	40	100	50	150
5	BTCH405	Material Science & Engineering	3	0	0	3	3	0	0	3	20	40	40	100	0	100
6	BTCH408	Industrial Pollution Control	2	0	0	2	2	0	0	2	20	40	40	100	0	100
7	AECC411	Environmental Studies	2	0	0	2	2	0	0	2	20	40	40	100	0	100
8	BTCH407	Industrial Internship	0	0	0	0	0	0	0	2	-	-	-	-	0	100
9	BTCH410	Artificial Intelligence in Chemical Engineering	3	0	0	3	3	0	0	3	20	40	40	100	0	100
		Total	**22**	**6**	**2**	**30**	**22**	**6**	**2**	**29**						**1050**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Teaching Scheme Semester – V

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1	BTCH501	Mass Transfer Operations-I	4	2	0	6	4	1	0	5	20	40	40	100	50	150
2	BTCH502	Chemical Reaction Engineering-I	3	2	1	6	3	1	1	5	20	40	40	100	50	150
3	BTCH503	Chemical Engineering Thermodynamics-II	3	0	1	4	3	0	1	4	20	40	40	100	-	100
4	BTCH504	Instrumentation & Process Control	4	2	0	6	4	1	0	5	20	40	40	100	50	150
5	NOC01	NPTEL Online Courses	0	0	0	0	0	0	0	2	-	-	-	-	-	100
6	AECC501	Disaster Risk Management	2	0	0	2	2	0	0	2	20	40	40	100	-	100
7	BTCH506	Industrial Internship	0	0	0	0	0	0	0	2	-	-	-	-	-	100
		Total	**16**	**6**	**2**	**24**	**16**	**3**	**2**	**25**						**850**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Teaching scheme semester – VI

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory : MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1	BTCH601	Mass Transfer Operations - II	3	2	1	6	3	1	1	5	20	40	40	100	50	150
2	BTCH602	Chemical Reaction Engineering - II	3	0	0	3	3	0	0	3	20	40	40	100	0	100
3	BTCH603	Process Equipment Design – I	3	2	0	5	3	1	0	4	20	40	40	100	50	150
4	BTCH605	Professional Elective - I	3	0	0	3	3	0	0	3	20	40	40	100	0	100
5	BTOE	Open Elective	3	0	0	3	3	0	0	3	20	40	40	100	0	100
6	AECC601	Indian Constitution	2	0	0	2	2	0	0	2	20	40	40	100	0	100
7	BTCH606	Industrial Internship	**0**	**0**	**0**		**0**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**100**
		Total	**17**	**4**	**1**	**22**	**17**	**2**	**3**	**22**						**800**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Teaching Scheme Semester – VII

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1	BTCH701	Process Modelling, Simulation and Optimization	4	2	0	6	4	1	0	5	20	40	40	100	50	150
2	BTCH702	Plant Design & Economics	3	0	0	3	3	0	0	3	20	40	40	100	-	100
3	BTCH708	Process Equipment Design - II	2	0	1	3	2	0	1	3	20	40	40	100	-	100
4	BTCH710	Chemical Process Safety	3	0	0	3	3	0	0	3	20	40	40	100	-	100
5	BTCH709	Transport Phenomena	3	0	0	3	3	0	0	3	20	40	40	100	-	100
6	BTCH706	Professional Elective - II	3	0	0	3	3	0	0	3	20	40	40	100	-	100
7	BTCH707	Industrial Internship	0	0	0	0	0	0	0	2	-	-	-	-	-	100
		Total	**18**	**2**	**1**	**21**	**18**	**1**	**1**	**22**						**750**

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

Teaching Scheme Semester – VIII

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
1	BTCH801	Project	0	20	0	20	0	20	0	10	-	-	-	-	100	100

Note: L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

PEC/OEC– I

Course Code	Course Name
BTCH605A	Petroleum Engineering
BTCH605B	Polymer Science & Technology
BTCH605E	Green Technology
BTCH605F	Industrial Engineering Practices
BTCH605G	Advanced Separation Techniques
BTCH605H	Carbon Capture and Sequestration
NOC01	NPTEL Online Courses

PEC/OEC– II

Course Code	Course Name
BTCH706A	Petroleum Refining Processes
BTCH706B	Polymer Processing
BTCH706C	Bioprocess Engineering
BTCH706E	Process Intensification
BTCH706F	Industrial Management Practices
BTOE1	Plant Utilities
BTOE2	Corrosion Science
BTOE8	Energy Technology

Summary of Credits:

Sr. No.	Semester	Course Code	Course Name	Theory marks	Practical marks	Course Credit
1	I	BTEC101	Basics of Electrical & Electronics	100	50	4
2	I	BTMA103	Mathematics – I	100	0	4
3	I	BTPY115	Engineering Physics	100	50	4
4	I	BTME106	Workshop	0	50	1
5	I	BTFS108	Fundamentals in Fire & Environment, Health, Safety	0	0	2
6	I	AECC111	Fundamentals of English	100	0	2
7	I	VACC101	Foundation Course	0	100	4
8	II	BTME202	Engineering Graphics	0	50	2
9	II	BTMA203	Mathematics - II	100	0	4
10	II	BTME209	Engineering Mechanics	100	50	4
11	II	BTCY205	Engineering Chemistry	100	50	4
12	II	BTCS206	Python Programming	100	50	4
13	II	AECC201	Communication Skills in English	100	0	2
14	II	BTCH208	Industrial Internship	0	100	2
15	II	VACC201	Tinkering and Mentoring	0	100	1
16	II	VACC*	Indian Knowledge System	100	0	2
17	III	BTMA301	Mathematics-III	100	0	4
18	III	BTCH310	Fluid Flow Operations	100	50	4
19	III	BTCH303	Applied Chemistry	100	50	5
20	III	BTCH304	Process Calculations	100	0	4
21	III	BTCH305	Mechanical Operations	100	50	5
22	III	AECC301	Entrepreneurship Development	100	0	2
23	III	BTCH307	Industrial Internship	0	100	2
24	IV	BTCH401	Chemical Engineering Thermodynamics - I	100	0	4
25	IV	BTCH402	Heat Transfer Operations	100	50	5
26	IV	BTCH403	Process Technology	100	50	5

27	IV	BTCH409	Numerical Methods in Chemical Engineering	100	50	3

28	IV	BTCH405	Materials Science & Engineering	100	0	3
29	IV	BTCH408	Industrial Pollution Control	100	0	2
30	IV	AECC401	Environmental Studies	100	0	2
31	IV	BTCH407	Industrial Internship	0	100	2
32	IV	BTH410	Artificial Intelligence in Chemical Engineering	100	0	3
33	V	BTCH501	Mass Transfer Operations-I	100	50	5
34	V	BTCH502	Chemical Reaction Engineering-I	100	50	5
35	V	BTCH503	Chemical Engineering Thermodynamics-II	100	0	4
36	V	BTCH504	Instrumentation & Process Control	100	50	5
37	V	NOC01	NPTEL Online Courses	-	-	2
38	V	AECC501	Disaster Risk Management	100	0	2
39	V	BTCH506	Industrial Internship	0	100	2
40	VI	BTCH601	Mass Transfer Operations - II	100	50	5
41	VI	BTCH602	Chemical Reaction Engineering - II	100	0	3
42	VI	BTCH603	Process Equipment Design – I	100	50	4
43	VI	BTCH605	Professional Elective - I	100	0	3
44	VI	BTOE	Open Elective	100	0	3
45	VI	AECC601	Indian Constitution	100	0	2
46	VI	BTCH606	Industrial Internship	0	100	2
47	VII	BTCH701	Process Modelling, Simulation and Optimization	100	50	5
48	VII	BTCH702	Plant Design & Economics	100	0	3
49	VII	BTCH708	Process Equipment Design - II	100	0	3
50	VII	BTCH710	Chemical Process Safety	100	0	3
51	VII	BTCH709	Transport Phenomena	100	0	3
52	VII	BTCH706	Professional Elective - II	100	0	3
53	VII	BTCH707	Industrial Internship	0	100	2
54	VIII	BTCH801	Project	0	100	10
			Total			**180**

COURSE CODE	COURSE NAME	SEMESTER
BTEC101	BASIC OF ELECTRICAL AND ELECTRONICS	I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisites	NIL
Course Category	Engineering Science
Course focus	Skill development
Rationale	Basic electrical and electronics knowledge is essential for understanding modern technology, from everyday applications to career opportunities. It provides a foundation for working with computers, telecommunications, renewable energy, and more. It promotes safety by teaching proper handling of electricity and hazard awareness. This knowledge enables DIY projects, repairs, and problem-solving skills. It also contributes to environmental sustainability by understanding energy consumption and designing efficient systems.
Course Revision/ Approval Date:	24-04-2017
Course Objectives	To enable the student to: 1. To **introduce** fundamental electrical laws and quantities required for DC and AC circuit analysis. 2. To **develop** analytical ability in single-phase and three-phase AC systems using RMS and average value computations. 3. To **provide** essential knowledge of electrical machines for informed motor selection and sizing. 4. To **familiarize** students with electrical and electronic components and datasheets for industrial and instrumentation use. 5. To **expose** students to signal concepts and measurement techniques using standard electrical test equipment.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Electrical Engineering **Theory:** Study of voltage, current, power & energy. Application of Ohm's law, Kirchhoff's law, Lenz law. Electromagnetic induction through the working of a transformer.	**20%**	**10**

Unit 2: Concept of 1-phase, 3- phase AC supply. **Theory:** Introduction of terms like RMS value, average value. Familiarity with components like resistors, capacitors, diodes, LED's, their application, uses, industrial specification. Introduction to component data sheets.	**25%**	**10**
Unit 3: Electrical Machines **Theory:** Understanding the construction, type, principle of operation of various motors like DC, Stepper, Servo, AC. Introduction to the concepts of motor selection and sizing.	**25%**	**10**
Unit 4: Electronics Engineering **Theory:** Introduction of electronic components like diodes, LED's, transistors, O Amps, Gates Industrial specification and data sheets of the components. Characteristics and usage of the components. Signals: Analog & Digital. Introduction to industrial data acquisition.	**20%**	**10**
Unit 5: Test Equipment **Theory:** Introduction to Multimeter and Oscilloscope.	**10%**	**5**

List of Practical	Weightage	Contact hours
1: Symbols of Electrical & Electronics equipment, Basics of Electrical safety & Study of Electrical Safety rules	**20%**	**3**
2: Patch cords, Digital Multimeter (DMM), Familiarization with Digital multimeter (DMM).	**20%**	**3**
3: Measurement of AC Voltage at 230 V AC Mains plug, Measurement of DC Voltage for cell phone battery of 3.8 V DC, Measurement of Resistance of Current coil & Potential coil of Energy meter, Measurement of Continuity of any wire/fuse.	**20%**	**3**
4: Study the basics of phase control transformer & verify its turn-ratio, Familiarization with Digital Storage Oscilloscope (DSO)	**20%**	**3**
5: Understand the construction & working of energy meter, Load Test on 1 Phase AC CSCR Type AC Motor, Load Test on DC Shunt Motor.	**20%**	**3**

Instructional Method and Pedagogy: Teaching basic electrical and electronics, a combination of instructional methods and pedagogies can be employed to enhance learning. A hands-on approach, such as laboratory experiments, allows students to directly engage with circuits and electronic components, reinforcing theoretical concepts.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: The student will be able **to apply** fundamental electrical laws to analyze voltage, current, power, and energy in DC and AC circuits.	Cognitive Cognitive	Apply Determine

CO2: The student will be **able to analyze** single-phase and three-phase AC systems by computing RMS and average values. CO3: The student will be **able to** interpret electrical machine construction and operating characteristics to justify motor selection and sizing. CO4: The student will be **able to** evaluate electrical and electronic components using datasheets for industrial and in-strumentation applications. CO5: The student will be **able to** apply signal concepts and test equipment to measure and analyze analog and digital signals in data acquisition systems.	Cognitive Cognitive Cognitive	Analyze Understand Apply

Learning Resources	
1.	Reference Books: 1. Thomas, G.B., Finney, R.L., Calculus and Analytic Geometry, 9th Ed.,Wesley/Narosa, (1998).
2.	Journals & Periodicals: 1. Journal of Electrical Engineering and Electronics 2. IET Power Electronics 3. International Journal of Electronics 4. IEEE Transactions on Education:
3.	Other Electronic Resources: 1. www.electronicsclub.info 2. www.circuitlab.com

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks

	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**
Project/ Industrial Internship Marks		
	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feedback on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	3	2	2
CO4	3	2	2
CO5	2	2	2

Mapping of POs & Cos

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

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTMA103	COURSE NAME MATHEMATICS-I	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	1	4	3	0	1	4

Course Pre-requisites	Differentiation and Integration (Basic calculus), Trigonometry
Course Category	Basic Science
Course focus	Skill Development
Rationale	Mathematics is essential for everyday life, providing practical applications and problem-solving skills. It forms the foundation for science, technology, engineering, and mathematics (STEM) fields. Learning mathematics enhances cognitive development, including critical thinking and analytical skills.
Course Revision/ Approval Date:	24-04-2017
Course Objectives **(As per Blooms' Taxonomy)**	1. To **develop** conceptual clarity in the fundamentals of limits, continuity, and differentiability of single-variable functions, including the treatment of indeterminate forms using L'Hospital's Rule. 2. To **examine** the behavior of sequences, series, and power series as tools for modeling and approximation in engineering applications. 3. To **acquire** proficiency in the fundamental concepts of differential and multivariable calculus used to address engineering and scientific problems 4. To **explore** the applications of partial derivatives in optimization and approximation problems, 5. To **interpret** and relate key concepts of linear algebra, such as eigenvalues, eigenvectors, and matrix transformations, to engineering contexts.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Review of limits, continuity, and differentiability **Theory:** Review of limits, continuity, and differentiability of function of single variable; indeterminate forms and 'Hospital's Rule.	**20%**	**07**
Unit 2: Sequences and series **Theory:** Sequences and series, Tests for convergence of series (nth term, Comparison, limit comparison, Ratio, Root, Integral, Geometric series,	**20%**	**10**
Alternating series), Power Series, Taylor Series, Maclaurin's Series.		

Unit 3: Partial Derivatives: **Theory:** Limit and continuity of functions of two variables, chain rule, total derivatives, Taylor's series expansion of function of two variables.	**20%**	**10**
Unit4: Applications of Partial Derivatives: **Theory:** Maxima and minima, Lagrange multipliers, errors and approximation, implicit functions, tangent plane and normal to a surface.	**20%**	**08**
Unit 5: Linear Algebra: **Theory:** Elementary operations and their use in getting the Rank, Inverse of a matrix and solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew- Hermitian, Normal & amp; Unitary matrices and their elementary properties. Characteristic polynomials, Eigen- values and Eigenvectors of a matrix, Cayley Hamilton theorem (without proof) and its use in finding the inverse of a matrix. Applications of Matrices.	**20%**	**10**
List Of Practical Tutorial	**Weightage**	**Contact hours**
Unit 1: 1. Limits, Continuity, Differentiability of one variable functions. 2. Limits, Continuity, Differentiability of two variable functions.	**20%**	**3**
Unit 2: 1. Partial Derivatives: Total Derivatives, Composite functions. 2.Application of Partial Derivatives: Maxima – Minima of functions, Taylor's Series.	**20%**	**3**
Unit 3: 1. Application of Partial Derivatives: Tangent Plane Normal line, Error approximation. 2. Matrices: Rank and Inverse of matrix.	**20%**	**3**
Unit 4: 1. Matrices: Solution of System of linear equations. 2. Eigen values and Eigenvectors of a matrix.	**20%**	**3**
Unit 5: 1. Convergence and Divergence of Sequence. 2.Convergence and Divergence of Series.	**20%**	**3**

Instructional Method and Pedagogy: For engineering mathematics, an effective instructional method involves a combination of problem-based learning, active learning, and technology integration. Engage students in solving real-world engineering problems, promoting critical thinking and application of mathematical concepts. Utilise visualisations, demonstrations, and mathematical software to enhance understanding.

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**

CO1: To **Analyze** and solve problems involving limits, continuity, and differentiation of single-variable functions. CO2: To **Evaluate** the convergence or divergence of sequences and series using appropriate convergence tests. CO3: To **Construct** and apply Taylor and Maclaurin series expansions for function approximation in engineering problems. CO4: To **Analyze** and compute partial derivatives and total derivatives of multivariable functions for engineering applications. CO5: To **Formulate** and solve systems of linear equations and analyze matrices using eigenvalues and eigenvectors for computational applications.	Cognitive Cognitive Cognitive Cognitive Cognitive	Understand Understand Apply Understand Apply

Learning Resources	
1.	Reference Books: Thomas, G.B., Finney, R.LCalculus and Analytic Geometry, 9th Ed.,Wesley/Narosa, (1998).
2.	Journals & Periodicals: 1. Journal of Optimization Theory and Applications 2. Journal of Mathematical Modelling and Algorithms 3. SIAM Journal on Applied Mathematics 4. Mathematical Problems in Engineering
3.	Other Electronic Resources: 1. www.onlinemathlearning.com 2. www.mathway.com

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Open Book Assignment	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**
Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feed-back on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	0	2	2
CO2	0	0	1
CO3	0	0	0
CO4	0	2	2
CO5	0	2	3

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	1	0	1	0	0	0	1	1	0	2
CO2	3	3	0	1	1	0	0	0	1	1	0	2
CO3	3	2	2	1	2	0	0	0	1	1	0	2
CO4	3	3	1	1	2	0	0	0	1	1	0	2
CO5	3	3	2	1	3	0	0	0	1	1	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE	COURSE NAME	SEMESTER
BTPY115	Engineering Physics	**I**

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
45	30	0	75	3	1	0	4

Course Prerequisites	Fundamentals of Mathematics
Course Category	Core/Applied
Course focus	Skill Development
Rationale	Engineering physics combines the principles of physics and engineering, bridging the gap between theory and practical applications. It equips students with problem-solving skills, a deep understanding of scientific principles, and the ability to apply them to engineering challenges.
Course Revision/ Approval Date:	July 7, 2025
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. To **evaluate** the role of Maxwell's equations in describing the electromagnetic spectrum. 2. To **analyze** the dual nature of matter–energy and the fundamentals of quantum mechanics. 3. To **apply** the knowledge of semiconductor devices to identify their types and applications. 4. To **apply** the concepts of analog and digital signals and the working of logic gates. 5. **Analyze** the construction and working of sensors to differentiate between various types

Course Content (Theory)	Weightage	Contact hours
Unit 1: Electromagnetism: Oscillations(mechanical/non-mechanical), Maxwell's Equations and significance, Origin of electromagnetic waves, Electromagnetic Spectrum and applications	20%	9
Unit 2: Modern Physics Matter & EM Energy, dual nature of matter(electron diffraction) & energy (photoelectric effect), Interference, Wave Function and its physical Significance, One Dimensional Time	20%	9

Course Content (Theory)	Weightage	Contact hours
Independent Schrodinger Equation and its application		
Unit 3: Physics of Semiconductors: Classification of materials (based on resistivity), Intrinsic & Extrinsic Semiconductors, p-type and n-type semiconductor, PN junction diode (biasing & IV characteristics), Application of diodes (rectifier, special purpose diodes)	22.2%	10
Unit 4: Digital Logic Circuits: Analog and Digital Signals, Logic Levels and Boolean system, Logic Gates, NOT/OR/AND gate using diodes	17.7%	8
Unit 5: Physics of Sensors: Transducers & Sensors (Definition & Classification), Working of temperature, optical, pressure, and smoke detecting sensor	20%	9

List of Practical	Weightage	Contact hours
Unit 1: (1) To determine the least count of Vernier calipers, micrometer screw gauge and spectrometer. (2) To determine the frequency of a tuning fork using Melde's experimental setup. (3) To determine acceleration due to gravity using a bar pendulum.	20%	6
Unit 2: (4) To determine the value of Planck constant using the photoelectric experimental setup. (5) To determine the radius of curvature of a given plano-convex lens using Newton's rings setup. (6) To determine the wavelength of a monochromatic source using diffraction grating experiment.	20%	6
Unit 3: (7) To study different types of rectifier circuits. (8) To study the characteristics of LED/Zener.	13%	4
Unit 4: (9) To study different logic gates.	7%	2
Unit 5: (10) Demonstration of a smoke detecting system.	7%	2
(11) Pre-End Sem Exam revision.	20%	6
(12) Journal Checking & VIVA preparation.	13%	4

Instructional Method and Pedagogy:

Chalk-board, Presentation, Discussion, Quiz, Demonstration, Hands-on Practicals

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Subdomain**
After successful completion of the above course, students will be able to:		
CO1: Evaluate the role of Maxwell's equations in describing and predicting behavior across the electromagnetic spectrum.	Cognitive	Understand & Remember
CO2: Analyze the dual nature of matter–energy and the physical significance of wave functions in fundamental quantum scenarios.		Understand & Interpret
CO3: Apply the working principles of semiconductor devices.		Understand & Apply
CO4: Evaluate the working of simple logic gates.		Apply & Create
CO5: Create a basic sensing setup based on the working principles of common sensors.		Understand & Explain

Learning Resources	
1.	Reference Books: 1. Concepts of Physics, by H. C. Verma, Bharati Bhawan (Publishers & Distributors). 2. A Textbook of Optics,N. Subrahmanyam, Brij Lal, M. N. Avadhanulu , S. Chand Publishers 3. Quantum Mechanics, G. Aruldhas, Second Edition, PHI Publication 4. Principles of Electronics, V. K. Mehta and Rohit Mehta, S. Chand Publishers 5. Digital Principles and Applications, Malvino and Leach, Seventh Edition, Tata McGraw Hill 6. Sensors and Transducers, Second Edition, D. Patranabis, PHI Publishers
2.	Journals & Periodicals: 1. IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control 2. IEEE Access
3.	Other Electronic Resources: 1. https://phet.colorado.edu/ 2. https://www.scilab.org/ 3. https://onlinecourses.nptel.ac.in/

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks (CEC)	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review/Assignment/Miscellaneous Activity: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 15 marks Journal: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

PSO/CO	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping of POs & Cos

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

COURSE CODE BTME106	COURSE NAME WORKSHOP	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	2	0	2	0	2	0	1

Course Pre-requisites	**NIL**
Course Category	Engineering Science
Course focus	Skill Development
Rationale	
Course Revision/ Approval Date:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. To **describe** the functions, layout, and scope of various workshop sections such as fitting, welding, machining, and smithy. 2. To **explain** the principles of basic joining techniques used in workshop practices. 3. To **apply** appropriate machine tools and measuring instruments for basic workshop operations. 4. To **relate** fundamental mechanical engineering concepts to practical workshop operations. 5. To **fabricate** simple components using standard workshop tools and processes following safety norms.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction Introduction, Workshop layout, Importance of various sections/shops of workshop, Types of jobs done in each shop. General safety rules and work procedure in workshop. Measuring Instruments.	**20%**	**09**
Unit 2: Welding Theory: Overview of arc and spot-welding operations.	**20%**	**09**
Unit 3: Fitting Theory: Overview of fitting operations	**20%**	**09**

Unit 4: Black smithy Theory: Overview of smithy processes	**20%**	**09**

Unit 5: Machining Theory: Overview of Lathe and shaper machines.	**20%**	**09**

List Of Practical	Weightage	Contact hours
1: Introduction to Engineering Workshop. Know general safety rules and work procedure of engineering workshop	**7%**	**2**
2: Sketch the layout of engineering workshop. Study the different shops and types of jobs done in each shop of engineering workshop	**7%**	**2**
3: Study about basic Measuring Instruments used in workshop.	**7%**	**2**
4: Study of Arc welding machine and its accessories.	**7%**	**2**
5: Demonstrate and perform job by using Arc welding machine.	**7%**	**2**
6. Study of Fitting tools.	**7%**	**2**
7. Demonstrate and perform job by using Fitting tools	**7%**	**2**
8. Study of Black smithy tools	**7%**	**2**
9. Demonstrate and perform job by using Black smithy tools.	**7%**	**2**
10. Study of Tinsmithy tools.	**7%**	**2**
11. Demonstrate and perform job by using Tinsmithy tools.	**7%**	**2**
12. Study of Lathe machine	**7%**	**2**
13. Demonstrate different operations on Lathe machine.	**7%**	**2**
14. Study of Shaper machine.	**7%**	**2**
15. Demonstrate different operations on Shaper machine.	**7%**	**2**

Instructional Method and Pedagogy: The instructional methods and pedagogies for teaching ICT involve a combination of theoretical knowledge and practical application**.**

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		
CO1: **Describe** the layout, functions, and safety practices of fitting, welding, machining, and smithy workshops.	cognitive	Understand
CO 2: **Explain** the principles of basic joining processes such as arc welding and spot welding.	cognitive	Understand
CO 3: **Operate** basic workshop tools, machines, and measuring instruments for assigned tasks.	cognitive	Understand
CO4: **Apply** fundamental mechanical engineering concepts while performing workshop operations.	cognitive	Understand
CO5: **Fabricate** simple components by selecting appropriate tools, machines, and processes.	cognitive	Understand

Learning Resources	
1.	Reference Books: 1. Hajra Choudhary, S. K., Elements of Workshop Technology, Media Promotors& Publishers Pvt. Ltd, 12thEdition, (2002). 2. Chapman, W.A.J., Workshop Technology, ELBS Low Price Text, Edward Donald Pub. Ltd., (1961). 3. Singh, D.K., Fundamentals of Manufacturing Engineering, Ane Books Pvt. Ltd, New Delhi, 2nd Edition, (2009). 4. Raghuvanshi, B.S., Course in Workshop Technology, Dhan Patrai & Sons, New Delhi, (1991)
2.	Journals & Periodicals: 1. Journal of Manufacturing Processes 2. Procedia Manufacturing 3. Manufacturing Letters "
3.	Other Electronic Resources: http://www.weldingtechnology.org http://www.piehtoolco.com/ http://sourcing.indiamart.com/engineering/articles/materials-used-hand-tools/

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks	00 marks	
Theory: End Semester Marks	00 marks	
Theory: Continuous Evaluation Component Marks	Attendance	00 marks
	MCQs	00 marks
	Open Book Assignment	00 marks
	Open Book Assignment	00 marks
	Total	**00Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO2
CO1	1	1	1
CO2	1	1	1
CO3	2	2	1
CO4	2	1	1
CO5	2	2	1

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	1	0	0	1	2	1	1	1	1	0	1
CO2	2	2	1	0	1	2	1	1	1	1	0	1
CO3	3	2	2	1	3	2	1	1	2	1	1	1
CO4	3	2	2	1	2	1	1	1	1	1	0	1
CO5	3	2	3	1	3	2	1	1	2	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTFS108	COURSE NAME FUNDAMENTALS OF FIRE, SAFETY, HEALTH &ENVIRONMENT	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	NIL
Course Category	Engineering Science
Course focus	Employability
Rationale	The rationale behind fire and environmental safety as a subject is to educate individuals and communities about the risks associated with fire and other environmental hazards, and to promote strategies and practices that minimize those risks.
Course Revision/ Approval Date:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. **Introduce** fundamental fire, safety, health and environmental challenges in built and industrial environments. 2. **Create** awareness of major industrial and societal incidents and their influence on safety practices and legislation. 3. **Explain** basic concepts of industrial safety, occupational health and environmental protection. 4. **Familiarize** students with the role of legislation, regulatory agencies and introductory fire safety and environmental sustainability concepts.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Theory: Challenges to safety in built environment, types of hazards likely to cause harm (fire, burns, electric shock, falls), natural disasters, fatalities	**20%**	**8**

involving hazardous environments. Important Case studies involving major incidents and their subsequent effect on safety outlook. Approach to addressing Fire & EHS challenges at organization and national level.		
Unit 2: The concept of industrial safety, health and environment - need, nature and importance. Focus on Human resource, and the concept of importance of 'man' as central theme in safety. Concept of accident prevention, occupational health and environmental protection. Problems of Industrial safety, occupational health and environmental pollution & modern concept of SHE.	**20%**	**05**
Unit 3: History and role of building codes and safety legislation, concept of safety versus risk, enforcement of codes and standards, role of government agencies and emergency services in enforcing legislation, government framework and infrastructure involved in safety legislation enforcement. Role of code enforcement, plan review and approval, record keeping, public education	**20%**	**04**
Unit 4: Industrial Fire & Safety management concepts – hazard identification and risk assessment, risk reduction and control methods. Design aspects such as segregation and separation, fire resisting construction, emergency exit arrangements, access for emergency agencies, fire protection systems, safe operational practices, maintenance and upkeep of systems, planning for emergency response. Design approaches for fire and safety, NFPA fire safety concepts tree.	**20%**	**05**
Unit 5: Environmental Pollution Air Pollution Sources and effects of air pollution, NAAQS Basic principles of air pollution control devices Global effects of air pollution, Air Pollution due to automobiles, photochemical smog. Water Pollution: Sources and effects, Effluent standards Domestic and Industrial wastewater and treatment principles, Land pollution: - Solid waste, solid waste management by land filling, composting. Social Issues and the environment, from unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people; its problems and concerns.	**20%**	**08**

Instructional Method and Pedagogy: The instructional method and pedagogy of the fire and safety subject typically involve a combination of theoretical knowledge, practical training, and hands-on exercises.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Explain** fire, safety, health and environmental challenges in built and industrial environments	Cognitive	Understand
CO2: **Describe** major industrial incidents and their influence on safety practices and legislation	Cognitive	Learn
CO3: **Explain** basic concepts of industrial safety, occupational health and environmental protection		
CO4: **Describe** introductory fire safety design concepts and environmental sustainability practices	Cognitive	Familiar

Learning Resources	
1.	Reference Books: 1. Cheunisinoff Graffia, Environmental Health & Safety Management, Reprint Jaico Publishing House. 2. Tarafdar, Industrial Safety Management
2.	Journals & Periodicals: 1. International Journal of Environmental Research and Public Health 2. Journal of Occupational and Environmental Hygiene
3.	Other Electronic Resources: OSHA, NFPA, EPA Provides information on environmental regulations, guidelines, and resources.

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Open Book Assignment	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**
Project/ Industrial Internship Marks	Quantity of the Project/Industrial in terms of Language, Presentation & format.	30 marks
	Practical understanding of the subject on the Project/Industrial.	30 marks
	Industry/ University mentor's feed-back on the Project/ Industrial.	30 marks
	Attendance	10 marks
	Total	**100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	2	2	3
CO3	2	2	3
CO4	2	3	3
CO5	2	2	3

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	0	3	3	1	0	0	0	1
CO2	3	2	1	2	0	3	3	2	0	0	0	1
CO3	3	1	1	1	0	3	3	2	0	0	0	1
CO4	3	2	3	1	0	2	3	1	0	0	0	1
CO5	3	2	1	1	0	3	3	1	0	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE AECC111	COURSE NAME Fundamentals of English	SEMESTER I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	00	00	2	2	00	00	2

Course pre-requisites	A student should have cleared 12th Class
Course Category	Mandatory Course
Course focus	Skills Development
Rationale	It enables learners to apply basic English knowledge to handle day-to-day Business interactions.
Course Revision Date:	27/04/2026
Course Objectives **(As per Bloom's Taxonomy)**	1. To strengthen core linguistic competence (grammar, syntax, structure). 2. To develop reading habits for academic and professional growth. 3. To enhance vocabulary through structured and contextual exposure. 4. To build effective writing skills for academic and workplace communication. 5. To develop oral communication and interpersonal competence. 6. To prepare learners for industry-ready communication demands.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Fundamentals of Language • Parts of Speech (functional approach) • Word Formation (prefix, suffix, root words) • Basic sentence formation • Synonyms, antonyms, homophones • Standard abbreviations in academic/professional contexts **Outcome Focus:** Linguistic foundation and accuracy	**20%**	6
Unit 2: Vocabulary Development and Reading Culture (Newly Introduced as Core Unit) • Types of vocabulary: academic, technical, general	**20%**	6

• Contextual vocabulary learning (learning through reading)
• Word families, collocations, and usage patterns
• Root-based vocabulary building (Latin/Greek roots – basic exposure)
• Reading-based vocabulary tasks:
  • Newspaper analysis (editorial sections)
  • Discipline-specific articles (basic level)
• Vocabulary notebooks and digital tools
• Weekly vocabulary targets and usage practice		

Unit 3: Sentence Mechanics and Structure • Types of sentences (functional use) • Phrase and clause structures • Punctuation and clarity • Determiners and quantifiers • Common structural errors **Outcome Focus:** Structural correctness and clarity	**20%**	6
Unit 4: Academic and Functional Writing • Paragraph writing (coherence and cohesion) • Essay writing (analytical and descriptive) • Report writing (basic format) • Notice and memo drafting • Introduction to professional email writing **Outcome Focus:** Workplace-oriented writing competence	**20%**	6
Unit 5: Communication and Speaking Skills • Functional communication (greetings, introductions, social interaction) • JAM (Just a Minute) • Group discussion and basic debate • Role-play (real-life scenarios: meetings, appointments, problem-solving) • Confidence-building strategies **Outcome Focus: Industry-relevant communication skills**	**20%**	6

Course Outcomes:

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

CO1: Apply and manipulate fundamental grammatical rules and language structures to construct error-free sentences in varied contexts. (Apply)

CO2: Analyze and interpret written texts to infer meaning, evaluate arguments, and demonstrate advanced reading comprehension. (Analyze)

CO3: Select and employ domain-specific vocabulary appropriately in oral and written communication across academic and professional contexts. (Apply)

CO4: Compose and organize coherent academic and professional texts using appropriate structure, style, and conventions. (Create)

CO5: Articulate and adapt communication effectively in formal and informal situations with clarity, confidence, and contextual appropriateness. (Apply–Analyze)

Learning Resources	
1.	**Textbook**: Wren & Martin (2001), English Grammar & Composition, New York
2.	**Reference Books** Raymond Murphy – English Grammar in Use Edgar Thorpe – Basic Vocabulary David Green – Contemporary English Grammar **Additional Resources** Newspaper Editorials (The Hindu / Indian Express)
3.	Harvard Business Review (selected simplified readings) Online vocabulary platforms (e.g., vocabulary apps, corpora-based tools)

Evaluation Scheme	**Total Marks**	
Theory: End Semester Marks	40 marks	
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Skill enhancement activities/case study	15 marks
	Presentation/ miscellaneous activities	10 marks
	Total	**40 Marks**
Theory: Mid semester Marks	20 marks	

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	1	1						
CO2	1	1						
CO3	1	1						
CO4	1	1						
CO5	1	1						

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	3	2	0	0		
CO2	3	3	3	2	0	0		
CO3	3	3	3	2	0	0		
CO4	3	3	3	3	0	0		
CO5	3	2	3	2	0	0		

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTCH208	ENGINEERING GRAPHICS	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
0	2	0	2	0	1	0	1

Course Pre-requisites	Nil
Course Category	Engineering Science
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	3/7/2025
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: Interpret and **apply** engineering drawing standards, conventions, and geometric principles for technical communication. 2: **Visualize** and communicate engineering components using orthographic and isometric projection techniques. 3: **Apply** CAD tools to generate accurate 2D engineering drawings adhering to prescribed standards. 4: **Develop** and present 3D models and sketches using CAD software for engineering applications.

List of Practicals	Weightage	Contact hours
1. Introduction to Engineering Graphics: Principles of engineering graphics and their significance, drawing instruments & accessories, lettering and numbering, types of lines, dimensioning methods, basic geometric drawing, reading a drawing.	11%	2
2. Orthographic Projection: Introduction to projection, types of projection, 1st angle and 3rd angle projection.	11%	2
3. Isometric Projection: Principles of isometric projection isometric scale, isometric views, conventions, conversion of isometric views to orthographic views and vice-versa	11%	2
4. Projection of Solids and Development of Surface: Classification of solids, projections of solids like cylinder, cone, pyramid, and prism with its inclination to reference plane, development of surfaces of right regular solids - prism, pyramid, cylinder and cone.	11%	2
5. Introduction of Computer Aided Engineering Drawing: Demonstrating	11%	2

knowledge of the theory of CAD software, use of software in drawing, CAD software user interface, commands, Coordinate System, menus and toolbars, planes, dimensioning, saving of files, Select and erase objects, zoom tools, and others		
6. Basic sketching using CAD tool: Sketch entities using tools origin, points, lines, circle, arcs, polygons, fillets and chamfer, trim, extend and offset, copy, cut, delete and others	11%	2
7. Advanced sketching using CAD tool: Sketching entities using relation constrains, Mirror, Patterning, full definition of drawing and others	11%	2
8. Basic 3D modelling using CAD tool: Extrude, cut, drawing on different planes, editing, symmetric, revolving, and others	11%	2
9. Computer aided drawing sheets: Preparing drawing sheets, creating different views, section view, drawing templates, and others	12%	2

Instructional Method and Pedagogy: Instructional Method and Pedagogy for Engineering Graphics: Lecture-based instruction, hands-on practice, group discussions, interactive demonstrations, real- world applications, assessments with feedback, technology integration, field trips, and guest lectures facilitate comprehensive learning, critical thinking, and practical skills development, highlighting

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		
CO1: **Apply** engineering drawing standards, conventions, and dimensioning principles to produce accurate technical drawings.	Cognitive	Understand
CO2: **Analyze** and generate orthographic and isometric projections to effectively visualize engineering components..		Undersand Create
CO3: **Create** precise 2D engineering drawings using CAD software in accordance with industrial drafting standards.		Create
CO4: **Develop** 3D geometric models using CAD tools to represent engineering components and assemblies.		Apply
CO5: **Integrate** multiple drawing views, sections, and dimensions to prepare complete and standardized engineering drawing sheets.		Analyse
CO6: **Analyze** complex solids through projection, sectioning, and surface development techniques for engineering interpretation.		

Learning Resources	
1.	**Reference Books:** ➢ Finkelstein Ellen et. al., "AutoCAD 2012 and AutoCAD LT 2012 Bible" Wiley India, New Delhi ➢ Bhatt N.D., Panchal V.M. & Ingle P.R., Engineering Drawing, Charotar Publishing.
2.	**Textbook:** ➢ Sham Tickooet. al., "AutoCAD 2012 for engineering and designers "Dream tech press, New Delhi ➢ Shah P.J., Engineering Graphics, S. Chand Publishing. ➢ Agrawal, B. & Agrawal C. M., Engineering Drawing, Tata McGraw Hill Publishers.
3	**Journals & Periodicals** ➢ Mechanics Based Design of Structures and Machines ➢ Engineering Structures ➢ Journal of Computational Design and Engineering ➢ Engineering with Computers
4	**Other Electronic Resources** ➢ https://www.udemy.com/topic/autocad/ ➢ https://www.autodesk.com/training ➢ https://www.coursera.org/autodesk

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks	-	
Theory: End Semester Marks	50 marks	
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	2	1	1
CO3	1	2	2
CO4	2	3	2
CO5	2	2	2
Avg.	2	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	1	0	0	0	0	2	0	1
CO2	3	3	1	1	1	0	0	0	0	2	0	1
CO3	2	1	2	0	3	0	0	0	0	2	0	1
CO4	2	2	3	0	3	0	0	0	0	2	0	1
CO5	3	2	2	0	2	0	0	0	1	2	0	1
Avg.	3	3	2	1	1	0	0	0	0	2	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTMA203	MATHEMATICS-II	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	1	4	3	-	1	4

Course Pre-requisites	Basic Mathematics
Course Category	Core
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. **To comprehend** the fundamental concepts and solution methods of first-order ordinary differential equations relevant to engineering systems. 2. **To develop** familiarity with the principles and analytical techniques used for higher-order linear differential equations arising in physical applications. 3. **To interpret** the basic concepts of probability and statistics for analyzing and describing engineering data. 4. **To grasp** the concepts and procedures of multiple integration and their applications in evaluating areas and volumes in engineering contexts. 5. **To appreciate** and explain the foundational ideas of vector calculus, including gradient, divergence, curl, and line integrals, used in modeling physical phenomena.

Course Content (Theory)	Weightage	Contact hours
Unit 1: First Order First Degree Differential Equation First ordered odes: Exact equations, Integrating factors, Linear and Bernoulli's equation, Homogeneous equation, Applications of first order equations: Orthogonal trajectories, Mixture problem, and Temperature problem.	20%	08
Unit 2: Higher order differential equation Higher ordered Linear ODEs with constant coefficients, Wronskians, Differential operators, Method of solving homogeneous equations, non-homogeneous equations, Inverse operators, Methods of solving non-	20%	10

homogeneous equations. Cauchy- Euler equations, Method of undetermined coefficients, Method of variation of parameters.		
Unit 3: Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.	20%	10
Unit 4: Multiple Integration Double and Triple integration, change of order of double integration, double integration in Polar form, Jacobians and change of variables formula. Applications to find area and volume.	20%	10
Unit 5: Vector Calculus Vector valued functions, gradient and directional derivatives, Divergence and curl, Vector identities. Line Integral and Green's Theorem.	20%	07

Instructional Method and Pedagogy: (Max. 100 words)

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Formulate** and solve first-order ordinary differential equations to model engineering and physical systems. CO2: **Analyze** and solve higher-order linear differential equations using appropriate analytical techniques for engineering applications CO3: **Analyze** and interpret statistical data using probability distributions to support engineering problem-solving and decision-making. CO4: **Evaluate** engineering quantities such as area and volume using multiple integration techniques in Cartesian and polar coordinates. CO5. **Apply** and analyze vector calculus operations to model and interpret physical phenomena such as flux, circulation, and field behavior	Cognitive	**Knowledge** **Evaluate** Understand Apply Evaluate

Learning Resources	
1.	**Reference Books:** ➢ Kreyszig, E., Advanced Engineering Mathematics, 8th Edition, Wiley

	& Sons, (1999). ➢ Anton, H., Elementary Linear Algebra with Applications, 8th Edition, John Wiley & Sons, (1995).
2.	**Textbook:** ➢ Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill,New Delhi, 2008.
3	**Journals & Periodicals** ➢
4	**Other Electronic Resources** ➢

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	2	2	2
CO4	2	1	1
CO5	3	3	2
Avg.	2.8	1.2	1.6

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	0	0	0	1	1	0	2
CO2	3	3	1	1	2	0	0	0	1	1	0	2
CO3	3	3	1	2	2	1	1	0	1	1	1	2
CO4	3	2	2	1	1	0	0	0	1	1	0	2
CO5	3	3	2	2	3	1	1	0	1	1	1	2
Avg.	3	3	2	1	2	0	0	0	1	1	0	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTME209	ENGINEERING MECHANICS	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisites	Basic knowledge of Physics and Mathematics
Course Category	Engineering Science Courses
Course focus	Employability
Rationale	The subject of Engineering Mechanics holds great importance as it provides the foundation for understanding the behaviour of structures and machines, ensuring safety, efficiency, and innovation in engineering projects on local, national, and international scales.
Course Revision/ Approval Date:	06/07/2023
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **To develop** the ability to analyze forces and moments acting on rigid bodies using principles of engineering mechanics. 2: **To impart** conceptual understanding of equilibrium, centroid, and moment of inertia relevant to engineering applications. 3: **To enable** students to apply principles of friction and particle dynamics for solving practical engineering problems. 4: **To build** analytical skills for modeling and solving statically determinate systems such as trusses and frames. 5: **To prepare** students with foundational mechanics knowledge required for advanced engineering analysis and problem-solving across core engineering disciplines.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Rigid Body Statics Vector algebra, force systems, moment of a force about a point and about an axis; simplest equivalent forces and moment; free body diagram; force equilibrium, equations of equilibrium; problems in two dimensions. Types of loading, supports and reactions; evaluating internal forces in bodies; axial force, Planar Trusses and frames: static indeterminacy, analysis by method	20%	09

of joints and method of sections.		
Unit 2: Centre of Gravity Centroid of lines, plane areas and volumes, Examples related to centroid of composite geometry	20%	09
Unit 3: Moment of Inertia First and second moment of area and mass, radius of gyration, parallel axis theorem, product of inertia, rotation of axes and principal M.I., Thin plates, M.I. by direct method (integration), composite bodies.	20%	09
Unit 4: Friction Types and laws of friction, impending motion problems involving large and small contact surfaces.	20%	09
Unit 5: Dynamics Kinematics and Kinetics of particles: Particle dynamics in linear & rectangular coordinates cylindrical coordinates and in terms of path variables.	20%	09

List Of Practical	Weightage	Contact hours
1: **Justify** law of parallelogram of forces for a coplanar concurrent force system in equilibrium.	11.1 %	2
2: **Justify** law of polygon of forces for a coplanar concurrent force system in equilibrium	11.1 %	2
3: **Calculate** the magnitude and nature of forces in members of the jib-crane.	11.1 %	2
4: **Verify** Lemi's theorem.	11.1 %	2
5. **Verify** the principle of moment using bell crank lever.	11.1 %	2
6. **Verify** the support reactions and verify the condition of equilibrium for a simply supported beam at ends.	11.1 %	2
7. **Calculate** Mass moment of inertia of a fly wheel.	11.1 %	2
8. **Determine** the co-efficient of static friction between 1. glass and wood; 2. wood and cloth; and 3. wood and metal. (Horizontal surface)	11.1 %	2
9. **Determine** the co-efficient of static friction between 1. glass and wood; 2. wood and cloth; and 3. wood and metal. (Inclined surface)	11.1 %	2

Instructional Method and Pedagogy: The course can employ a combination of lectures, interactive demonstrations, hands-on problem-solving exercises, group discussions, and case studies. Utilizing visual aids, technology integration, and real-world applications enhances student engagement, critical thinking, and practical skills development in Engineering Mechanics.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: **Analyze** and solve rigid body statics problems involving force systems, moments, and equilibrium conditions in two- and three-dimensional systems.	Cognitive	Understand
CO2: **Determine** and apply centroid concepts to analyze composite geometries relevant to engineering structures and components.		Understand
CO3: **Compute** and evaluate moments of inertia and radii of gyration for simple and composite bodies using analytical and transformation methods.		Apply
CO4: **Analyze** engineering systems involving friction to predict impending motion and equilibrium under different contact conditions.		Apply
CO5: **Apply** principles of particle kinematics and kinetics to model and solve dynamic engineering problems using appropriate coordinate systems.		Apply

Learning Resources	
1.	**Reference Books:** ➢ Beer, F.P., Johnston, E.R., Vector Mechanics for Engineers, Vol. 1 - Statics, Vol. 2, Dynamics, 9thEdition, Tata McGraw Hill, (2011). ➢ Meriam, J.L., Kraige, L.G., Engineering Mechanics, Vol. I Statics, Vol. 2 Dynamics, 6thEdition, John Wiley, (2008). ➢ Timoshenko, S., Young, D.H., Engineering Mechanics, McGraw Hill Inc., (1940). ➢ Shames, I.H., Rao, G.K.M., Engineering Mechanics – Statics and Dynamics, Pearson 's Education, (2006). ➢ Desai and Mistry, "Engineering Mechanics", Popular Prakashan. ➢ R. S. Khurmi, Engineering Mechanics S. Chand, New Delhi. ➢ D. S. Kumar, Engineering Mechanics S. K. Kataria & Sons, New Delhi ➢ Bhavikatti Mechanics of Solids, New Age publication
2	**Journals & Periodicals**

	➢ Mechanics Based Design of Structures and Machines ➢ Materials & Design ➢ Engineering Structures ➢ Journal of Computational Design and Engineering ➢ Engineering with Computers.
3	**Other Electronic Resources** ➢ NPTEL Online Course- Engineering Mechanics, IIT Madras

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	3	3
CO5	3	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	0	0	0	0	0	0	0
CO2	3	3	2	1	1	0	0	0	0	0	0	0
CO3	3	3	2	1	2	0	0	0	0	0	0	0
CO4	3	3	2	1	1	1	0	0	0	0	0	0
CO5	3	3	2	2	2	0	0	0	0	0	0	1
Avg.	3	3	2	1	1	0	0	0	0	0	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTCY205	ENGINEERING CHEMISTRY	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisites	Basic knowledge of chemistry and Mathematics
Course Category	Core
Course focus	Employability
Rationale	Chemistry is considered as basic subject for Engineering.
Course Revision/ Approval Date:	
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1. **Provide** students with a conceptual foundation of engineering chemistry relevant to chemical engineering systems and materials.. 2. **Enable** students to analyze water chemistry, corrosion, fuels, and lubricants for industrial and engineering applications.. 3. **Develop** the ability to apply scientific principles and quantitative methods to solve basic engineering chemistry problems. 4. **Train** students to perform and interpret standard chemical laboratory experiments using appropriate analytical techniques. 5. **Create** awareness of industrial relevance, safety, and environmental implications of chemical materials and processes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Water Technology Chemistry of water, Types of impurities in water, Types of hardness, Units of hardness, Estimation of hardness-EDTA method, Disadvantages of using hard water for industrial purpose. Scale and sludge formation in boiler, Caustic Embrittlement-Priming and foaming. Softening of water: Ion exchange process, Lime soda process (with numerical), Zeolite process Desalination. Reverse osmosis. Drinking water and its characteristics. Numerical to calculate hardness of water	20%	15

Unit 2: Corrosion, Control and Prevention Introduction, Corrosion problems, Types of corrosion: Chemical Corrosion-Pilling Bedworth Rule and Electrochemical corrosion. Theory of corrosion, pitting corrosion, crevice corrosion, waterline corrosion. Factors affecting corrosion, Corrosion control methods, Corrosion inhibitors. Protective	20%	10
Coatings: Metallic coatings – Galvanizing, Tinning and electroplating – Non-metallic coatings – Chromate coating and Anodising. Powder coating – methods of application and advantages.		
Unit 3: Fuels & Combustion Fossil fuels & classification, Calorific value & its types, Determination of calorific value by Bomb calorimeter, Proximate and Ultimate analysis of coal and their significance, calculation of calorific value by Dulong's formula, Knocking, relationship between' knocking & structure of hydrocarbon, Octane number, Cetane number, combustion and it related numerical problems.	20%	10
Unit 4: Lubricants Introduction, Mechanism of lubrication, Classification of lubricants, significance & determination of Viscosity, Viscosity Index, Flash & Fire Points, Cloud & Pour Points, Carbon Residue, Aniline Point, Acid Number, Saponification Number.	20%	10
Unit 5: Instrumental Techniques In Chemical Analysis: Lambert's and Beer's Law and its applications, Introduction, Principle, Instrumentation and applications of IR & UV spectroscopy, Gas Chromatography & its applications.	20%	15

List Of Practical	Weightage	Contact hours
1. To estimate the amount of total hardness present in the given sample of water by EDTA method.	12.5 %	2
2. To Measure the pH value Of Given Solutions.	12.5 %	2
3. To determine alkalinity of given water sample.	12.5 %	2
4. To determine the acidity of the given water sample.	12.5 %	2
5. To measure a rate of corrosion of Iron in different medium.	12.5 %	2
6. To measure viscosity of a given sample.	12.5 %	2
7. To determine flash point and fire point of a given sample.	12.5 %	2
8. To determine cloud point and pour point of a given sample	12.5 %	2

Instructional Method and Pedagogy: (Max. 100 words)

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Apply** principles of water chemistry to analyze hardness, treatment methods, and related numerical problems for industrial applications. CO2: **Analyze** corrosion mechanisms and evaluate suitable prevention and control strategies for engineering materials.. CO3: **Evaluate** fuels based on proximate/ultimate analysis, combustion behavior, and calorific value calculations. CO4: **Apply** and interpret lubricant property tests to assess suitability for mechanical and industrial systems.. CO5: **Analyze** experimental data obtained from chemical analysis techniques to draw valid engineering conclusions.	Cognitive	Understand Apply Analyse Apply Understand

Learning Resources	
1.	**Reference Books:** ➢ Wiley's Engineering Chemistry, Multiple Authors, Wiley International ➢ Engineering Chemistry, R. Gopalan ➢ L. H. Van Vleck; Elements of Material Science and Engineering, Addison-Wesley Publishing Co.
2.	**Textbook:** ➢ Engineering Chemistry, P.C. Jain, Dhanpat Rai Pub. Co. ➢ Engineering Chemistry, S. S. Dara, S. Chand Pub. New Delhi
3	**Journals & Periodicals** ➢ Journal of Chemical Technology, Environmental Science and Technology, Chemical Engineering Science, Energy and Fuels
4	**Other Electronic Resources** ➢ NPTEL Online Course.

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	2	1
CO3	3	2	2
CO4	3	3	2
CO5	2	2	2
Avg.	2	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	0	0	0	1	0	0	2	2
CO2	3	3	2	2	1	0	0	0	2	0	0	2
CO3	2	3	2	3	1	0	0	0	2	0	0	3
CO4	2	2	3	2	2	0	0	0	2	0	0	3
CO5	2	2	2	2	1	0	1	1	2	1	0	2
Avg.	3	1	2	1	0	0	0	1	0	0	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTCS206	COURSE NAME PYTHON PROGRAMMING	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	40	3	1	0	4

Course Pre-requisites	Introduction to Programming
Course Category	
Course focus	Employability
Rationale	The Python syllabus aims to provide students with a strong foundation in programming using Python. It covers topics such as variables, data types, control structures, functions, file handling, object-oriented programming, and libraries. This equips students with the skills to develop applications, analyze data, and automate tasks using Python.
Course Revision/ Approval Date:	28/6/2025
Course Objectives (As per Blooms' Taxonomy)	1. **Build** strong foundational competency in Python programming concepts and control structures for solving engineering-oriented computational problems. 2. **Enable** effective handling of scientific and engineering data using Python data structures and numerical libraries relevant to chemical process analysis. 3. **Develop** practical capability in using Python tools and visualization libraries for modeling, simulation, and interpretation of chemical engineering data. 4. **Strengthen** application-oriented programming skills for solving real-world chemical engineering problems using domain-specific Python libraries.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Python: • Basic syntax and Structure of python programming • Variables and Identifiers • Built- In Data Types • Logical Expressions and Operators • If-Else, elif , Nested If-Else • While loop, Do-while, For loop, Nested loops • Break, Continue and pass Statements • Installation of Python, and IDLE • Installing Anaconda Navigator • Using Jupyter Notebook, Spyder & Pycharm.	**20%**	**10**

Unit 2: Features of Python • Defining a function, Python Built-in Functions, Calling a function, Types of functions, Function Arguments, Default Argument, Anonymous functions, Global and local variables. • String Manipulation - accessing Strings, Basic Operations, String slices and Function and Methods. • Tuple: Introduction, accessing tuples, Operations. • Dictionaries: Introduction, accessing values in dictionaries, Working with dictionaries, Properties. • Sets: Introduction, accessing values in sets, Working with sets, Properties. • Classes and Object-Oriented Programming, Abstract Data Types and Classes Inheritance, Encapsulation and Information Hiding.	**20%**	**9**
Unit 3: File Handling and date time classes • Reading from a file • Writing to a file • Other Operations on Files • Dates and Time: Basic date and time classes • Different time formats • Converting between formats, Formatting dates and times, • Parsing date/time information	**20%**	**7**
Unit 4: Python For Visualization & Plotting • NumPy for vector/matrix operations (e.g., stoichiometry) • Pandas for handling chemical lab/plant data tables • Matplotlib/Seaborn for plotting graphs (e.g., conversion vs. time) • 2d and 3d plotting using Matplotlib. • Introduction to SciPy for solving numerical problems.	**20%**	**7**

Unit 5: Application of Python programming
• Working with CoolProp, SymPy, ChemPy libraries
• Calculating entropy, enthalpy using Python functions
• Curve fitting experimental data using scipy.optimize
• Use of Python Ordinary Differential Equation ODE Solvers.
• Introduction of AI/ML & IoT in chemical engineering
  o AI-powered control systems
  o Real-time monitoring and adjustment of process variables using IoT based sensors.
  o Corrosion prediction using AI algorithms and IoT Sensors.
	20%	**7**

List of Practical	Weightage	Contact hours
1. a) Write a code showing the working of all Logical Expressions and Operators. b) Write a code showing the all Built- In Data Types and Usage of input output statements. c) Write a code showing the working of if else & nested if else. d) Write a code showing the working of while, do-while and for loop. e) Design a simple calculator using elif .	**20%**	**4**
2. a) Write a code to display greatest of three numbers using user defined function. b) Write a code to display the factorial of a number using recursive function. c) Write a code to display all the string manipulation functions. d) Write a code to display the working of lists, tuples, dictionary, sets with its associated methods & functions. e) Write a code to display the student details using a student class and its appropriate methods.	**20%**	**4**
3. a) Write a code to show working of all the file operations b) Write a code to show working of all the Date and Time classes	**20%**	**2**
4. a) Given the lists x = np.arange(11) and $y=x^2$, create a 2 by 3 subplot where each subplot plots x versus y using plot, scatter, bar, loglog, semilogx, and semilogy. Title and label each plot appropriately. b) Use fft and ifft function from numpy to calculate the FFT amplitude spectrum and inverse FFT to obtain the original signal. Plot both results. Time the fft function using this 2000 length signal. c) Use numpy.linalg.solve to solve the following equations. $4x_1+3x_2-5x_3=2$ $-2x_1-4x_2+5x_3=5$ $8x_1+8x_2=-3$ d) Compute the root of the function f(x)=x3−100x2−x+100 using f_solve.	**20%**	**2**
5. a) Use the trapz function to approximate $\int_0^{\pi} \sin(x)\,dx$ for 11 equally spaced points over the whole interval. b) Use CoolProp to calculate the specific heat of saturated water vapor at *1 atm* c) Use SymPy to find derivative, integration, limits, quadratic equation. Take any simple equation for each. d) Use Chempy and printing a list of elements with their mass.	**20%**	**2**

Instructional Method and Pedagogy:
Lecture-based instruction, Project based learning, Flipped Classroom, Case Studies, Problem based learning, Collaborative Learning

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Apply** Python programming fundamentals, syntax, and control structures to develop basic engineering computation programs. CO2: **Analyze** and manipulate data using Python strings, lists, tuples, sets, and dictionaries for scientific and engineering data processing. CO3: **Analyze** and manipulate data using Python strings, lists, tuples, sets, and dictionaries for scientific and engineering data processing. CO4: **Design** and develop Python-based visualization and plotting applications using scientific libraries for chemical engineering data analysis. CO5: **Develop and evaluate** Python applications for real-time chemical engineering problems including process modeling, thermodynamic calculations, and data-driven decision-making.	Cognitive	Understand Understand Comprehend Design Apply

Learning Resources	
1.	**Textbooks:** 1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India 2. R. NageswaraRao, "Core Python Programming", dreamtech **Reference Books:** 1. Wesley J. Chun. "Core Python Programming - Second Edition", Prentice Hall 2. Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication 3. Luke Sneeringer, "Professional Python", Wrox

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks

Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	2	2	3
CO4	2	3	2
CO5	3	3	3

Mapping of POs & COs

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

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

AECC201	COMMUNICATION SKILLS IN ENGLISH	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	0	2	2	0	0	2

Course Pre-requisites	Basic English Grammar & Intermediate communication skills
Course Category	Ability Enhancement Compulsory Course
Course focus	Employability and Skill Development
Rationale	
Course Revision/ Approval Date:	18/01/2022
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **To develop** foundational communication skills in English through structured listening, speaking, reading, and writing activities. 2: **To build** effective writing skills required for academic tasks and basic workplace communication. 3: **To apply** language knowledge for professional communication in multicultural and global contexts. 4:**To cultivate** professional communication practices aligned with corporate and organizational environments. 5. **To apply** digital communication skills using appropriate technological tools and platforms for academic and professional purposes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Communicative Skills Basics of Communication, Verbal & Non-verbal Communication, Barriers to Effective Communication, Strategies of Effective Communication	20%	06
Unit 2: Grammar & Vocabulary Types of sentences, Synonyms, Antonyms, Tenses - Past, Present & Future, Homophones, Modals, Verb forms, Phrasal Verbs, Error correction, commonly misused words, technical term.	20%	06
Unit 3: Listening & Reading Skills Definitions (Listening & Reading), Types of Listening, Barriers to Effective	20%	06

Listening, Traits of a Good Listener, Types of Reading, Techniques of Effective Reading, Reading Tasks (Critical & Inferential).		
Unit 4: Writing Skills & Speaking Skills Letter writing - Complaint & Leave, Article, Precise writing, Report writing, Note taking and note making, Creative Writing Introducing self, Interview Skills, Public Speaking, Debates, Role plays, Group Discussion.	20%	06
Unit 5: **ICT/ Digital/ E-Skills** Computer Assisted Language Learning (CALL), Mobile Assisted Language Learning (MALL), Emails, Blogs, Digital/ E-Portfolio, Filling Online Application Forms	20%	06

Instructional Method and Pedagogy: (Max. 100 words)

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		
CO1: **Demonstrate** effective foundational communication skills in English through listening, speaking, reading, and writing activities.	Cognitive	Understand
2: **Apply** appropriate writing skills to produce clear and structured texts for academic and workplace communication.		Understand Apply
3: **Apply** language knowledge to communicate professionally in multicultural and global contexts.		Create
4: **Exhibit** professional communication behavior aligned with corporate and organizational expectations.		Apply
5: **Use** digital communication tools effectively for academic and professional interaction.		

Learning Resources	
1.	**Reference Books:** ➢ Horpe, Edgar and Showick Thorpe "Basic Vocabulary" Pearson Education India, 2012. ➢ Green, David. "Contemporary English Grammar Structures and Composition" MacMillan Publishers, New Delhi, 2010. ➢ Wren &Martin (2001), English Grammar & Composition, New York. ➢ Mudambadithaya G.S., (2002) English Grammar and composition.

	➢ Lupton, Mary Jane (1998). Maya Angelou: A Critical Companion. Westport: Greenwood Press. ISBN 978-0-313-303225. ➢ Booher, Diana. (2004), Booher's Rules of Business Grammar, OUPUr, Penny, (2002), Grammar Practice Activities, OUP
2.	**Textbook:** ➢ Murphy, Raymond "Murphy's English Grammar with CD" Cambridge University Press, 2004
3	**Journals & Periodicals** ➢ The Journal' Basic English Grammar ➢ Fluent U' English Language and Cultural Journal ➢ The Journal of English Academics' ➢ Elsevier' The research on language ➢ Index Noedicus: A Cumulative Index to English Language Periodicals ➢ The Illustrated English Language Periodicals
4	**Other Electronic Resources** ➢ Wordsworth - Language software

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1
Avg.	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	0	1	0	1	2	3	1	2
CO2	1	2	2	1	0	1	0	1	2	3	2	2
CO3	1	2	2	1	0	2	0	1	2	3	2	2
CO4	1	1	2	0	0	2	0	2	3	3	2	2
CO5	1	1	1	0	2	1	1	2	2	3	2	3
Avg.	1	1	1	1	0	1	0	1	2	3	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE VACC106	COURSE NAME INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM (IKS)	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	0	2	2	0	0	2

Course Pre-requisites	Nil
Course Category	Value Added Course (VAC)
Course focus	Indian Heritage, Indigenous Knowledge, Ethics, Sustainable Development, and Holistic Education.
Rationale	Indian civilization has developed one of the world's oldest and most comprehensive systems of knowledge, encompassing philosophy, mathematics, astronomy, medicine, governance, architecture, environmental conservation, and education. The National Education Policy (NEP) 2020 advocates integrating Indian Knowledge Systems (IKS) into higher education to foster cultural rootedness, critical thinking, ethical values, and multidisciplinary learning. This course introduces students to the historical evolution, philosophical foundations, scientific achievements, and contemporary relevance of Indian Knowledge Systems. It aims to helplearnersappreciateIndia'sintellectualheritagewhileunderstandingitsapplicationsin addressing modern societal and global challenges.
Course Revision/ Approval Date:	June 2026
Course Objectives (As per Blooms' Taxonomy)	1. **Remember:** To identify and recall the major sources, concepts, and branches of the Indian Knowledge System. 2. **Understand:** To explain the contributions of ancient Indian traditions in education, mathematics, astronomy, medicine, governance, and ethics. 3. **Apply:** To relate the principles of Indian Knowledge Systems to present-day issues of sustainability, leadership, and societal development. 4. **Analyze:** To compare traditional Indian knowledge frameworks with contemporary scientific and educational paradigms. 5. **Create: To** formulates innovative ideas and solutions by integrating indigenous knowledge with modern practices.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Foundations of Indian Knowledge System Meaning and scope of IKS. Evolution of Indian civilization and knowledge tradition. Vedas, Upanishads, Itihasas, and Puranas as repositories of knowledge, Guru- Shishya Parampara and Ancient Indian Universities (Takshashila, Nalanda, Vikramashila)	30%	10
Unit 2: Scientific and Intellectual Heritage of India Indian Mathematics; Decimal system, Zero, Algebra, Vedic Mathematics, Astronomy and Cosmology; Aryabhata, Varahamihira, Bhaskara. Ayurveda and traditional healthcare system. Contribution to Architecture, Metallurgy, Agriculture, and Water Management.	40%	10
Unit 3: Contemporary Relevance of IKS Indian Ethics and Value System, Arthashastra and principle of governance, Environmental NEP 2020, Global relevance and future prospects of IKS.	30%	10

Instructional Method and Pedagogy: The course will be delivered through interactive lectures, case studies, storytelling, group discussions, documentary screenings, reflective writing, and seminar presentation,Students Will critically examine indigenous knowledge traditions and explore their application in contemporary society through multidisciplinary perpesctives. Activity –based learning, heritage studies, and local case example Will be incorporated wherever feasible.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able: CO1: **Recall** and describe the origin, evolution, and major sources of Indian Knowledge Systems. CO2: **Explain** the contribution of Indian traditions in mathematics, astronomy, medicine, and education CO3: **Apply** the principles of Indian ethics, sustainability, and governance to contemporary situation. CO4: **Analyze** the similarities and differences between indigenous knowledge system and modern scientific approaches. CO5:**Develop** innovative ideas integrating Indian Knowledge systems with present –day societal and environmental challenges.	Remember Understand Apply Analyze Create	Recall, List, Describe, State. Explain, Discuss, Apply Compare Design,

Learning Resources	
1.	**Reference Books:** **(A)** R. Balasubramaniam **Indian Knowledge Systems for the 21st Century.** **(B)** Babe Debroy

	The Bhagavad Gita for Millennials. **(C)** R. P .Kulkarni **Ancient Indian Education : Brahmanical and Buddhist**
2.	**Textbook:** **(A)** B .Mahadevan, Vinayak Rajat Bhat & Nagendra PavanaR. **Introduction to Indian Knowledge System, PHI** Learning. **(B)** Kapil Kapoor & Avadesh Kumar Singh (Eds.) **Indian Knowledge Systems: Vol .I & II, D.K.Printworld**. **(C)** S. Radhakrishnan **Indian Philosophy, Oxford** University Press.
4.	**Other Electronic Resources:** **(A) SWAYAM / IKS Division** • Introduction to Indian Knowledge System. • Indian Culture and Heritage. • Indian Scientific Heritage. • **(B) Government portals** • IKS Division, Ministry of Education. • AICTE Indian Knowledge System Portal. • IGNCA Digital Library. **(C)Digital Archives** • Digital Library of India. • Bharatavani Portal. • National Digital Library of India (NDLI).

Evaluation Scheme	**Total Marks**
Practical Marks	

Attendance and Participation	05
Assignment / Activity	10
Seminar / Presentation	10
Quiz / Internal Assessment	10
End Semester Test	15
Total	**50**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	2	3	3
CO4	2	3	3
CO5	2	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 none

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	0	0	0	1	1	1	1	2	0	2
CO2	2	1	1	1	1	2	2	1	1	2	0	2
CO3	1	2	2	1	1	3	3	3	2	2	1	2
CO4	2	3	2	3	2	2	2	1	2	2	1	3
CO5	2	3	3	2	2	3	3	2	3	2	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 none

COURSE CODE VACC207	COURSE NAME Indian Logic and Critical Thinking	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	15	00	45	30	15	00	3

Rationale:	The course is designed in alignment with UGC Guidelines for Indian Knowledge Systems (IKS) and addresses a significant gap in undergraduate education — the absence of structured exposure to India's rich traditions of logical reasoning, epistemology, and critical inquiry. Indian philosophy has produced one of the world's most sophisticated systems of logic, argumentation, and debate, yet these traditions remain largely absent from modern academic curricula. This course draws from: • Classical Indian schools of logic (Nyaya ,Buddhist ,Jain) • Epistemological frameworks (Pramana Shastra) • Modern critical thinking and argumentation theory • UGC National Education Policy (NEP2020) recommendations on IKS integration

Course Pre-requisites	Nil (Open to all first-year UG students)
Course Category	Ability Enhancement Compulsory Course (AECC)–IKS Aligned
Course focus	Indian Knowledge Systems (IKS) + Logical Reasoning and Critical Inquiry
Rationale	The course develops structured reasoning, argumentation, and critical analysis skills rooted in India's classical logical traditions .It integrates Nyaya philosophy, Buddhist dialectics, Jain Anekantavada, and modern critical thinking methodologies to cultivate rigorous Intellectual competencies in undergraduate students
Course Revision/ Approval Date:	05/05/2026
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. To **introduce** learners to the foundational concepts and schools of Indian Logic (Nyaya, Buddhist, Jain) 2. To **explain** the Indian theory of knowledge (Pramana) and its categories 3. To **apply** the Nyaya syllogistic method (Panchavayava Vakya) to real-world arguments 4. To **analyse** fallacies (Hetvabhasa) and distinguish valid from invalid reasoning 5. To **evaluate** arguments using both Indian and contemporary critical thinking frameworks 6. To **develop** structured debate ,discussion ,and intellectual inquiry skills rooted in Indian traditions

Course Content (Theory)	Weightage	Contact hours
Module 1: Introduction to Indian Logic and Epistemology • What is Indian Logic? Historical and philosophical context • The Nyaya Darshana :Overview and significance • Pramana: Sources of valid knowledge—Pratyaksha, Anumana , Upamana, Shabda • Comparison with Western epistemology • Scope of logic in Indian philosophical schools :Nyaya, Vaisheshika, Mimamsa, Buddhism, Jainism **Sanskrit Integration:**"Ñमाणैरथ[परीk¢णंÛयायः"—Logic is the examination of Objects through valid means of knowledge (NyayaSutra1.1.1)	**20%**	**6**
Module 2: Anumana—Indian Theory of Inference • Structure of the Indian syllogism (Pancavayava Vakya): Pratijna, Hetu, Udaharana, Upanaya, Nigamana • Vyapti (invariable concomitance):the logical heart of inference • Types of Anumana: Purvavat, Sheshavat ,Samanyatodrisht • Hetvabhasa :Fallacies of inference—Savyabhichara ,Viruddha, Satpratipaksha, Asiddha, Badhita • Comparison with Aristotelian syllogism and modern deductive logic **Sanskrit Integration:**"ēयाि◌ंतप¢धम[ताÊ◌ानात्अनु◌ंमितः"–Inference arises from knowledge of invariable concomitance and the property of the minor term	**10%**	**6**
Module 3: Debate ,Dialectics and Argumentation in Indian Tradition • Kathavatthu and Nyaya tradition of structured debate • Three forms of debate: Vada (honest discourse), Jalpa (disputational), Vitanda (destructive criticism) • Chala (quibbling) ,Jati (futile rejoinders) ,Nigrahasthana (grounds of defeat) • Buddhist logic : Dignaga and Dharmakirti's contributions • Jain Anekantavada ,Syadvada ,and Saptabhangi—logic of perspectives **Sanskrit Integration:** "वादे वादे जायते तsवबोधः" – Truth emerges through reasoned discourse	**20%**	**6**
Module 4: Critical Thinking—Indian and Contemporary Integration • Tarka (hypothetical reasoning) and its role in Indian logic • Cognitive biases and informal fallacies: Indian and modern perspective. • Distinguishing good reasoning from sophistry • Application of logical principle in everyday decision- making	**20%**	**6**

• Case studies; Application of Nyaya logic to contemporary problems in science, law, and public discourse • **Sanskrit Integration:** "तर्कादृऽमीिंतृठः" – Reasoning alone is not sufficient without evidence (Brahmasutra) — Discussion on limits of pure logic		
Module 5: Applied Logic—Practical Reasoning Sessions Breath-based practices (*Pranayama*) • Structured debate practice using Vada format • Argument mapping and logical analysis of texts • Identifying fallacies (Hetvabhasa) in contemporary media and discourse • Group reasoning exercises using Pancavayava syllogism • Reflective writing on reasoning patterns	**10%**	**15**

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able: CO1: **Explain** the major schools of Indian logic and their epistemological foundations CO2 **Apply** the Pancavayava syllogism and Pramana theory to construct valid arguments CO3: **Identify** and analyse fallacies (Hetvabhasa) in given arguments CO4:**Evaluate** multiple perspectives using Jain Anekantavada and comparative logical frameworks CO5: **Develop** disciplined ,evidence-based reasoning habits applicable in academic and professional contexts	Cognitive	Explain Apply Identify Evaluate Develop

Learning Resources	
1.	**Primary Sources:** • Nyaya Sutras of Gautama (withVatsyayanaBhashya) • Tarkasangraha of Annambhatta • Nyayabindu of Dharmakirti • Kathavatthu (Pali Canon—selected excerpts) • Pramanavarttika of Dharmakirti
2.	**Secondary Sources:** • B.K. Matilal—Perception : An Essay on Classical Indian Theories of Knowledge • S.C.Vidyabhushana—A History of Indian Logic • Satishchandra Chatterjee—The Nyaya Theory of Knowledge • UGC IKS Resource Books on Indian Philosophy
3.	**Modern Integration:** • Irving Copi—Introduction to Logic (for comparative study) • Alec Fisher—The Logic of Real Arguments

Evaluation Scheme	Total Marks
Practical Marks	

Argument Construction Assignment	15
Fallacy Identification Quiz	15
Vada (Debate) Participation	20
Reflective Journal	15
Class Participation& Discussion	10
End-Semester Application Project	25
Total	**100**

Mapping of PSOs & Cos

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	2	3	3
CO3	2	3	3
CO4	2	2	3
CO5	3	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 none

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	0	2	0	2	0	2	1	2	0	2
CO2	2	3	2	2	0	2	0	3	1	3	0	2
CO3	2	3	1	2	0	2	0	3	1	2	0	2
CO4	1	3	2	2	0	3	1	3	2	3	1	3
CO5	2	3	2	2	1	3	1	3	3	3	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 none

COURSE CODE VACC208	COURSE NAME Indian Economic Thought and Arthasashtra	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	15	00	45	30	15	00	3

Rationale:	The course is designed in alignment with UGC Guidelines for Indian Knowledge Systems (IKS) and addresses a critical gap in under graduate education—the near-total absence of India's own rich economic traditions from the economics curriculum. India has a 3,000-year-old tradition of systematic economic thought, spanning from the Vedic period through the Arthashastra, the Dharmashastra literature, Buddhist economic ethics, and Gandhian economics. Modern economics education relies almost entirely on Western frameworks, neglecting India's own profound contributions to fiscal management, market regulation, labour organisation, and welfare economics. This course draws from: • Kautilya's Arthashastra (4th century BCE)—the world's oldest comprehensive treatise on political economy • Vedic and Upanishadic economic concepts • Buddhist and Jain economic ethics • Gandhian economic philosophy • Comparative analysis with modern economic thought

Course Pre-requisites:	Nil(Open to all first-year UG students)
Course Category	Ability Enhancement Compulsory Course(AECC)–IKS Aligned
Course focus	Indian Knowledge Systems(IKS)+Political Economy ,Governance, and Development Thought
Rationale	The course introduces students to India's own traditions of economic thinking, from ancient fiscal management and market regulation in the Arthashastra to Gandhian economics and village self-sufficiency models. It bridges classical Indian economic wisdom with modern economic challenges, fostering critical and contextualized understanding of development, governance ,and Sustainability.
Course Revision Date:	05/05/2026
Course Objectives **(As per Bloom's Taxonomy)**	1. To **introduc**e learners to the history and scope of Indian economic thought across different periods 2. To **explain** the economic framework of Kautilya's Arthashastra –its fiscal, administrative, and regulatory structure. 3. To **apply** Indian economic concepts (Dharma-Artha balance,

	Trusteeship, cooperative principles) to contemporary economic issues 4. To analyse the contribution of Buddhist, Jain ,and Gandhian economic thought to sustainable development 5. To **evaluate** the relevance of Indian economic traditions for modern policy, governance, and development challenges 6. To **compare** Indian economic thought with Western economic paradigms and identify unique contributions

Course Content (Theory)	Weightage	Contact hours
Module 1: History and Foundations of Indian Economic Thought • What is Indian Economic Thought? Scope, periodisation ,and significance • Vedic economic concepts: Wealth (Dhana), exchange (Vanijya), taxation (Bali, Shulka) • The Purushartha framework: Artha as the legitimate pursuit of material well-being • Dharmashastra literature and economic regulation: Manusmriti, Yajnavalkya Smriti • Arthashastra tradition before Kautilya: Earlier Arthashastra teachers (Brihaspati, Usanas) • Comparison with ancient Greek and Mesopotamian economic traditions **Sanskrit Integration:** "अथ□□ य मूलं रा□यम" **(**Arthasya mulam rajyam) the foundation of wealth is the state — Arthashastra)	20%	6
Module 2:Kautilya's Arthashastra—The World's First Political Economy • Introduction to Kautilya (Chanakya) and the Arthashastra: Historical context, structure, and significance • Saptanga theory: State as an economic organism (Swami, Amatya, Janapada, Durga ,Kosha ,Danda, Mitra) • Kosha (treasury) as the foundation of the state: Revenue ,expenditure, and fiscal management Market regulation in Arthashastra :Price control ,weights and measures, consumer protection • Agriculture (Krishi) and land management :Land revenue system and agricultural productivity • Trade and commerce (Vanijya): Domestic and international trade regulation • Labour organisation: Guilds (Shrenisystem), wages, and worker welfare • Monetary system: Currency (Rupa),banking, and credit	**20%**	**6**

• **Sanskrit Integration:**" "कोषमूलो द□ः" (Koshamulo dandah –The army (enforcement) is rooted in the treasury — Arthashastra)		
Module 3: Buddhist and Jain Economic Ethics • Buddhist economic thought: The Middle Way (Majjhima Patipada) applied to economics • Right Livelihood (Samma Ajiva): Ethical dimensions of economic activity • Buddhist principles of wealth distribution and welfare (Dana,Sangha economics) • E.F. Schumacher's Small is Beautiful and its roots in Buddhist economics • Jain economic ethics: Aparigraha (non-possessiveness), Asteya (non-stealing), and their economic implications • Anekantavada applied to economic pluralism • The Jain merchant tradition: Ethical business practices and community banking (Nidhi, Mahajan system) • Comparative analysis: Buddhist and Jaine conomics vs .modern welfare economics **Sanskrit Integration: "अप□र□हः"** (Aparigraha – Non-possessiveness — Yoga Sutras; also, a Jain Mahavratha with direct economic implications)	**20%**	**6**
Module 4:Gandhian Economics and Alternative Development Models • Gandhian economic philosophy: Its foundations in Indian tradition and moral economy • Trusteeship theory: Wealth as a social trust ,not private property • Gram Swaraj(village self-rule):Decentralised economic self-sufficiency • Swadeshi economics: Local production ,consumption ,and economic nationalism • Bread Labour (Shrama) and the dignity of work in Gandhian thought • Sarvodaya: Welfare of all as the goal of economic activity (Vinoba Bhave, J.P. Narayan) • Comparison with Keynesian economics ,welfare economics, and sustainable development goals (SDGs) • Contemporary relevance : Gandhian economics and circular economy, sustainable development, and rural development **Sanskrit Integration :** "सव□ भव□तु सु□खनः""(**Sarve bhavantu Sukhinah**)–May all be happy—an expression of the Sarvodaya ideal rooted in Upanishadic thought)	**20%**	**6**
Module 5: Contemporary Relevance and Policy Applications • Indian economic thought and its relevance to modern India: Planning, development, and governance • Arthashastra principles in modern public administration and fiscal policy	**10%**	**6**

• Buddhist economics and the Gross National Happiness index (Bhutan model) • Indian cooperative traditions and modern cooperative economics (AMUL, cooperative banking) • Indian village economy (Jajmani system) and modern rural development • Comparison of Indian economic models with capitalism, socialism, and mixed economy • Decolonising economics: Making a case for Indian economic frameworks in the 21st century • Indian economic wisdom and the United Nations Sustainable Development Goals (SDGs) **Sanskrit Integration:** "लोकसं□हमेवा□प स□प□यन ् कतुम□ ह□□स" (Lokasangraham evapi sampashyan kartum arhasi–Considering the welfare of all, you must act — Bhagavad Gita 3.20)		
Module 6 (Practical): Economic Analysis Lab and Applied Projects • Case study analysis: Applying Arthashastra principles to contemporary governance and policy challenges • Economic data analysis :Village economy ,cooperative sector, and traditional economic institutions • Field visits to cooperative societies ,traditional markets, and rural self-help groups • Policy brief writing :Recommending solutions using Indian economic frameworks Comparative text analysis: Arthashastra vs .Adam Smith's Wealth of Nations.	**10%**	

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able: CO1;**Explain** the historical development and foundational concepts of Indian economic thought from the Vedic period to the modern era CO2: **Analyse** the economic framework of Kautilya's Arthashastra ,including its fiscal ,regulatory, and administrative dimensions CO3 : **Apply** Buddhist ,Jain ,and Gandhian economic principles to evaluate contemporary issues of sustainability, welfare, and ethical business	Cognitive	Explain Analyse Apply Compare

CO4: **Compare** Indian economic thought with Western economic paradigms and identify India's unique contributions to economic theory and practice CO5: **Evaluate** contemporary economic policy challenges using Indian economic frameworks and propose contextualised solutions		Evaluate

Learning Resources	
1.	**Primary Sources:** • Kautilya's Arthashastra– R.Shamasastry (tr.) and L.N.Rangarajan (tr.) • Selected excerpts from Manusmriti on economic regulation • Buddhist Pali texts on Dana and Right Livelihood (AnguttaraNikaya) • Gandhi ,M.K.–Hind Swaraj and Village Swaraj 1. Vinoba Bhave–selected writings on Sarvodaya
2.	**Secondary Sources:** • Balbir S.Sihag–Kautilya: The True Founder of Economics • T.R.Sharma – Ancient Indian Economic Thought • Mark Lindley–J.C.Kumarappa: Mahatma Gandhi's Economist • E.F.Schumacher– Small is Beautiful 1. Dharampal–The Beautiful Tree and Indian Science and Technology in the Eighteenth Century
3.	**Modern Integration:** • Amartya Sen–*The Argumentative Indian* • Jean Dreze and Amartya Sen–*An Uncertain Glory: India and its Contradictions* • NITI Aayog reports on sustainable development • NPTEL lectures on Indian Economic History 1. UGC- recommended IKS textbooks on Indian social and economic traditions

Evaluation Scheme	**Total Marks**
Practical Marks	

Arthashastra Text Analysis Assignment	15
Economic Case study Presentation	20
Field Visit Report	15
Reflective Journal	10
Policy Brief/ Research Paper	20
Class Participation and Discussion	10
End- Semester Application Project	10
Total	**100**

Activities	Practices
1.Primary Text Analysis	• Reading circles on Arthashastra (translated excerpts) • Comparison of ancient and modern fiscal policies
2.Field Visits and Immersive Learning	• Visit to cooperative societies (e.g. ,AMUL, Iffco), traditional markets, Panchayati Raj institutions • Interaction with practitioners of cooperative and village economics
3.Economic Policy Simulations	• Mock budget exercise using Arthashastra principles • Policy debate on development models (Gandhian vs. market economics)
4.Comparative Economic Analysis	• Comparison of Indian fiscal lsystems with modern taxation • Arthashastra market regulation vs .modern consumer protection laws
5.Reflective Economic Journaling	Not just "what I learned "But: 1. How do Indian economic values challenge my assumptions about wealth? 2. What economic practices in my community reflect Indian traditions?
6.Cooperative and Rural Economy Study	• Data collection on local cooperative societies • Analysis of Jajmani system remnants in rural Gujarat

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	2	2
CO3	1	2	2
CO4	2	3	3
CO5	2	3	3
Avg.	1.4	2.2	2.2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 none

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	0	1	0	1	1	1	1	2	1	2
CO2	3	3	2	2	1	2	1	2	1	2	3	2
CO3	2	2	2	2	1	3	3	3	2	2	2	2
CO4	2	3	1	2	1	2	2	2	1	2	1	3
CO5	3	3	3	3	2	3	3	2	2	3	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 none

COURSE CODE VACC105	COURSE NAME YOGA AND WELLNESS	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
1	2	0	3	1	1	0	2

Course Pre-requisites	Basic physical fitness; no prior yoga experience required.
Course Category	Ability Enhancement / Life Skills (Value Aided Credit Course - VACC)
Course Focus	Skill Development, Mental Health, and Physical Well-being
Rationale	In a high-pressure academic environment, students require tools to manage stress, improve posture, and maintain physical health. This course bridges ancient yogic wisdom with modern fitness needs.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	1. **Remember:** To recognize and recall the names, Sanskrit terminology, and sequences of Sukshma Vyayama, Asanas, and Pranayama. 2. **Understand:** To explain the physiological and psychological benefits of specific yoga practices and their role in holistic wellness. 3. **Apply:** To demonstrate the correct execution of postures and breathing techniques with proper alignment and safety precautions. 4. **Analyze:** To examine the relationship between modern sedentary lifestyles (stress/posture) and the counteractive effects of yogic interventions. 5. **Create:** To design a personalized 15-minute "Desk Yoga" or "Daily Wellness" sequence tailored to specific individual needs or constraints.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Foundations of Movement & Yogic Warm-up • **Concepts:** Introduction to Yoga and Wellness; Philosophy of "Steady and Comfortable" (Sthira-Sukham). • **Practical: Sukshma Vyayama (Yogic Warm-up):** Systematic joint movements from neck to toes. • **Specifics:** Griva Shakti Vikasaka (Neck), Skandha Chakra (Shoulders), Kati Shakti Vikasaka (Trunk), and Janu Shakti Vikasaka (Knee).	30%	20
Unit 2: Asana Dynamics, Core Strength & Fitness • **Concepts:** Body Alignment and the Science of Stretching; Building Core Stability. • **Asanas (Practical):** o **Standing:** Tadasana, Vrikshasana, Trikonasana. o **Sitting:** Paschimottanasana, Ardha Matsyendrasana, Vajrasana. o **Prone:** Bhujangasana, Shalabhasana. o **Supine:** Sarvangasana (or Setu Bandhasana), Shavasana. • **Fitness Integration:** Sun Salutations (Surya Namaskar) for cardiovascular endurance and core engagement.	40%	20
Unit 3: Pranayama & Modern Stress Recovery (20 Hours) • **Pranayama:** Sectional breathing (Abdominal, Thoracic, Clavicular), Nadisodhana, and Bhramari. • **Relaxation Modalities: QRT (Quick Relaxation Technique):** 2-minute body scanning. o **DRT (Deep Relaxation Technique):** 15-minute guided Shavasana. • **Applied Yoga:** Eye relaxation techniques (Trataka/Palming) and Desk-based stretches for wrist/spine health during long study hours.	30%	20

Instructional Method and Pedagogy: The instructional approach is strictly experiential, utilizing a **Demonstration-Imitation** model where students replicate the instructor's live movements under direct supervision. Safety is maintained through **Hands-on Correction**, combining verbal cues with physical adjustments to ensure precise anatomical alignment. Students develop self-awareness via the **Mirroring Technique**, using studio mirrors and peer observation to refine their posture. Mental recovery is facilitated through **Guided Relaxation**, using audio-led QRT and DRT sessions for deep rest.

Course Outcomes	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1 : Recall and **describe** the sequence of **Sukshma Vyayam** (yogic warm-ups) and the 12 steps of **Surya Namaskar** with their respective benefits.	Cognitive	Remember
CO2 : **Demonstrate** the ability to perform various **Asanas** (Standing, Sitting, Prone, Supine) with correct physical alignment and breath synchronization.		Apply
CO3 : Critically **analyze** their own postural limitations and compare the physiological effects of different **Pranayama** techniques on heart rate and mental state.		Analyses and Evaluation
CO4 : **Design** a personalized **"Desk Yoga"** and **Eye Relaxation** routine specifically tailored for academic or office-based environments to mitigate sedentary strain.		Create
CO5 : **Summarize** the principles of **QRT and DRT** (Quick and Deep Relaxation) and explain how these practices proactively manage stress and enhance core strength.		Understand

Learning Resources	
1.	**Reference Books:** 1. Yoga Anatomy – Leslie Kaminoff & Amy Matthews. (Crucial for understanding the muscle mechanics and core strength aspects of Asanas). 2. The Heart of Yoga: Developing a Personal Practice – T.K.V. Desikachar. (Provides a framework for creating personalized routines as per CO4). 3. Stress and Its Management by Yoga – K.N. Udupa. (A scientific reference for the physiology behind QRT, DRT, and Pranayama).
2.	**Text Books:** 1. Asana Pranayama Mudra Bandha – Swami Satyananda Saraswati (Yoga Publications Trust). (The gold standard for practical step-by-step guidance).Journal of American Chemical Society, ACS Publications. 2. Light on Yoga: Yoga Dipika – B.K.S. Iyengar (Schocken Books). (Excellent for detailed anatomical alignment and posture photographs). 3. Stress and Its Management by Yoga – K.N. Udupa. (A scientific reference for the physiology behind QRT, DRT, and Pranayama).
3.	**Other Electronic Resources:** 1. NPTEL & SWAYAM Platforms

	2. MOOCs & International Platforms: 3. Government & Digital Libraries

Evaluation Scheme	**Total Marks**
Practical Marks	

Attendance & Discipline	05 marks
Practical Exam	20 marks
Viva	15 marks
Theory (Quiz)	10 marks
Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	2	3	3
CO4	2	3	3
CO5	2	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	0	0	1	1	0	0	1	0	2
CO2	2	0	0	0	0	2	1	0	2	1	0	2
CO3	2	3	0	2	0	2	1	0	0	1	0	3
CO4	2	2	3	2	1	3	3	2	2	2	2	3
CO5	2	2	2	1	0	3	3	2	2	2	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE VACC 301	COURSE NAME **Vedic Mathematics**	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	0	0	30	2	0	0	2

Course Pre-requisites	**None**
Course Category	Value Added Elective
Course Focus	Skill development
Rationale	The present course will give the idea about different concepts of Vedic Mathematics like Arithmetic, Algebra, Geometry and Trigonometry.
Course Revision/ Approval Date:	July 30,2023
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Understand** Concepts of Vedic Mathematics to promote joyful learning of mathematics. 2. **Learn** Vedic Mathematics to enhance computation skills. 3. **Develop** logical and analytical thinking 4. **Apply** Vedic mathematics to solve problems of Algebra, Geometry and Trigonometry. 5. **Understand** the rich heritage of mathematical temper of Ancient India.

Course Content (Theory)	Weightage	Contact hours
Unit 1: History of Vedic Maths and its Features, Vedic Maths formulae: Sutras and Upsutras Addition in Vedic Maths: Without carrying, Dot Method, Subtraction in Vedic Maths: Nikhilam Navatashcaramam Dashatah (All from 9 last from 10) , Fraction -Addition and Subtraction	20%	6

Unit 2: Miracle Multiplication and Excellent Division: Base Method, Multiplication by Urdhva Tiryak Sutra (any two numbers up to four digits), Miracle multiplication: Any number by series of l's and 9's, Multiplication by 12, Division by Urdhva Tiryak Sutra (Vinculum method)".	20%	6
Unit 3: Lightening Squares and Rapid Cubes, Squares of any two-digit numbers: Base method, Square of numbers ending in 5: Ekadhikena Purvena Sutra, Square of any numbers using duplex, Easy square roots: Dwandwa Yoga (duplex) Sutra, Cubing: Yavadunam Sutra	20%	6
Unit 4: Square root of 2: Baudhayana Shulbasutra, Enlighten Algebra and Geometry, Factoring Quadratic equation: Anurupyena, Adyamadyenantyamanty Sutra, Concept of Baudhayana (Pythagoras) Theorem	20%	6
Unit 5: Circling a square: Baudhayana Shulbasutra, Concept of pi: Baudhayana Shulbasutra, Concept angle () 0o, 30o, 45o, 60o and 90o: Baudhayana number	20%	6

Instructional Method and Pedagogy:
Chalk & board, group discussions, assignments, , Online materials, Practice examples

Learning Resources	
1.	**Reference Books:** 1. A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi 2. Enjoy Vedic Mathematics, S M Chauthaiwale, R Kollaru, The Art of Living, Bangalore 3. Magical World of Mathematics, VG Unkalkar, Vandana Publishers, Banglore.
2.	**Text Books:** 1. The Essential of Vedic Mathematics, Rajesh Kumar Thakur, Rupa Publications, New Delhi, 2019 2. Vedic Mathematic by Bharati Krishna Tirthaji, Motilal Banarasidas, New Delhi, 2015.

Evaluation Scheme	**Total Marks**
Practical Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review / Presentations / Practice Assignments	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	2	1
CO2	1	2	1
CO3	2	2	1
CO4	1	2	1
CO5	1	2	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	0	1	0	0	0	0	1	0	2
CO2	3	3	1	0	1	0	0	0	0	1	0	2
CO3	3	3	1	0	1	0	0	0	0	1	0	2
CO4	3	3	2	0	1	0	0	0	0	1	0	2
CO5	2	1	0	0	0	2	2	2	1	2	1	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE VACC205	COURSE NAME Ethics and Leadership in Indian Thought	SEMESTER II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	15	00	45	30	15	00	3

Course Pre-requisites	Nil (Open to all first-year UG students)
Course Category	Ability Enhancement Compulsory Course (AECC) – IKS Aligned
Course Focus	Indian Knowledge Systems (IKS) + Value-Based Leadership and Ethical Development
Rationale	The course is designed in alignment with UGC Guidelines for Indian Knowledge Systems (IKS) and responds to the growing need for value-based leadership education rooted in India's civilisational heritage. Modern leadership education often borrows exclusively from Western management traditions, overlooking the profound and time-tested leadership wisdom embedded in Indian texts such as the Bhagavad Gita, Arthashastra, Panchatantra, Ramayana, and Mahabharata. This course draws from: • Classical Indian ethical frameworks (Dharma, Niti, Sadachar) • Leadership models from Indian epics and historical figures • Indian management philosophy and its contemporary relevance UGC NEP 2020 recommendations for value-based and IKS-integrated education
Course Revision/ Approval Date:	05/05/2026
Course Objectives (As per Blooms' Taxonomy)	1. **To introduce** learners to the foundational ethical frameworks in Indian thought (Dharma, Niti, Sadachar, Ahimsa) 2. **To explain** classical Indian models of leadership drawn from epics, texts, and historical exemplars 3. **To apply** the concept of Nishkama Karma (desireless action) and Dharmic leadership to real-world ethical dilemmas 4. **To analyse** the leadership philosophies of iconic Indian figures (Chanakya, Ashoka, Vivekananda, Gandhi) 5. **To evaluate** contemporary organisational and social challenges through Indian ethical frameworks. 6. **To develop** personal leadership philosophy rooted in Indian values and integrated with global best practices

Course Content (Theory)	Weightage	Contact hours
Module 1: Foundations of Indian Ethics • What is Dharma? Multiple dimensions: Sanatana Dharma, Varnashrama Dharma, Rajadharma, Apaddharma • Indian ethical categories: Sadachar, Niti, Rta, Ahimsa, Satya • The concept of Purushartha: Dharma, Artha, Kama, Moksha as an integrated ethical framework • Karma theory and ethical accountability • Ethics in daily life: Yama and Niyama (Yoga Sutras) Sanskrit Integration: "**धमर्ः र¢ित रि¢तः" (**Dharmo rakshati rakshitah – Dharma protects those who protect it — Manusmriti)	20%	6
Module 2: Leadership Models in Indian Epics and Texts • Rajadharma: The ideal ruler in Indian tradition — Mahabharata, Ramayana, Arthashastra • Bhagavad Gita as a leadership manual: Nishkama Karma, Sthitaprajna (person of steady wisdom), Lokasamgraha • Leadership lessons from the Ramayana: Rama as servant-leader • Panchatantra and Niti Shastra: Practical wisdom for leadership and governance • Buddhist leadership model: The Bodhisattva ideal — com-passionate leadership • Jain leadership: Aparigraha (non-possessiveness) and Anekantavada in leadership S**anskri**t Integration: "**यदयदाचरित ेृ¢ठèतत्तदेवेतरो जनः" (**Yady-adacharati shreshthas tat tad evetaro janah – Whatever a great person does, others follow — Bhagavad Gita 3.21)	20%	06

Module 3: Chanakya's Arthashastra and Statecraft as Leadership • Introduction to Kautilya's Arthashastra: Context and significance • Saptanga theory of state: The seven pillars of governance as organisational structure • Chanakya's concept of the ideal leader (Swami): Qualities and competencies • Mantrishakti, Prabhu-shakti, Utsaha-shakti: Three sources of leadership power • Ethics in Arthashastra: Balancing Artha and Dharma • Intelligence, diplomacy, and strategic thinking in Kautilyan leadership Application to modern organisational leadership and governance Sanskrit Integration: "**सुखèय मूलं धम[ः, धम[èय मूलं अथ[ः" (**Sukhasya mulam dharmah, dharmasya mulam arthah – The root of happiness is Dharma; the root of Dharma is Artha — Arthashastra)	20%	10
Module 4: Iconic Indian Leaders and Their Ethics • Swami Vivekananda: Service as leadership, strength-based ethics, universal values • Mahatma Gandhi: Satyagraha, Trusteeship theory, ethical economics and leadership • Dr. B.R. Ambedkar: Social ethics, justice, and transformational leadership • Rabindranath Tagore: Creative leadership and humanistic education • Ashoka the Great: From conquest to compassionate governance (Dhamma) • Contemporary Indian leaders and their ethical frameworks • Comparative analysis: Indian leadership vs. Western leadership models (Servant Leadership, Transformational Leadership) Sanskrit Integration: "**आ×मनो मो¢ाथ¸ जगदिधताय च" (**Atman moksartham jagad hitaya cha – For one's own liberation and for the welfare of the world — Ramakrishna Mission motto)	20%	06
Module 5: Applied Ethics, Decision-Making, and Contemporary Relevance • Ethical decision-making using Indian frameworks: Dharma Sankata (ethical dilemma) analysis • Corporate ethics and CSR through the lens of Indian values (Trusteeship, Lokasamgraha) • Environmental ethics: Indian concept of Vasudhaiva Kutumbakam and sustainability • Gender ethics in Indian thought: Shakti, Stri Dharma, and feminist reinterpretation • Conflict resolution through Indian frameworks: Sama, Dana, Bheda, Danda	10%	6

• Leadership in the 21st century: Integrating Indian wisdom with global challenges Sanskrit Integration: "**वसुधैव कुटुबकम्" (**Vasudhaiva Kutumba-kam – The world is one family — Maha Upanishad)		

Module 6 (Practical): Leadership Lab and Ethical Reflection

- Case study analysis using Indian ethical frameworks
- Role-play and simulation: Ethical dilemmas from Indian epics applied to modern scenarios
- Leadership style self-assessment through Indian frameworks
- Personal leadership philosophy development workshop

Guest lectures by practitioners and leaders

Course Outcomes	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1: Explain** the foundational ethical frameworks of Indian thought including Dharma, Purushartha, Karma, and Niti	Cognitive	Explain
CO2: **Apply** the leadership lessons of the Bhagavad Gita, Arthashastra, and Indian epics to contemporary organisational contexts		Apply
CO3: **Analyse** the leadership philosophies of iconic Indian figures and evaluate their relevance to modern leadership challenges		Analyse
CO4: **Evaluate** ethical dilemmas (Dharma Sankata) using structured Indian frameworks and make value-based decisions.		Evaluate
CO5:**Develop** a personal leadership philosophy integrating Indian ethical values with contemporary leadership best practices		Develop

Learning Resources	
1.	**Reference Books:** **Primary Sources:** • Bhagavad Gita (selected chapters: 2, 3, 4, 6, 12, 18) • Kautilya's Arthashastra (selected portions in translation) • Valmiki Ramayana – Rajadharma sections • Mahabharata – Shantiparva (Rajadharma sections) • Panchatantra (selected stories with ethical analysis)
2.	**Secondary Sources:** • S. Radhakrishnan – The Bhagavadgita • R. Shamasastry (tr.) – Arthashastra • Devdutt Pattanaik – Business Sutra • V.P. Varma – Studies in Hindu Political Thought • R.K. Mukherjee – Ancient Indian Education
3.	**Modern Integration:** • Peter Northouse – Leadership: Theory and Practice (for comparative analysis) • Robert Greenleaf – Servant Leadership (comparative) • Harvard Business Review case studies on ethical leadership NPTEL lectures on Indian Philosophy and Ethics

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Practical Marks

Ethical Dilemma Analysis Assign-ment	15
Leadership Role-Play / Case Presentation	20
Reflective Leadership Journal	15
Personal Leadership Philosophy Essay	20
Class Participation and Discussion	10
End-Semester Integrative Project	20
Total	**100**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	2	2
CO3	1	2	2
CO4	1	3	2
CO5	2	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 No ne

Mapping of POs & COs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	1	0	0	0	2	1	3	1	2	1	2
CO2	0	1	1	0	0	2	1	2	3	2	3	2
CO3	0	2	1	1	0	2	1	2	3	2	2	3
CO4	0	3	1	1	0	3	2	3	2	2	2	2
CO5	1	2	2	1	1	2	2	3	3	3	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE VACC206	COURSE NAME Sustainable Management in Indian Traditions	SEMESTER II / III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
30	00	00	30	02	00	00	02

Course Pre-requisites	None
Course Category	Value Added Course (VAC)
Course Focus	Sustainability, Indigenous Knowledge, Environmental Ethics, Resource Management.
Rationale	Indian civilization has historically practiced sustainable management of natural resources through traditional ecological knowledge, community participation, ethical governance, and harmonious coexistence with nature. Ancient texts such as the Vedas, Upanishads, Arthashastra, and various indigenous practices offer valuable insights into water conservation, agriculture, forestry, biodiversity protection, waste management, and circular economy principles. The course aims to familiarize students with these traditional approaches and explore their relevance in addressing contemporary sustainability challenges and achieving the Sustainable Development Goals (SDGs).
Course Revision/ Approval Date:	June 2026
Course Objectives (As per Blooms' Taxonomy)	To enable the students to: 1. Understand the philosophy and principles of sustainable management embedded in Indian traditions. 2. Learn the indigenous practices related to agriculture, water conservation, biodiversity, and community resource management. 3. Develop critical thinking regarding the integration of traditional wisdom with modern sustainability practices. 4. Apply Indian traditional management principles to solve present-day environmental and societal problems. 5. Understand the role of Indian Knowledge Systems in achieving sustainable development and environmental stewardship.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Foundations of Sustainable Management in Indian Traditions • Concept of sustainability in Indian philosophy: Vasudhaiva Kutumbakam and harmony with nature. • Ecological wisdom embedded in the Vedas, Upanishads, and Puranas. • Panchamahabhutas (Five Elements) and their relevance to environmental stewardship. • Traditional value systems promoting conservation, moderation, and responsible consumption. • Community-based resource management and the Guru-Shishya tradition of knowledge transfer.	30%	10
Unit 2: Indigenous Resource Management and Circular Economy Practices: • Traditional water conservation systems: Stepwells, Baolis, Johads, Temple Tanks, and Rainwater Harvesting. • Sustainable agriculture practices: Organic farming, mixed cropping, seed preservation, and sacred groves .• Indigenous livestock and forest resource management practices. • Circular economy concepts in Indian traditions: Reuse, recycling, and zero-waste lifestyles. • Case studies of successful traditional resource management models in India.	40%	06
Unit 3: Contemporary Relevance of Indian Sustainable Practices • Kautilya's Arthashastra and principles of sustainable governance. • Indian ethics and environmental responsibility. • Indigenous knowledge for climate resilience and biodiversity conservation. • Indian Knowledge Systems (IKS), Sustainable Development Goals (SDGs), and NEP 2020. • Integration of traditional wisdom with modern sustainability practices for future development.	30%	10

Instructional Method and Pedagogy:
Chalk and board lectures, case studies, documentary presentations, group discussions, field observations, heritage case analyses, assignments, student seminars, and online learning resources will be employed. The pedagogy emphasizes experiential and interdisciplinary learning by connecting

traditional knowledge systems with contemporary sustainability practices.

Course Outcomes	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Do-main
After successful completion of the above course, students will be able to: **CO1**: **Explain** the basic concepts of sustainability in Indian traditions and ancient literature.	Understand,	Explain, Describe, Identify
CO2: **Apply** traditional water conservation and agricultural practices to contemporary environmental problems.	Apply	
CO3 :**Analyze** indigenous biodiversity conservation and community resource management systems.	Analyze	Use, Solve, Demonstrate
CO4: **Apply** principles of Arthashastra and traditional governance for sustainable management.	Apply	Compare, Differentiate, Evaluate
CO5: **Understand** the significance of Indian Knowledge Systems in promoting sustainable development and environmental ethics.	Understand	Use, Interpret, Solve

Learning Resources	
1.	**Reference Books:** 1. B. Mahadevan, Vinayak Rajat Bhat & Nagendra Pavana R. Introduction to Indian Knowledge System. 2. R. Balasubramaniam Indian Knowledge Systems for the 21st Century. 3. S.K. Ramachandra Rao Indian Environmental Traditions. 1. Kautilya. Arthashastra. 2. Kapil Kapoor & Avadesh Kumar Singh. Indian Knowledge Systems. 3. M.S. Swaminathan. Sustainable Agriculture and Traditional Knowledge. 1.
2.	**Journals & Periodicals:**
3.	**Other Electronic Resources:**

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review: 10 marks **Total: 40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	2	3	2
CO3	2	3	2
CO4	3	2	2
CO5	2	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	0	0	0	1	2	2	0	1	0	2
CO2	1	2	2	1	1	2	3	2	1	1	1	2
CO3	1	3	2	2	1	3	3	2	2	1	1	2
CO4	1	2	2	1	1	3	3	3	2	2	3	2
CO5	1	1	1	0	0	2	3	3	1	2	1	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTMA301	COURSE NAME MATHEMATICS-III	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	1	4	3	0	1	4

Course Pre-requisites	**Advance Mathematics**
Course Category	Basic Sciences
Course Focus	
Rationale	
Course Revision/ Approval Date:	24-04-2017
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Understand** computations involving complex numbers. 2. **Understand** the behavior of complex functions as compared to real functions. 3. **Study** periodic functions and their representations as series. 4. I**ntroduce** students to partial differential equations. 5. **Apply** the concepts of Laplace and Fourier transforms.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Complex Analysis Theory: Complex Analysis Complex number, polar form and triangle inequality. Function of a complex variable, Elementary functions, Definition and properties of analytics functions; Cauchy-Riemann equations.	20%	10
Unit 2: Complex Integration Theory: Cauchy's integral theorem and its applications.; Regular and irregular singular points, Residues and the Cauchy residue formula; Evaluation of improper integrals.	20%	06

Unit 3: Partial Differential Equations First order partial differential equations, Formation of partial differential equations from given solutions, Four standard forms of non-linear first order equations. Application of first order partial differential equations: One-dimensional Heat and Wave equation, Two-dimensional Heat equation.	20%	10
Unit 4: Fourier Series Theory: Fourier series, Half-ranged cosine and sine series.	20%	06
Unit 5: Laplace Transform Theory: Laplace and Inverse Laplace transforms, shifting theorems, Convolution theorem, Laplace transform of Derivative and Integration, Solution of linear ODE's using Laplace transform. Initial and boundary value.	20%	13

Instructional Method and Pedagogy: Chalk-Duster and Notes

Course Outcomes	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: **Understand** functions involving complex numbers.	Cognitive	Understand
CO2: **Compute** some real improper integrals using techniques of complex functions.		Evaluate
CO3: **Expand** one variable functions in Fourier series.		Create
CO4: **Solve** some most important partial differential equations occurring in engineering applications.		Apply
CO5: **Select** and combine the necessary Laplace transform techniques to solve second-order ordinary differential equations involving the Dirac delta (or unit impulse).		Apply

Learning Resources	
1.	**Reference Books:** 1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill,New Delhi, 2008. 2. Kreyszig, E., Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, (1999). 3. Boyce, W.E., and DiPrima, R., Elementary Differential Equations, 8th Edition, John Wiley Sons, (2005).
2.	**Journals & Periodicals:**
3.	**Other Electronic Resources:**

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review: 10 marks **Total: 40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	2	2	1
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	0	0	0	0	1	0	2
CO2	3	3	2	3	2	0	0	0	0	1	0	2
CO3	3	3	3	2	3	0	0	0	0	1	0	2
CO4	3	3	3	3	2	0	1	0	0	1	0	2
CO5	3	3	3	2	3	0	0	0	0	1	0	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH310	COURSE NAME FLUID FLOW OPERATIONS	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	5	3	2	0	4

Course Pre-requisites	**Mathematics I & II**
Course Category	Professional Core
Course Focus	Employability
Rationale	International relevance
Course Revision/ Approval Date:	24-04-2017 21-03-2023 29-05-2025
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Impart** fundamental knowledge in fluid flow phenomena. 2. **Understand** the basics equations of fluid flow phenomena. 3. **Introduce** design of fluid transporting systems. 4. **Provide** the clear understanding of pumps, blowers, compressors and fans. 5. **Introduce** compressible fluid system.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Fluid Mechanics Introduction, concept of continuum, ideal & real fluids, properties of fluids. Fluid statics & its applications: Manometers, pressure measurement devices, gravity decanters & Centrifugal decanters. Introduction to Fluid dynamics, concept of viscosity, classification of fluid streams, stream lines, average velocity, mass velocity, velocity field, velocity gradient etc. Rheology of fluids, Newtonian and Non- Newtonian fluids & Reynolds' experiment.	15%	7
Unit 2: Basic Equations of Fluid Flow	25%	12

Introduction to basic equations of fluid flow, Bernoulli equation and its application. Reynolds number and its significance, Laminar & Turbulent flow, Concept of Boundary layer & thickness of boundary layer, wake & eddy formations, In- compressible flow in pipes & channels, Frictional losses in closed channels and pipe fittings, contraction & expansion losses, power requirement for flow. Friction factor – Hagen Poiseuille equation, friction loss in non-circular conduits, friction factor chart- Moody diagram.		
Unit 3: Metering Devices & Introduction to Compressible Fluids Pipe, pipe- standards, fittings, pipe joints, optimum pipe size, valves, types, constructional features, function, steam traps & control valves, Pressure drop in pipe. The displacement and current meters, variable area meter, Orifice meter, venturimeter, flow nozzles, Rotameter, weirs and notches, Pitot tube, velocity meter - Anemometer, turbine flow meter, current meters, hot wire anemometer, laser doppler anemometry, flow visualization. Study of Fans, Blowers, ejectors, compressors and surging issues. Introduction to compressible flow through pipes and nozzles, isothermal, isentropic & adiabatic flow.	30%	15
Unit 4: Fluidization Conditions for Fluidization, Types of fluidization, Geldart classification of particles. Minimum fluidization velocity, Pressure drop. Particulate and bubbling fluidization. Applications of fluidization. Slurry and pneumatic transport. Flows through packed bed-Ergun equation, terminal velocity.	15%	5
Unit 5: Agitation & Mixing Agitation & Mixing of liquids, Purpose of agitation, Different types of agitators and their selection & criteria impellers, propellers, flow number, power number dimensionless groups, power required calculation for agitation, Scale up of agitated vessel.	15%	6

Instructional Method and Pedagogy: Presentation**,** Videos, Chalk-Duster and Notes

List of Practical	Weightage (%)	Contact hours
1. To measure the pressure between two points by U-tube manometer for variable flow rate.	10	2
2. To measure the pressure between two points by U-tube manometer for variable cross-sectional area.	10	2
3. To find the behaviour of Flow-Laminar and Turbulent and its visualization on Reynolds Apparatus	10	2
4. To validate Bernoulli's Theorem as applied to the flow of water in tapering circular duct.	10	2
5. To calibrate and study Rotameter	10	2
6. To calibrate and study Venturimeter by determining the co-efficient of discharge	10	2
7. To calibrate and study Orificemeter by determining the co-efficient of discharge	10	2
8. To understand working principle of pitot tube and to measure the velocity of flow	10	2
9. To confirm the Head loss predicted by a pipe friction, associated with flow of water through a given pipe	10	2
10. To determine the Coefficient of discharge of rectangular Notch	10	2

Course Outcomes	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: **Understand** the fundamentals of fluid flow phenomena.	Cognitive	Remember
CO2: **Design** of pipeline systems, Centrifugal pump and mixing systems.		Create
CO3: **Knowledge** of metering devices.		Apply
CO4: **Knowledge** of fluidization.		Understand
CO5: **Knowledge** of compressible systems.		Understand

Learning Resources	
1.	**Reference Books:** 1. W. L. Mc Cabe, J. C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, (2006). 2. J. M. Coulson & J. F. Richardson, "Chemical Engineering Vol. I", 6th Edition, Butterworth Heinemann Publications, (2004). 3. G. S. Sawhney, 'Fundamentals of fluid mechanics', 2nd Edition, I. K. International.
2.	**Journals & Periodicals:**
3.	**Other Electronic Resources:**

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	1	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	1	0	0	0	2	1	1	3
CO2	3	3	3	2	1	0	0	0	2	1	1	3
CO3	2	3	3	3	1	0	0	0	2	1	1	3
CO4	2	2	3	3	2	0	0	0	2	1	1	3
CO5	2	2	2	2	2	0	1	1	2	2	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH303	COURSE NAME APPLIED CHEMISTRY	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	2	0	6	4	2	0	5

Course Pre-requisites	**Engineering Chemistry**
Course Category	Professional Core
Course Focus	
Rationale	
Course Revision/ Approval Date:	24-04-2017
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Familiarize** students with little knowledge of nuclear science and its application. 2. **Impart** sound knowledge in the different fields of physical chemistry. 3. **Study** various analytical instruments to understand the characteristics of different materials. 4. **Develop** analytical capabilities of students so that they can characterize, transform and use materials in engineering and apply knowledge gained in solving related engineering problems. 5. **Understand** green chemistry and its importance in the field of chemical aspects.

Course Content (Theory)	Weightage	Contact hours
Unit 1: : Surface chemistry Adsorption (physical and chemical adsorption), Adsorption isotherms (Freundlich and Langmuir adsorption isotherm equations), BET isotherm (qualitative), Application in heterogeneous catalysis. Colloids: Classification of colloids, preparation, purification and properties of colloids, Action of soap, Industrial applications of colloidal systems.	15%	10

Unit 2: Electro Chemistry Introduction, half reaction, electrode potential, Nernst's equation, Electro chemical cell, type of electrodes, Reference electrodes, Faraday's Law of Electolysis, buffer solution, buffer capacity, Handerson-Hesselblatch equation for acidic and basic buffer with numerical.	15%	10
Unit 3 Inorganic Chemistry Common metal properties Radioactivity and Nuclear chemistry: Radioactivity, types of radiations, rate of radioactive decay, nuclear reactions, Fission and Fusion reactions, Nuclear reactors, Nuclear hazards and nuclear waste disposal. Catalysis: Homogeneous Lewis acid- base catalysts, organometallic catalysts and industrially examples. Heterogeneous catalysts basic concepts and industrial examples.	20%	12
Unit 4: Green chemistry Mechanisms and recent advances (green chemistry, catalysis, etc.) of following processes: Alkylation and acylation, e.g. alkylation of benzene, phenols, etc. Halogenation, e.g. chlorination of toluene Nitration and sulfonation, e.g. nitration, sulfonation of benzene, etc. Hydrogenation and reductive alkylations, e.g. hydrogenation of nitrobenzene, reductive alkylation reactions of anilines, etc. Oxidation, e.g. oxidation of xylenes, etc. Polymerization, e.g. polyethylene, polypropylene, polyester and nylon, etc.	30%	20
Unit 5: Analytical chemistry Statistical Aspects, Molecular and atomic spectroscopy method. Thermal & Chromatographic methods.	20%	8

List of Practicals	**Weightage (%)**	**Contact hours**
1. To determine the adsorption isotherm of acetic acid by activated charcoal	10	2
2. Conductometric titration: Strong acid vs Strong base.	10	2
3. Conductometric titration: Strong acid vs weak base.	10	2
4. pH metric titration: Strong acid vs Strong base.	10	2
5. To study about effect of temperature on rate of reaction.	10	2

6. To study about effect of concentration on rate of reaction.	10	2
7. Preparation of para nitro acetanilide from acetanilide	10	2
8. Preparation of para bromo acetanilide from acetanilide.	10	2
9. Preparation of chrome alum.	10	2
10. To study about spectrophotometer.	10	2

Instructional Method and Pedagogy: Presentation**,** Videos, Chalk-Duster and Notes

Course Outcomes	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Understand** the various aspects of physical chemistry	Cognitive	Remember
CO2: **Learning** about electrochemistry		Understand
CO3: **Learn** about nuclear chemistry, nuclear reactor and its application in various power generation field		Understand, apply
CO4: **Understand** about the green chemistry and the importance of it in various fields		Create
CO5: **Learn** the various analytical methods used to determine property and quality of the material		Analyse

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
<tr><td>Theory: Mid semester Marks</td><td>20 marks</td></tr>
<tr><td>Theory: End Semester Marks</td><td>40 marks</td></tr>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
<tr><td>Article Review</td><td>10 marks</td></tr>
<tr><td>Total</td><td>40 Marks</td></tr>
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<tr><td>Practical Marks</td><td>
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<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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Learning Resources	
1.	**Reference Books:** 1. Essential of Physical Chemistry, B.S.Bahl, G.D. Tuli and Arun Bahl, S. Chand and Co. Ltd. 2. Inorganic Chemistry, P. L. Soni, S. Chand & Sons. 3. Instrumental Methods of Analysis by Willard, Merritt and Dean EWP. 4. Principles of Physical Chemistry, B.R.Puri, L.R.Sharma and M.S.Pathnia. 5. Vishal Pub. Co. Instrumental Methods of Analysis, B. K. Sharma.
2.	**Journals & Periodicals:**
3.	**Other Electronic Resources:**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	2	1	1
CO3	3	1	1
CO4	3	2	2
CO5	2	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	1	1	0	0	0	0	0	0	1
CO2	3	3	2	2	1	0	0	1	0	0	0	1
CO3	3	3	2	1	1	2	2	2	0	0	1	1
CO4	2	3	3	2	2	3	2	2	0	0	0	1
CO5	3	3	2	3	3	1	1	0	0	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH304	COURSE NAME PROCESS CALCULATIONS	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	1	4	3	0	1	4

Course Pre-requisites	**None**
Course Category	Professional Core
Course Focus	
Rationale	
Course Revision/ Approval Date:	24-04-2017
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Understand** the Laws of Conservation of Mass and Energy. 2. **Understand** the concept of Stoichiometry, Block Diagrams, Process Flow Diagrams and Piping & Instrumentation Diagrams. 3. **Carryout** material balance of systems like single & multiple step processes, recycle, purge and bypass streams of different industries with or without chemical reactions. 4. **Do** energy balance of different systems with and without chemical reactions. 5. **Apply** the concept of material and energy balances in actual industrial operations.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Dimensions & Units Introduction top process calculation, concept of unit, Fundamental & Derived Dimensional consistency, Different ways of expressing units of quantities & physical constant, Unit conversion & its significance, Introduction to block diagram, PFD and P&ID	20%	7

Unit 2: Material Balance without chemical reaction Calculation of mole, molecular weight, equivalent weight etc., Composition of gaseous mixture, liquid mixture, solid mixture Material balance around equipment: Evaporator, Extractors, Distillation, Absorber, dryer, Mixing etc., Humidification, Use of Psychrometric charts and determination of humidity.	20%	10
Unit 3: Material Balance with chemical reaction & Recycle Operations Concept of limiting and excess reactant, Yield, Conversion, Selectivity etc., Material balance involving reactions with special reference to fertilizers, petrochemicals, combustion etc. Importance of Purge, Bypass and Recycle streams, Calculation based on purge, bypass & recycle stream in process	20%	10
Unit 4: Introduction to Energy Balance First law of thermodynamics and its application, Heat capacity of gases & gaseous mixtures, Heat capacity of liquids and solids, Equation of state	20%	8
Unit 5: Energy Balance Enthalpy changes accompanying chemical reaction: Heat of reaction, Heat of formation, Heat of combustion, Heat of mixing, Dissolution of solids etc. Various examples to calculate heat change with or without phase change. Enthalpy- concentration charts and its application, Adiabatic and non- adiabatic reaction, Theoretical and actual flame temperature.	20%	10

List of Tutorials	Weightage (%)	Contact hours
1. Problems based on units & conversions in MS Excel/Scilab.	12	1
2. Problems based on calculation of mole, composition of mixture in MS Excel/Scilab.	12	1
3. Problems based on material balance without chemical reaction in MS Excel/Scilab.	13	1
4. Problems based on material balance with chemical reaction in MS Excel/Scilab.	13	1
5. Problems based on purge, bypass & recycle stream in MS Ecel/Scilab.	12	1

6. Problems based on first law of thermodynamics and equation of state in MS Excel/Scilab.	12	1
7. Problems based on heat capacity of mixtures in MS Excel/Scilab..	13	1
8. Problems based on enthalpy changes in MS Excel/Scilab.	13	1

Instructional Method and Pedagogy: Presentation**,** Videos, Chalk-Duster and Notes

Course Outcomes	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **To understand** different system of units and dimensions with conversion	Cognitive	Remember
CO2: **Describe** the concepts for expressing compositions and behaviour of different gases and solutions		Understand
CO3: **Sketch** block diagrams of various chemical process and can solve material balance problems		Apply
CO4: Use fundamentals of thermodynamics and can **solve** energy balance problems.		Apply
CO5: Do material balance and examine and **solve** complex problems of industries related.		Evaluate

Learning Resources	
1.	**Reference Books:** 4. Stoichiometry", B.I. Bhatt, S. B. Thakore, McGraw Hill Education, 5th Edition, 2010. J. M. Coulson & J. F. Richardson, "Chemical Engineering Vol. I", 6th Edition, Butterworth Heinemann Publications, (2004). 5. Basic Principles & Calculations in Chemical Engineering", David M. Himmelblau, James B. Riggs, PHI Learing Pvt. Ltd, 7th edition, 2006. 6. Elementary Principles of Chemical Processes", Richard M. Felder, Ronald

	W. Rousseau, Wiley, 3rd Edition, 2004.
2.	**Journals & Periodicals:** Journal of Chemical Education, ACS Publications. Journal of American Chemical Society, ACS Publications.
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	Attendance: 05 marks MCQs: 10 marks Open Book Assignment: 15 marks Article Review: 10 marks **Total: 40 Marks**
Practical Marks	Attendance: 05 marks Practical Exam: 20 marks Viva: 10 marks Journal: 10 marks Discipline: 05 marks **Total: 50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	0	0
CO2	1	0	0
CO3	2	0	0
CO4	1	0	0
CO5	2	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	0	0	2	0	0	0	0	1	0	1
CO2	3	3	2	0	2	0	0	0	0	1	0	1
CO3	3	3	2	0	2	0	0	0	0	1	0	1
CO4	2	3	2	0	2	0	0	0	0	1	0	1
CO5	3	3	2	0	2	0	0	0	0	1	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH305	COURSE NAME MECHANICAL OPERATIONS	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	2	0	6	4	2	0	5

Course Pre-requisites	**Mathematics I & II, Basics of Chemistry**
Course Category	Professional Core
Course Focus	
Rationale	
Course Revision/ Approval Date:	24-04-2017
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. **Familiarize** the student with characterization handling, storage of solids and screening 2. **Familiarize** the student with Principles of size reduction and size reduction equipment's 3. **Familiarize** the student with the methods of separations based on motion of a particle through fluids 4. **Familiarize** the student with filtration operation and industrial filters 5. **Familiarize** the student with the concept of fluidization and its applications

Course Content (Theory)	Weightage	Contact hours
Unit 1: Solid particles and their flow properties Characterization of solid particles and mixed particles (morphology and size distribution), particle size measurement techniques, specific surface of mixture, screen analysis of particles. Properties of masses of particles. Storage, conveyors and elevators Transportation and of solids including Pneumatic transport and hydraulic transport of solids and their safety aspects. Mixers for cohesive solids as well as for free flowing solids.	20%	10

Unit 2: Size reduction & size enlargement of solids Purpose and Principles of comminution, energy and power requirements in comminution, crushing efficiency, laws of comminution: Rittinger's law, Kick's law, Bond crushing law and work index. Types of size reduction equipments, Crushers: jaw crushers, gyratory crushers Grinders: hammer mills and impactors, tumbling mills, action in tumbling mills Ultrafine grinders: fluid energy mills. Cutting machines: knife cutters. Open-circuit and closed-circuit operation Size enlargement: by agglomeration, briquetting, compacting, granulation, tableting, etc.	20%	18
Unit 3: Particle size separation By Screening: screening equipment: stationary screens and grizzlies, gyrating screens, vibrating screens, comparison of ideal and actual screens, blinding of screen, screen efficiency, capacity and effectiveness of screens Numericals on efficiency of screen	20%	8
Unit 4: Separations based on motion of a particle through fluids Terminal settling velocity, settling under Stoke's law regime and Newton's law regime. Gravity settling processes, gravity classifiers, sorting classifiers, sink-and-float methods, differential settling methods, jigging, Wilfly table, elutriation, Cyclones, hydrocyclones, centrifugal decanters and froth flotation. Clarifiers and thickeners, construction and working of lamella clarifier, flocculation, batch sedimentation, rate of sedimentation. Equipment for sedimentation: thickeners. Sedimentation zones in continuous thickeners. Clarifier and thickener design, centrifugal sedimentation, Electrostatic & magnetic separation processes. Solid gas separation and Gas cleaning equipment: Bag filters, electrostatic precipitator, scrubbing & safety aspects of the equipment's.	20%	14
Unit 5: Filtration Types of filtration, principles of cake filtration, constant pressure, constant rate filtration, compressible and in- compressible cakes, filter media resistance and cake resistance, filter media, filter aids, filtration equipment's including belt filter(batch, continuous) and their selection criteria & safety aspects, Washing of filter cakes.	20%	10

List of Practical	Weightage (%)	Contact hours
1. Sieve analysis	12	2
2. Jaw crusher.	12	2
3. Roll crusher	13	2
4. Ball mill / Hammer mill	13	2

5. Settling and Sedimentation	12	2
6. Cyclone separator (Both series and parallel arrangements)	12	2
7. Froth Flotation	13	2
8. Filtration (Vacuum filtration, filter press)	13	2

Instructional Method and Pedagogy: Presentation**,** Videos, Chalk-Duster and Notes

Course Outcomes	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Understanding** of various fundamental operations, Transportation and properties of solid particles	Cognitive	Remember
CO2: **Application** of operations include size reduction, and enlargement.		Apply
CO3: **Design** aspects of screening device and its understanding of its types.		Apply
CO4: **Understanding** of various separation operations and application of it.		Understand
CO5: **Understanding** of filtration operation and application of suitable filtration operation in process.		Apply

Learning Resources	
1.	**Reference Books:** 1. W. L. Mc Cabe, J. C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, (2006). 2. J.M. Coulson & J.F. Richardson 'Chemical Engineering' Vol. - 2, 6th Ed. Elsevier, (2003). 3. G.G. Brown Ed. 'Unit Operations' John Wiley & Sons, (1950).
2.	**Journals & Periodicals:**
3.	**Other Electronic Resources:** NPTEL

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Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	1	2	3

1: Slight (low); 2: Moderate (Medium);
3: Substantial (High); 0 None

Mapping of POs & Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	0	0	0	2	1	1	3
CO2	3	3	3	2	1	0	0	0	2	1	1	3
CO3	2	3	3	3	1	0	0	0	2	1	1	3
CO4	2	2	3	3	2	0	0	0	2	1	1	3
CO5	2	2	2	2	2	0	1	1	2	2	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE AECC311	COURSE NAME ENTREPRENEURSHIP DEVELOPMENT AND INNOVATION	SEMESTER III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	30	2	0	0	2

Course Pre-requisites	Nil
Course Category	**Ability Enhancement Compulsory Course (AECC)**
Course Focus	The course focuses on developing entrepreneurial mindset, innovation, creativity, critical thinking, and startup development skills through experiential and industry-oriented learning. It enables students to identify real-world problems, validate customer needs, design innovative solutions, develop prototypes, and understand business modelling, marketing strategies, financial planning, and venture pitching. The course emphasizes practical learning, teamwork, leadership, and innovation-driven entrepreneurship aligned with emerging industry and startup ecosystem requirements.
Rationale	The course is designed to foster entrepreneurial thinking, innovation, leadership, and problem-solving skills among students through practice-oriented, experiential, application-based learning. It enables learners to identify opportunities, validate customer needs, develop innovative solutions, and understand startup creation, business modelling, financial planning, and venture feasibility. The course also supports employability, self-employment, and startup creation in alignment with NEP 2020 and the innovation ecosystem.
Course Revision/ Approval Date	Approved in BoS Meeting dated 14th May, 2026
Course Objectives (As per Bloom's Taxonomy)	1. To **understand** entrepreneurship, innovation, and opportunity identification processes. 2. To **enable** students to identify and validate real-world problems and customer needs. 3. To **equip** students with skills to develop innovative solutions and prototype-based approaches for venture creation. 4. To **impart** knowledge of business models, marketing strategies, and financial planning for venture

	creation. 5. To **develop** competencies in venture feasibility analysis, teamwork, and effective communication through presentations.

Course Content (Theory)	**Weightage**	**Contact Hours**
Unit No. 1: Entrepreneurial Mindset, Problem Identification and Customer Discovery 1. Introduction to Entrepreneurship, Innovation and Learning Approach 2. Industry Analysis and Opportunity Identification 3. Real-world Problem Identification and Validation 4. Customer Segmentation 5. Jobs-to-be-Done (JTBD) 6. Customer Persona Development 7. Customer Validation and Customer–Problem Fit xplore **Modules 1 and 2** on the Wadhwani Foundation AI-Enabled Portal and complete the Venture Journey.	25%	7
Unit No. 2: Solution Ideation, Opportunity Assessment and Market Analysis 1. Ideation Techniques for Innovative Solutions 2. Generating Innovative Solution Ideas 3. Opportunity Assessment and Competition Mapping 4. Introduction to Startup Financial Planning Explore **Modules 3 and 4** on the Wadhwani Foundation AI-Enabled Portal and complete the Venture Journey.	16%	4
Unit No. 3: Prototype Development, Validation and Opportunity Feasibility Assessment 1. Introduction to Prototype Development and MVP 2. Building an Initial Prototype (PoC) 3. Prototype Testing and Early Validation 4. Opportunity Feasibility and Market Positioni 5. Opportunity Size Estimation and Feasibility Analysis Explore **Modules 5 and 6** on the Wadhwani Foundation AI-Enabled Portal and complete the Venture Journey.	18%	5
Unit No. 4: Business Modelling, Marketing and Sales Strategy 1. Business Models and Revenue Generation 2. Revenue Models and Lean Canvas Components	18%	5

3. Developing a Lean Canvas for a Startup 4. Marketing Fundamentals and Go-to-Market (GTM) Strategy 5. Sales Strategy and Customer Acquisition Explore **Modules 7 and 8** on the Wadhwani Foundation AI-Enabled Portal and complete the Venture Journey.		
Unit No. 5: Financial Planning, Team Building, Venture Growth and Entrepreneurial Pitching 1. Financial Planning for Startup Ventures 2. Path to Profitability and Funding Options 3. Building Entrepreneurial Teams 4. Scaling Ventures and Growth Strategies 5. Startup Ecosystem and Government Support 6. Entrepreneurial Storytelling and Pitch Preparation Explore **Modules 9, 10 and 11** on the Wadhwani Foundation AI-Enabled Portal and complete the Venture Journey.	23%	9
Total	**100%**	**30**

Instructional Method and Pedagogy	The course will employ a combination of instructional methods, including lectures, case studies, group discussions, role plays, games, quizzes, presentations, hackathons, field visits, startup interviews as experiential learning activities, and venture creation activities to enhance entrepreneurial thinking, innovation, and practical problem-solving skills among students.
Course Outcomes	**CO1: Analyze** industry trends and entrepreneurial opportunities. **CO2: Identify and validate** customer segments, needs, and problem–solution fit using appropriate tools and techniques. **CO3: Develop** innovative solutions and prototypes. **CO4: Apply** business models, marketing strategies, and financial planning for venture creation **CO5: Evaluate** venture feasibility using data-driven pitch presentations
Assessment & Evaluation (100 Marks):	1. Mid-Sem Exam: 20 marks 2. End-Sem Exam: 40 marks 3. Continuous Evaluation: 40 marks o Conceptual and Application-Based Quizzes: 10 marks o Rubric-Based Venture Pitch Evaluation (Viva): 25 marks o Participation and Entrepreneurial Engagement: 5 marks

Learning Resources:	
1	**Textbook:** 1. Entrepreneurship; Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha; McGraw Hill Education. 2. Entrepreneurial Development; S. S. Khanka; S. Chand Publications. 3. The Lean Startup; Eric Ries; Crown Business. 4. Business Model Generation; Alexander Osterwalder and Yves Pigneur; Wiley Publications. 5. Entrepreneurship: Successfully Launching New Ventures; Bruce R. Barringer and R. Duane; Pearson Education.
2	**Reference Book:** 1. Entrepreneurship: Theory, Process and Practice; Donald F Kuratko; Cengage Learning. 2. Innovation and Entrepreneurship; Peter F. Drucker; Harper Business. 3. The Startup Owner's Manual; Steve Blank and Bob Dorf; Gildan Media (Publisher) 4. Managing Innovation; Tidd, J. & Bessant, J.; Wiley Publications. 5. Technology Ventures, Thomas H. Byers, Richard C. Dorf and Andrew J. Nelson; McGraw Hill.
3	**Journals & Periodicals:** 1. Journal of Entrepreneurship – SAGE Publications 2. Entrepreneurship Theory and Practice – Wiley Publications 3. International Journal of Innovation Management – World Scientific Publishing 4. Harvard Business Review – Harvard Business Publishing 5. Journal of Small Business Management – Wiley Publications 6. Technovation – Elsevier Publications 7. Journal of Business Venturing – Elsevier Publications 8. International Entrepreneurship and Management Journal – Springer Publications 9. Small Business Economics – Springer Publications 10. Indian Management – All India Management Association (AIMA)
4	**Electronics Resources:** 1. Wadhwani Foundation Entrepreneurship Learning Portal: https://web.nen.wfglobal.org/en/all-program 2. Startup India Portal – https://www.startupindia.gov.in 3. MSME Ministry Portal – https://msme.gov.in 4. Invest India – https://www.investindia.gov.in 5. NPTEL and SWAYAM Online Courses on Entrepreneurship and Innovation

	6. Y Combinator Startup Library – https://www.ycombinator.com/library 7. Google for Startups – https://startup.google.com 8. https://www.guiitarstartupcouncil.org

Mapping of PSOs & Cos

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1					
CO2					
CO3					
CO4					
CO5					
AVG.					

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
AVG.												

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH401	COURSE NAME CHEMICAL ENGINEERING THERMODYNAMICS-I	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	1	4	3	0	1	4

Course Pre-requisites	Basics of Science, Process Calculations
Course Category	Core
Course focus	Employability
Rationale	International relevance
Course Revision/ Approval Date:	14/5/2026
Course Objectives **(As per Blooms' Taxonomy)**	1. Provide students with a strong foundation in thermodynamic concepts, properties, and laws relevant to chemical engineering systems. 2. Enable students to apply the first law of thermodynamics to analyze closed and open systems involving energy interactions. 3. Develop the ability to analyze phase behavior and thermodynamic properties using equations of state and property data. 4. Equip students to evaluate energy transformation processes such as refrigeration and liquefaction cycles. 5. Prepare students to perform and interpret energy balance calculations for chemical engineering operations and processes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction of Thermodynamics & Basic Concept Scope & limitation of thermodynamics, Definitions and fundamental concepts, Equilibrium state and phase rule, Temperature and zeroth law of thermodynamics, Heat reservoir and heat engine, Reversible and irreversible processes.	**20%**	**7**
Unit 2: First Law of Thermodynamics The first law of thermodynamics, First Law of Thermodynamics for Cyclic Process, Internal Energy, First Law of Thermodynamics for Non-flow Process, Enthalpy, First Law of Thermodynamics for Flow Process, Heat capacity.	**20%**	**8**

Unit 3: PVT Behavior and Heat Effect Process involving ideal gas, Equations for state of real gas, Compressibility chart, Standard heat of reaction, Standard heat of formation, Standard heat of combustion	**20%**	**10**
Unit 4: Second Law of Thermodynamics Limitations of the first law of thermodynamics, General statement of second law of thermodynamics, Entropy, Carnot principle, Mathematical statement of second law of thermodynamics, Third law of thermodynamics.	**20%**	**10**
Unit 5: Applications of the Laws of Thermodynamics Fundamental equations and relationships, flow in pipes, Flow through Nozzles, Ejectors, Throttling process, Compressors. Refrigeration: Coefficient of performance, Carnot refrigerator, Vapour compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pumps. Power Generation Cycles: The Steam-Power Plant: Rankine cycle, reheat cycle, regenerative cycle, Internal combustion engines: Otto cycle, Diesel cycle, Gas-turbine Power Plant: Brayton Cycle	**20%**	**10**

List Of Tutorial	**Weightage**	**Contact hours**
Unit 1: **1.** Problems based on work, pressure & energy in MS Excel/Scilab. **2.** Problems based on reversible & irreversible processes in MS Excel/Scilab.	**20%**	**4**
Unit 2: **3.** Problems based on the first law of thermodynamics on no flow processes in MS Excel/Scilab. **4.** Problems based on the first law of thermodynamics on flow processes in MS Excel/Scilab	**20%**	**4**
Unit 3: **5.** Problems based on processes involving ideal gases in MS Excel/Scilab. **6.** Problems based on equations of state for real gas in MS Excel/Scilab. **7.** Problems based on heat effects accompanying chemical reactions in MS Excel/Scilab.	**20%**	**6**
Unit 4: **8.** Problems based on Entropy in MSExcel/Scilab. **9.** Problems based on the second law of thermodynamics in MS Excel/Scilab	**20%**	**4**
Unit 5: **10.** Problems based on refrigeration in MS Excel/Scilab.	**20%**	**2**

Instructional Method and Pedagogy: Chalk-board, Power point presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Apply** fundamental laws of thermodynamics to determine thermodynamic properties and energy interactions in closed and open systems**.** CO2: **Analyze** phase behavior and thermodynamic property data using equations of state and property relations. CO3: **Analyze** energy transformation processes to solve numerical problems related to work, heat, and efficiency. CO4: **Evaluate** refrigeration and liquefaction cycles based on performance parameters such as COP and efficiency. CO5: **Apply** energy balance principles to analyze chemical engineering operations and processes.	Cognitive	Apply Analyze Analyze Evaluate Apply

Learning Resources	
1.	Reference Books: Y. V. C. Rao, Chemical Engineering Thermodynamics, Universities Press (1997). B. G. Kyle 'Chemical Process Thermodynamics 3rd Ed., Prentice Hall India, (1994).
2.	Journals & Periodicals: The Journal of Chemical Thermodynamics, Elsevier Journal of Chemical Education, ACS Publications
3.	Other Electronic Resources: Chemical Engineering Thermodynamics, NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	3	0
CO2	3	2	0
CO3	3	2	0
CO4	3	2	0
CO5	3	2	0
Avg.	3	2.2	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	0	0	0	0	1	0	0	1
CO2	3	3	2	1	1	0	0	0	1	0	0	1
CO3	3	3	2	2	1	0	0	0	1	0	0	1
CO4	3	3	2	1	0	0	0	0	1	0	0	1
CO5	3	3	2	2	1	0	0	0	1	0	0	1
Avg.	3	3	1.8	1.4	0.6	0	0	0	1	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH402	COURSE NAME HEAT TRANSFER OPERATIONS	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	1	5	3	2	1	5

Course Pre-requisites	Basics of Thermodynamics
Course Category	Core
Course focus	Employability
Rationale	international relevance
Course Revision/ Approval Date:	14/5/2026
Course Objectives **(As per Blooms' Taxonomy)**	1. To explain and interpret heat transfer mechanisms governing industrial chemical processes with reference to energy efficiency and safety considerations. 2. To analyze and compare the performance of various heat exchangers and thermal equipment used in chemical and allied process industries. 3. To apply fundamental heat transfer principles for quantitative analysis of conduction, convection, radiation, and phase-change operations. 4. To evaluate engineering problems involving thermal systems using appropriate heat transfer correlations, dimensionless numbers, and empirical models. 5. To develop problem-solving competence for selection and preliminary design of heat transfer equipment under practical industrial constraints.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Heat Transfer Fundamentals Modes of heat transfer; General laws of heat transfer Heat transfer by Conduction: Fourier's law, One dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient, heat transfer from extended surfaces, two and three dimensional problems, various types of thermal insulations, Unsteady state heat conduction	**25%**	**15**

Unit 2: Heat transfer by Convection Theory: Fundamentals of convection - Newton's law of cooling, External & Internal Forced convection, Natural convection – physical mechanism, grashoff number and Rayleigh number, over surfaces, combined forced and free convection dimensional analysis, dimensionless numbers. Heat Transfer with phase change and its design aspects: Basics of Heat transfer with phase change – mechanism of pool & flow boiling, drop wise and film condensation in horizontal tubes, Nusselt's approach and its extension.	**25%**	**15**
Unit 3: Heat transfer by Radiation Thermal radiation, Blackbody Radiation, Radiative Properties, View Factor	**15%**	**9**
Unit 4: Heat Exchangers Types of heat exchangers, Analysis of heat exchangers, LMTD & NTU effectiveness method. Selection of heat exchangers.	**17%**	**10**
Unit 5: Evaporation Types, classification, selection. Single effect and multiple effect evaporators, evaporator calculations. Energy conservation in evaporation. Vacuum evaporation	**18%**	**11**

List Of Practical	Weightage	Contact hours
Unit 1: **1.** Thermal conductivity of metal bar **2.** Thermal conductivity of composite wall	**20%**	**4**
Unit 2: **3.** Heat transfer in natural convection. **4.** Heat transfer in forced convection – laminar flow **5.** Heat transfer in forced convection – turbulent flow. **6.** Heat transfer in an agitated vessel	**40%**	**8**
Unit 3: **7.** Emissivity measurement apparatus. **8.** Stefan-Boltzmann apparatus..	**20%**	**4**
Unit 4: **9.** Shell and Tube heat exchanger. **10.** Finned tube heat exchanger.	**20%**	**4**

List Of Practical Tutorial	Weightage	Contact hours
Unit 1: **1.** Problems related to 1D,2D & 3D heat conduction equation through plane, cylinders & spheres. **2.** Problems related to composite walls, cylinders & spheres. **3.** Problems related to critical radius of insulation for cylinder & sphere. **4.** Problems related to fins. **5.** Problems related to unsteady state heat conduction.	**20%**	**3**
Unit 2: **6.** Problems related to convection **7.** Problems related to internal forced convection **8.** Problems related to external forced convection **9.** Problems related to natural convection **10.** Problems related to phase change, boiling & condensation.	**20%**	**4**
Unit 3: **11.** Problems related to thermal radiation & Blackbody. **12.** Problems related to radiative properties & view factor.	**20%**	**2**
Unit 4: **13.** Problems related to LMTD **14.** Problems related to NTU effectiveness method.	**20%**	**2**
Unit 5: **15.** Problems related to single effect evaporators **16.** Problems related to multiple effect evaporators **17.** problems related to evaporator calculation and energy conservations	**20%**	**4**

Instructional Method and Pedagogy: Chalk-board, Power point presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1. **Analyze** steady-state and transient heat conduction problems in plane walls, cylinders, and spheres using analytical and graphical methods. CO2: **Evaluate** convective heat transfer phenomena in forced and natural convection systems using appropriate dimensionless correlations**.**	Cognitive	Analyze Evaluate

CO3: **Analyze** and predict heat transfer coefficients for conduction, convection, radiation, and phase-change processes under industrial operating conditions**.** CO4: **Assess** and select suitable heat transfer equipment (heat exchangers and evaporators) based on process requirements and performance criteria. CO5: **Formulate** and solve engineering problems related to thermal systems, incorporating energy balance, efficiency, and sustainability considerations.		Analyze Assess Formulate

Learning Resources	
1.	Reference Books: 1. S. B. Thakore and B. I. Bhatt, Introduction to Process Engineering and Design, McGraw Hill Publication House, 2nd Edition. 2. Y.V.C. Rao, HeatTransfer, 2nd Edition. 3. J. M. Coulson & J. F. Richardson, Chemical Engineering, Vol.1, 6 th Edition, Elsevier. 4. Yunus .A.Cengel, heat transfer – a practical approach, second edition
2.	Journals & Periodicals: 1. International Journal of Heat and MassTransfer, 2. Experimental Thermal and Fluid Science, Heat and Mass Transfer Research Journal CanSR
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Practical Marks	

Attendance	05 marks
Practical Exam	20 marks
Viva	10 marks
Journal	10 marks
Discipline	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	2	0
CO3	2	2	0
CO4	2	1	0
CO5	2	1	0
Avg.	2	.4	0.2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	0	1	1	1	1	0	1	1
CO2	2	1	1	1	0	1	1	1	0	0	0	1
CO3	1	2	3	1	1	1	1	1	1	0	1	1
CO4	1	0	1	0	0	1	1	1	0	0	0	0
CO5	1	0	1	0	0	1	1	1	0	0	0	0
Avg.	1.4	1	1.6	0.6	0.2	1	1	1	0.4	0	0.4	0.6

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Chemical Engineering Course Curriculum Academic Year 2026-27

COURSE CODE BTCH403	COURSE NAME PROCESS TECHNOLOGY	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	2	0	6	4	2	0	5

Course Pre-requisites	Process Technology
Course Category	Core
Course focus	Employability
Rationale	International relevance
Course Revision/ Approval Date:	14/5/2026
Course Objectives (As per Blooms' Taxonomy)	1. Provide students with a comprehensive understanding of major chemical process industries and their role in industrial production. 2. Enable students to analyze manufacturing processes used in chemical industries with respect to raw materials, reactions, and operating conditions. 3. Develop the ability to interpret process flow diagrams and identify the function of major process equipment. 4. Instill the ability to evaluate safety, health, and environmental considerations in chemical process industries. 5. Expose students to recent developments and technological advancements in chemical process industries.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Industrial Acids & Chlor-Alkali Industry **Industrial Acids:** Hydrochloric Acid manufacture by synthesis process, Sulfuric Acid & Oleum manufacturing processes, technologies, engineering problems, energy recovery, material construction piping & storage, DCDA process. Phosphoric Acid production processes/technologies by wet & Electric furnace, advantages & disadvantages, Nitric Acid engineering problems involved. Material of construction of piping etc. **Chlor-alkali Industry:** Manufacturing process of Caustic soda, Chlorine and engineering and design problems involved. Sodium Carbonate (Soda Ash): Manufacturing process/ technologies for sodium carbonate production, engineering problems limitations etc	**25%**	**12**

Unit 2: Industrial Gases, Cement and Soap Industries **Industrial gases:** Properties and uses of Hydrogen, Steam reforming, Green Hydrogen Concept, Manufacturing and challenges. Oxygen, nitrogen, Carbon dioxide, carbon monoxide and rare gases. **Cement Industries:** Introduction to cement industries, Types of cement, manufacture by wet process & dry process, engineering problems. **Soap Industries:** Types of soaps, Soap manufacture, recovery and purification	**20%**	**13**
Unit 3: Paper, Pulp, Fermentation **Paper & Pulp Industry:** Pulping techniques, Kraft process, black liquor recovery & major challenges in production via various methods. **Fermentation Industry:** Introduction to sugar manufacture and manufacture of Alcohol/ Ethanol & Methanol	**20%**	**10**
Unit 4: Paint & Dye Industry **Paint Industry:** Types of paint, constituents & its properties, PVC of paint manufacture of paints. **Dye industry:** Classification of Dyes, Dye intermediates, manufacturing	**10%**	**5**
Unit 5: Fertilizer Industry Introduction to plant nutrients, micro-macro nutrients, types of fertilizers **Nitrogen Fertilizers:** Ammonia, Urea, ammonium sulphate production, manufacture & storage, handling and uses ; Snamprogetti process for Urea production **Phosphatic fertilizers:** Raw materials, ground phosphate rock, single super phosphate, triple super phosphate, methods of production, characteristics and specifications. **Potassium fertilizers:** Potassium Chloride, Potassium nitrate, Potassium sulphate, production, manufacture & storage, handling and uses. **Miscellaneous Fertilizer and Bio Fertilizers:** Manufacturing of NPK, Ammonium Sulphate Phosphate (ASP), Calcium Ammonium Nitrate (CAN). Types of Bio fertilizers, Nitrogen-fixing bio fertilizers, bio fertilizers, Preparation of a bio fertilizers. Environmental & Energy factors affecting the industry .solid, liquid and gases waste released form the industry.	**25%**	**15**

List Of Practical	Weightage	Contact hours
Unit 1: **1.** Nitration of salicylic acid by conventional method. **2.** Green synthesis of 5-nitrosalicylic acid.	**20%**	**2**
Unit 2: **3.** To determine the loss of igniting the cement sample. **4.** Preparation of soap by hot method **5.** Preparation of soap by cold method	**25%**	**4**
Unit 4: **6.** To determine Chemical Oxygen Demand (COD) of given effluent sample. **7.** Preparation of azo dye. **8.** Preparation of Indigo dye. **9.** Preparation of urea formaldehyde resin	**30%**	**8**
Unit 5: **10.** To determine the amount of potassium in the given sample of fertilizer.	**25%**	**2**

Instructional Method and Pedagogy: Chalk-board, Power point presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Analyze the structure and operation of major chemical process industries based on raw materials, reactions, and products.		Analyze
CO2: Apply knowledge of manufacturing processes to explain process steps and operating conditions used in chemical industries**.**		Apply
CO3: Interpret process flow diagrams and evaluate the role of process equipment used in chemical plants**.**		Interpret
CO4: Evaluate safety, health, and environmental issues associated with chemical process industries and suggest basic preventive measures.		Evaluate
CO5: Assess recent technological trends and innovations in chemical process industries with respect to sustainability and efficiency.		Assess

Learning Resources	
1.	Reference Books: 1. Shukla S. D. and G. N. Pandey, a Text Book of Chemical Technology, Vikas Publishing House, 1986. 2. Kirk and Othmer, 'Encyclopedia of Chemical Technology', 5th Ed, 24 volumes, (2006) 3. P.H. Groggins Unit Operations in Organic Sysnthesis. Mcgrow-Hill Edition.1938.
2.	Journals & Periodicals:
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks	20 marks	
Theory: End Semester Marks	40 marks	
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	0	0
CO2	2	2	0
CO3	2	1	0
CO4	2	2	0
CO5	2	1	0
Avg.	2	1.2	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	0	0	0	1	1	1	1	1	0	1
CO2	2	3	2	0	1	1	1	0	0	0	1	1
CO3	1	1	2	1	1	0	0	1	1	0	0	0
CO4	1	3	2	3	1	1	1	1	0	0	1	1
CO5	1	2	1	0	0	1	1	0	0	0	0	0
Avg.	1.4	2	1.4	0.8	0.6	0.8	0.8	0.6	0.4	0.2	0.4	0.6

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH404	COURSE NAME NUMERICAL METHODS IN CHEMICAL ENGINEERING	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	4	2	2	0	3

Course Pre-requisites	Chemical Process Calculations, Mathematics-I, II
Course Category	Core
Course focus	Employability
Rationale	International relevance
Course Revision/ Approval Date:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	1. To prepare students to apply and analyze numerical methods for solving algebraic and transcendental engineering equations. 2. To enable students to formulate and solve systems of linear equations and interpolation problems using numerical techniques. 3. To prepare students to implement interpolation algorithms using MATLAB for engineering data approximation. 4. To develop competence in evaluating and interpreting numerical differentiation and integration methods for engineering applications. 5. To equip students to design and implement numerical algorithms for solving ordinary differential equations in engineering models.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Numerical solutions to algebraic equations Mathematical Modelling and Chemical Engineering Problem Solving, Conservation Laws, Taylor Series and error propagation, Bracketing Methods – Graphical methods, bisection method and false position method, Open methods – Fixed Point iteration, Newton Raphson, Secant method, Linear Algebraic Equations Gauss Elimination, LU Decomposition Gauss Siedel.	**30%**	**13**
Unit 2: Numerical approximations and data maneuvering Curve Fitting – Linear Regression, Multiple Linear Regression, Polynomial Regression, Non-linear regression, Interpolation, Spline interpolation, Fourier series, numerical integration and differentiation – trapezoidal rule, Simpson's rules.	**20%**	**10**

Unit 3: Numerical solutions to ordinary differential equations Ordinary differential equations – Euler Method, Runge Kutta – 1,2,3,4 Methods, Adaptive RK Methods, Stiffness, Boundary value and Eigen Value problems, chemical engineering problems: case studies.	**25%**	**10**
Unit 4: Numerical solutions to partial differential equations Partial differential equations – Finite difference: elliptic equations, parabolic equations, Finite element method – general approach, finite element in one dimension, two dimensional problems, chemical engineering problems: case studies	**25%**	**12**

List Of Practical	Weightage	Contact hours
Unit 1: . **1.** Matlab Introduction and Programs of Bisection, False position, Newton Raphson Method, Secant Method	**20%**	**4**
Unit 2: **2.** Matrices in Matlab and Solution of System of linear equations in Matlab, Eigen Value and eigen vectors using Matlab. **3.** Programs of Difference Table, newtons forward and Backward Interpolations.	**20%**	**4**
Unit 3: **4.** Matlab Programs of Newton's divided difference interpolation	**20%**	**4**
Unit 4: **5.** Matlab Programing of Lagrange's Interpolation, Trapezoidal rule, Simpson's one third and 3/8th rule. **6.** Curve plot and Graphs in Matlab	**20%**	**4**
Unit 5: **7.** Curve fitting in Matlab	**20%**	**4**

Instructional Method and Pedagogy: Chalk-board, Power point presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
On completion of the course, students will be able to:		
CO1: Analyze and select appropriate numerical methods to solve nonlinear algebraic and transcendental equations with justified accuracy.	Cognitive	Analyze
CO2: Apply numerical methods to obtain approximate solutions to solve system of linear equations problems.		Apply
CO3: Apply appropriate interpolation methods and evaluate the accuracy of predicted data values for engineering problems.		Apply
CO4: Evaluate numerical differentiation and integration techniques for engineering applications and interpret computational results		Evaluate
CO5: Develop and implement numerical solutions of ordinary differential equations for modeling engineering processes.		Develop

Learning Resources	
1.	Reference Books: 1. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, 8th edition, McGraw-Hill Education, 2021. 2. Victor J. Law, Numerical Methods for Chemical Engineers Using Excel, VBA, and MATLAB, 1st edition, CRC Press, 2013. 3. Abdelwahab Kharab and Ronald B. Guenther, An Introduction to Numerical Methods: A MATLABORATORY Approach, 5 th edition, Chapman and Hall/CRC, 2023. 4. Amos Gilat, Numerical Methods for Engineers and Scientists: An Introduction with Applications Using MATLAB, 1st edition, John Wiley & Sons, 2007. 5. Michael R. King and Nipa A. Mody, Numerical and Statistical Methods for Bioengineering: Applications in MATLAB, 1st edition, Cambridge University Press, 2010.
2.	Journals & Periodicals:
3.	Other Electronic Resources:

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

COURSE CODE BTCH405	COURSE NAME MATERIAL SCIENCE & ENGINEERING	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	Basics of Science
Course Category	Core
Course focus	Employability
Rationale	international relevance
Course Revision/ Approval Date:	14/5/2026
Course Objectives **(Asper Blooms' Taxonomy)**	1. To correlate material structure at different scales with mechanical and physical properties. 2. To analyze mechanical behavior of metals and alloys using phase diagrams and testing methods. 3. To evaluate performance of ferrous and non-ferrous alloys under service conditions. 4. To apply corrosion control, NDT techniques, and material selection tools. 5. To justify selection of polymers, ceramics, and composites based on performance and sustainability.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Engineering materials Classification of Engineering materials Introduction to levels of internal structure like macro, micro, crystal and atomic and correlated properties, Characterization Methods/Tools to reveal the different level of structure.	**20%**	**10**
Unit 2: Mechanical Properties, Phase Equilibria and Characterization of Engineering Materials Steady & Non steady diffusions, Stress-Strain, Elastic and plastic deformations, Slip systems, strengthening, mechanisms, Phases, microstructure, phase equilibria, Fe-Fe3C phase diagram. Reaction of iron carbon system Mechanical behaviour of Fe-C alloys and alloys. Mechanical testing and standards: testing methods, tensile, impact, hardness, fracture, toughness & fatigue. NDT examination – Ultrasonic, magnetic particle, Dye penetration inspection & Radiography	**20%**	**15**

Unit 3: Engineering Alloys and Their Industrial Applications Introduction of alloys and their importance in industry. Properties of Ferrous & Non Ferrous alloys, Uses of various grades of stainless steels are to be explained from corrosion point of view, high temperature	**20%**	**6**
Unit 4: Corrosion Control and Materials Selection in Engineering Design Corrosion, control & mitigation of metals & alloys. Material selection and design consideration, materials and industrial design, material property charts, material selection, strategy and procedure requirements, etc.	**20%**	**6**
Unit 5: Advanced Engineering Materials: Polymers, Composites and Ceramics Introduction to Composite and Ceramic material, Molecular weight, Molecular configurations of polymers, Mechanisms of deformation and strengthening in polymers, glass transition economic, environmental and societal issues related to engineering materials; case studies related to few engineering products/equipment	**20%**	**8**

Instructional Method and Pedagogy: Chalk-board, Power point presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Analyze the relationship between structure, properties, and applications of engineering materials.		Analyze
CO2: Compare and **evaluate** metals, ceramics, polymers, and composite materials for engineering applications.		Evaluate
CO3: Analyze mechanical behavior of materials using phase diagrams, diffusion concepts, and testing data.		Analyze
CO4: Assess and apply appropriate materials and emerging developments for specific engineering applications.		Apply
CO5: Apply engineering principles to material selection considering performance, sustainability, and societal impact.		Apply

Learning Resources

1.	**Reference Books:** 1. Materials Science and Engineering, by William Smith, Javed Hashmi and Ravi Prakash. McGraw Hill Education, (2013). 2. V. Raghavan, "Material Science and Engineering – A First Course by. Prentice Hall of India, (2004). 3. UHLIG'S corrosion handbook, 3rd edition, John Wiley & SonsInc. Mechanical Metallurgy by George E Dieter. McGraw Hill Education, (1986). 4. A K Bhargava and C P Sharma, "Mechanical Behaviour and Testing of Materials". Prentice Hall of India, (2011)

2.	Journals & Periodicals:
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	1	1	1
CO3	2	2	1
CO4	3	3	1
CO5	3	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	0	1	3	1	3	1	0	0	0	1
CO2	1	2	2	1	0	0	0	0	0	0	0	0
CO3	3	3	1	3	3	3	3	0	1	1	2	1
CO4	2	2	1	3	3	2	2	1	0	1	2	0
CO5	2	1	2	1	0	3	1	0	0	0	0	1
Avg.	1.8	2.2	1.2	1.8	1.8	1.8	1.8	0.4	0.2	0.4	0.8	0.6

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH408	COURSE NAME INDUSTRIAL POLLUTION CONTROL	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	Basics of Science
Course Category	Core
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/5/2026
Course Objectives **(Asper Blooms' Taxonomy)**	1. Enable students to analyze sources, types, and impacts of industrial pollution on air, water, and land. 2. Develop the ability to evaluate air pollution control technologies used in chemical industries. 3. Equip students to analyze and design wastewater treatment systems based on effluent characteristics. 4. Enable students to assess solid and hazardous waste management practices for industrial applications. 5. Instill the ability to apply pollution abatement and sustainable practices in chemical engineering fields.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction Introduction Types of emissions from Chemical industries and Effects of environment, Type of pollution and their sources, Effluent guidelines and standards, Importance of industrial pollution abatement, Concept of sustainable development, Greenhouse gases, Global warming and climate change	**10%**	**2**
Unit 2: Environment regulatory legislations Introduction to the water (Pollution and control of pollution) Act, 1974, The air (Pollution and control of pollution) Act, 1981, The environmental (Protection) Act, 1986	**10%**	**1**
Unit 3: Water Pollution and abatement Techniques Sources and characteristics water pollution, Effects of water pollution, control & prevention methods – Primary, secondary & tertiary , The Water (Prevention and Control of Pollution) Act, 1974 and limits. Measurement of Water Quality.	**30%**	**12**

Unit 4: Air Pollution and control Air pollutants, Preventive and Controlling mechanism of Air Pollutants. Introduction and application of Gravity settler, cyclone separator, Electrostatic Precipitator, Scrubber	**25%**	**8**
Unit 5: Solid Waste Management Analysis and quantification of hazardous and non-hazardous wastes, Treatment and disposal of solid wastes (Bio-medical Waste, Industrial Solid Waste: Dyes & Pigment, Pharmacy, Glass & Ceramics, Rubber, Polymer, Nuclear Power Plant, Energy Industries etc.)	**25%**	**7**

Instructional Method and Pedagogy: Chalk-board, Power point presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Analyze industrial activities to identify sources and impacts of environmental pollution**.**		Analyze
CO2: Evaluate and select air pollution control devices based on pollutant characteristics and operating conditions.		Evaluate
CO3: Apply pollution control strategies to minimize emissions and effluents from industrial processes**.**		Apply
CO4: Analyze and design suitable wastewater treatment techniques to meet regulatory standards**.**		Analyze
CO5: Evaluate solid and hazardous waste characteristics to recommend appropriate handling and management methods.		Evaluate

Learning Resources	
1.	Reference Books: 1. Masters, G.M., Introduction to Environmental Engineering and Science, Prentice Hall off India, (2008). 2. De Nevers, N., Air Pollution Control Engineering, McGraw-Hill (2000). 3. J.R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", V Edn. John Wiley, New York, 2007.
2.	Journals & Periodicals: Journal of Industrial Pollution Control
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	0	0
CO2	2	1	1
CO3	2	2	2
CO4	3	3	1
CO5	3	3	1
Avg.	2.4	1.8	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	0	1	0	1	3	3	2	3	0	1
CO2	1	1	2	0	0	1	2	2	3	3	0	1
CO3	3	2	1	0	2	1	1	2	3	3	2	3
CO4	3	3	3	2	1	3	2	3	3	3	3	2
CO5	3	3	3	2	1	3	2	3	3	3	3	2
Avg.	2.4	2.2	1.8	1	0.8	1.8	2	2.6	2.8	3	1.6	1.8

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE AECC401	COURSE NAME ENVIRONMENTAL STUDIES	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Tot al Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	-	3

Course Pre-requisites	Nil
Course Category	AECC
Course focus	Environmental science, sustainability, ecological balance, environmental pollution, biodiversity conservation, climate change, and sustainable development.
Rationale	This course introduces learners to the fundamental concepts of environmental science, sustainability, ecological balance, environmental pollution, biodiversity conservation, climate change, and sustainable development. The course aims to develop environmental awareness, ethical responsibility, and problem-solving abilities among students from multidisciplinary backgrounds in alignment with NEP 2020 and Sustainable Development Goals (SDGs).
Course Revision/ Approval Date:	14/5/2026
Course Objectives **(As per Blooms' Taxonomy)**	1. **Develop** understanding of environmental systems, ecosystems and biodiversity. 2. **Explain** environmental pollution, climate change and natural resource management issues. 3. **Analyze** environmental challenges using scientific, technological and societal perspectives. 4. **Promote** environmental ethics, sustainability practices and responsible citizenship. 5. **Apply** sustainable solutions for environmental conservation and societal well-being.

Course Content (Theory)	**Weightage**	**Contact hours**
UNIT I: Fundamentals of Environmental Studies and Ecosystems- Definition, scope, and importance of environmental studies,Components of environment: atmosphere, hydrosphere, lithosphere, biosphere, Ecosystem structure and functions, Food chain, food web, ecological pyramids. Energy flow in ecosystems, Biogeochemical cycles, Ecological	25%	6

succession		

UNIT II: Natural Resources and Biodiversity Conservation - Renewable and non-renewable resources,Water resources, forest resources, mineral resources, energy resources, Biodiversity: types and importance, Threats to biodiversity, In-situ and ex-situ conservation, Environmental ethics and sustainable lifestyles	25%	6
UNIT III: Environmental Pollution and Waste Management Air pollution, water pollution, soil pollution, noise pollution,Sources, effects, and control measures, Solid waste management, E-waste and biomedical waste, Industrial pollution, Environmental health hazards	25%	6
UNIT IV: Climate Change, Sustainability, and Environmental Management – Global warming and climate change,Greenhouse gases and carbon footprint,Ozone layer depletion,Sustainable development goals (SDGs),Environmental Impact Assessment (EIA),Disaster management and environmental risk, Green technologies and circular economy	25%	6
UNIT V: Environmental Policies, Ethics, and Community Participation – Environmental protection acts and policies,National and international environmental movements,.Environmental ethics and social responsibility,Public awareness and environmental education,Role of individuals, industries, NGOs, and government,Community participation and green campus initiatives	25%	6

Instructional Method and Pedagogy:

1. Experiential learning
2. Field-based learning
3. Case study analysis
4. Problem-based learning
5. Group discussion and collaborative learning
6. ICT-enabled teaching,Environmental audit activities,Community engagement,

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		

CO1: **Explain** ecosystem structure, biodiversity and environmental components. CO2: **Identify** causes and impacts of environmental pollution and climate change. CO3: **Analyze** environmental problems and propose sustainable mitigation strategies. CO4: **Apply** principles of environmental conservation, waste management and sustainability in real-life situations. CO5: **Demonstrate** environmental ethics, social responsibility and participatory approaches toward sustainable development.	Cognitive	Explain Understand Analyze Analyze Analyze

Sr. No.	Type	Complete Reference
1	Core Textbook	Environmental Studies for Undergraduate Courses. Bharucha, E. (2005). *Environmental Studies for Undergraduate Courses of All Branches of Higher Education*. Universities Press (India) Pvt. Ltd., Hyderabad, in association with University Grants Commission. ISBN: 9788173715402.
2	Recommended Textbook	Textbook of Environmental Studies for Undergraduate Courses. Bharucha, E. (2023/2024 Edition). *Textbook of Environmental Studies for Undergraduate Courses: As per UGC Guidelines and NEP 2020*. Oxford University Press, New Delhi.
3	Recommended Textbook	Textbook of Environmental Education for Undergraduates. *Textbook of Environmental Education for Undergraduates: In Line with NEP 2020 and UGC Guidelines and Curriculum Framework for Environmental Education at Undergraduate Level (June 2023)*. Atlantic Publishers & Distributors Pvt. Ltd., New Delhi, 2025. ISBN: 9788126939169.
4	Reference Book	Environmental Science. Miller, G. T., & Spoolman, S. (2019). *Environmental Science* (16th Edition). Cengage Learning, Boston. ISBN: 9781337562072.
5	Reference Book	Principles of Environmental Science. Cunningham, W. P., & Cunningham, M. A. (2021). *Principles of Environmental Science: Inquiry and Applications* (9th Edition). McGraw Hill Education, New York. ISBN: 9781260579710.
6	Reference Book	Environmental Science and Engineering. Henry, J. G., & Heinke, G. W. (2016). *Environmental Science and Engineering* (3rd Edition). Pearson Education, India. ISBN: 9789332557109.
7	Reference Book	Environmental Studies. Rajagopalan, R. (2018). *Environmental Studies: From Crisis to Cure* (4th Edition). Oxford University Press, New Delhi.
8	Reference Book	Environmental Studies. Kaushik, A., & Kaushik, C. P. (2021). *Environmental Studies* (6th Edition). New Age International Publishers, New Delhi. ISBN: 9789390591190.
9	Reference Book	Ecology and Environment. Sharma, P. D. (2022). *Ecology and Environment* (14th Edition). Rastogi Publications, Meerut.
10	Policy/Framework Reference	University Grants Commission. (2023). *Guidelines and Curriculum Framework for Environment Education at Undergraduate Level*. UGC, New Delhi.
11	Policy Reference	Ministry of Education. (2020). *National Education Policy 2020*. Government of India, New Delhi.
12	International Reference	United Nations. *Transforming Our World: The 2030 Agenda for Sustainable Development*. United Nations, New York.

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of POs & COs

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	0	1	1	2	3	1	1	1	0	2
CO2	2	2	1	1	1	3	3	2	1	1	0	2
CO3	2	3	2	2	2	3	3	2	2	2	1	2
CO4	2	2	3	2	2	3	3	3	2	2	1	2
CO5	1	2	1	1	1	3	3	3	3	3	1	3
Avg.	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**1**	**2**

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

	COURSE NAME ARTIFICIAL INTELLI-GENCE IN CHEMICAL ENGINEER-ING	SEMESTER IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	-	3

Course Pre-requisites	Programming concepts, Statistics and numerical methods, Fundamental chemical engineering principles
Course Category	Program elective / Open elective
Course focus	Digitalization and Intelligent Process Engineering
Rationale	Artificial Intelligence (AI) is increasingly being applied in modern chemical industries for process monitoring, predictive maintenance, data analysis, and process optimization. The integration of AI with chemical engineering enables intelligent decision-making and improves operational efficiency. This course introduces the fundamentals of artificial intelligence and machine learning techniques and explores their applications in chemical engineering systems. Students will gain an understanding of how AI-based tools can be used for process modeling, fault detection, and optimization in chemical industries.
Course Revision/ Approval Date:	14/5/2026
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. The course is designed to provide the link between artificial intelligence and real time processes in various practical Applications. 2. It provides the basic concepts of machine learning with examples for linkage with automation based industrial Procedures. 3. The level of the course is chosen to be such that all students aspiring to be a part of artificial intelligence directly or Indirectly in near future should get these concepts. 4. The course attempt to apply the concept of artificial intelligence for the design, stability analysis and controllability Of chemical processes. 5. To evaluate AI-based solutions for improving efficiency and sustainability in chemical industries.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Fundamentals of Artificial intelligence Introduction to Artificial Intelligence and Machine Learning, evolution of AI in engineering systems, types of industrial process data in chemical plants, overview of data-driven modelling approaches, importance of AI in modern process industries, applications of AI in chemical engineering including process monitoring, fault detection, predictive maintenance, and process optimization.	20%	8
Unit 2: Advanced AI technologies and methods Evolutionary Computing (EC): Principles of evolutionary computing, with a focus on genetic algorithms, covering their Structure and application in optimization problems found in chemical engineering. Natural Language Processing (NLP): Introduction to NLP and its applications in analyzing scientific literature, patents, and documentation within the chemical Engineering domain.	30%	12
Unit 3: Optimization techniques in AI Genetic Algorithms (GA): Detailed exploration of GAs for solving com plex optimization problems in chemical engineering. Simulated Annealing (SA) and Particle Swarm Optimization (PSO): Introduction and application of SA and PSO in finding Optimal solutions under constraints typical in chemical processes.	30%	12
Unit 4: Application of AI in Chemical Engineering AI in Process Control: Utilizing AI for improving process control strategies, including predictive maintenance and real-time Optimization. AI in Material Science: Leveraging AI for material discovery and development, emphasizing the use of AI in Predicting material properties and formulations. AI in Environmental Engineering: Application of AI in waste treatment, Emission control, and environmental monitoring.	20%	10

Instructional Method and Pedagogy:

1. Chalk and board teaching
2. PowerPoint presentations
3. Demonstration of AI tools and machine learning techniques
4. Case study discussions related to AI applications in chemical industries
5. Simulation demonstrations for data analysis and process optimization
6. Group discussions on emerging trends in artificial intelligence and digitalization in chemical engineering

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1: Understand basics, history, and evolution of AI, differentiating it from traditional computing. CO2: Identify and explain AI agents and their roles in chemical engineering. CO3: Apply fuzzy systems and neural networks in chemical engineering problem-solving. CO4: Design and implement genetic algorithms and deep learning for chemical engineering optimization. CO5: Utilize AI optimization techniques to enhance chemical engineering processes. CO6: Critically assess AI's impact and ethical considerations in chemical engineering	Cognitive	Understand, Apply, Analyze, Evaluate

Learning Resources	
1.	**Text Books:** 1. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, Addison-Wesley Publishing Company, 2004. 2. Nils J. Nilsson, Principles of Artificial Intelligence, Illustrated Reprint Edition, Springer Heidelberg, 2014. 3. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition, PHI, 2009.
2.	**Reference Books:** • 4. Nils J. Nilsson, Quest for Artificial Intelligence, 1st Edition, Cambridge University Press, 2010.

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	2	1	2
CO4	2	2	2
CO5	2	2	3
Avg.	2	1.4	1.8

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	0	1	2	0	1	0	0	1	0	1
CO2	3	2	1	1	3	0	1	0	0	1	0	1
CO3	3	2	2	1	3	0	1	0	0	1	0	1
CO4	2	2	2	1	3	1	1	0	0	1	0	1
CO5	2	1	1	1	3	1	1	1	1	1	0	2
Avg.	2.6	1.8	1.2	1	2.8	0.4	1	0.2	0.2	1	0	1.2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTCH501	MASS TRANSFER OPERATIONS - I	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	2	0	6	4	1	-	5

Course Pre-requisites	Fluid Flow Operations, Heat Transfer Operations
Course Category	Core
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	22/06/2026

Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. To develop a strong foundation in mass transfer principles governing diffusion and interphase mass transfer processes. 2. To explain phase equilibria and mass transfer mechanisms relevant to gas–liquid separation operations. 3. To familiarize students with gas–liquid contact equipment and their selection for industrial applications. 4. To introduce fundamental concepts of gas absorption and distillation processes used in chemical industries. 5. To enable preliminary design and performance calculations of absorbers and distillation columns.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Mass Transfer Fundamentals and Molecular Diffusion Molecular and eddy diffusion (in gases, liquids, biological solutions, and gels), Fick's law of diffusion. Steady state diffusion in fluid, Measurement of diffusivity by Stephen tube, Various mass transfer co relationship, Mass-heat momentum transfer analogies, unsteady state diffusion	20%	12
Unit 2: Interphase Mass Transfer & Equipment for Mass Transfer Operations Interphase mass transfer: Equilibrium, concept of local and overall mass	20%	12

transfer coefficients and their relationship, Material balances application to gas-liquid and liquid-liquid systems. **Equipment for gas-liquid operations:** Equipment for gas- liquid operation, their classification and selection criteria. Gas Dispersed: Bubble columns, Mechanically Agitated vessels, Tray Towers etc. Liquid Dispersed: Venturi scrubbers, wetted-wall towers, spray towers, packed towers, etc.		
Unit 3: Gas absorption Mechanism of gas absorption, equilibrium solubility of gases in liquids, concept of ideal and non-ideal solution, choice of solvent for absorption, calculation of HETP, HTU, NTU, calculation of height of tower, types of packing, modeling of plate column and packed column.	20%	12
Unit 4: Distillation- Basic concept and single stage distillation Vapour-liquid equilibria for ideal and non-ideal systems, positive and negative deviations from ideality, relative volatility,Raoult's law, enthalpy concentration diagrams, Flash and simple distillation, vacuum distillation, Batch and steam distillation, types of reboiler.	20%	12
Unit 5: Distillation- Fractional distillation and basic design Fractional distillation, infinite, minimum and optimum reflux ratio, multicomponent distillation, azeotropic distillation, extractive distillation, concept of reflux, distillation methods (McCabe Thiele and Ponchon Savarit methods) to find out number of theoretical stages.	20%	12

List of Practical	Weightage	Contact hours
1: Diffusivity of vapour in air	14.28%	2
2: Mass Transfer coefficient in Wetted wall column	14.28%	2
3: Gas absorption in a packed column.	14.28%	2
4: Mass transfer with and without chemical reaction.	14.28%	2
5: VLE experiments.	14.28%	2
6. Simple Distillation	14.28%	2
7. Distillation in a packed column.	14.28%	2

Instructional Method and Pedagogy: Chalk-board, PowerPoint presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		

CO1: Analyze mass transfer processes using principles of molecular diffusion, mass transfer coefficients, and inter-phase transport. **CO2: Evaluate** phase equilibria and mass transfer behavior for gas–liquid systems in separation processes. **CO3: Determine** NTU, HTU, HETP and analyze and compare gas–liquid contact equipment based on operating principles and industrial applicability. **CO4: Apply** mass transfer concepts to perform basic design and performance calculations for absorption and distillation operations. **CO5: Determine** column height for packed towers and calculating number of stages in tray towers used in absorption and distillation processes.	Cognitive	Analyze Evaluate Analyze Apply Analyze

Learning Resources	
1.	**Reference Books:** 1. W.L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, Tata McGraw Hill. 2. B. K. Dutta, Principles of Mass Transfer and Separation Processes, 2nd edition, Prentice Hall of India, 2007. 3. Seader, Henley, Roper, 'Seperation Process Principles', 3rd edition, John Wiley and Sons. 4. Lyle Albright, 'Albright's Chemical Engineering Handbook', CRC Press. 5. N.Ananthraman, K.M. Meera Begum, 'Mass Transfer- Theory and Practice', PHI Publications
2.	**Textbook:** R. E. Treybal, Mass Transfer Operations, 3rd Edition, McGraw Hill.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Practical Marks	

Attendance	05 marks
Practical Exam	20 marks
Viva	10 marks
Journal	10 marks
Discipline	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	2	3
CO3	2	2	1
CO4	3	3	2
CO5	3	3	2
Avg.	2.8	2.2	1.8

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	0	0	0	0	0	0	0	0	1
CO2	3	3	1	1	1	0	0	0	0	0	0	1
CO3	2	2	2	0	0	0	0	0	0	0	1	1
CO4	3	3	3	1	1	0	0	0	0	0	2	1
CO5	3	3	3	1	2	0	0	0	0	0	2	1
Avg.	2.8	2.8	2	0.6	0.8	0	0	0	0	0	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTCH502	Chemical Reaction Engineering-I	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	1	6	3	1	1	5

Course Pre-requisites	Applied Chemistry, Mathematics
Course Category	Core
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	22/06/2026
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. Explain and interpret the fundamental principles of chemical reaction kinetics and mechanisms governing homogeneous reactions. 2. Apply kinetic models to design and analyze ideal chemical reactors for single reactions under isothermal and non-isothermal conditions. 3. Evaluate the performance of multiple reactor configurations and reactor networks for improved conversion and selectivity. 4. Assess the influence of temperature and pressure on reaction rate, equilibrium, and reactor design decisions. 5. Analyze non-ideal flow behavior using RTD concepts to predict and improve real reactor performance.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Kinetics of homogeneous reaction Introduction to Chemical Reaction Engineering, Classification of reactions, Rate of reaction with its various forms and various factors affecting the rate of reaction. Kinetics of homogeneous reaction Classification of reactions, Concept of Rate of reaction. Molecularity and order of reaction, Rate constant. Temperature dependency and concentration dependency of the reaction rate.	20%	09

Unit 2: Interpretation of batch reactor data Constant volume batch reactor, analytical method to find rate equation, Variable volume batch reactor. Ideal reactor for single reaction: batch, CSTR and PFR.	20%	09

Unit 3: Design for single and multiple reactions: Design for single reactions Size comparison of single reactors, multiple reactor systems, recycle reactor and autocatalytic reactions. Multiple reactions: Design for parallel reactions Introduction to multiple reactions, qualitative and quantitative treatment of product distribution and of reactor size, the selectivity.	20%	09
Unit 4: Design of series reactions, Temperature and pressure effect **Design for series reactions** Quantitative and qualitative treatments for plug flow or batch reactor and mixed flow reactor, their performance characteristics, kinetic studies and design for maximizing the desired product, successive irreversible reactions of different orders, reversible reactions, irreversible series parallel reactions. **Effect of Temperature and pressure in reaction engineering** Heats of reaction and equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure. Optimum temperature progression, Evaluation of adiabatic and nonadiabatic reactor performance. Thermal stability of reactors.	20%	09
Unit 5: Distillation- Fractional distillation and basic design RTD and various techniques to find it, The E, F and C Curves, their interrelationship, conversion in non-ideal flow reactors, Zero parameter and One parameter models for non-ideal reactors.	20%	09

List of Practical	**Weightage**	**Contact hours**
1: Determination of Activation energy for reaction between Sodium thiosulfate and HCl	12.5%	2
2: Isothermal Batch Reactor	12.5%	2
3: Isothermal CSTR and PFR	12.5%	2
4: CSTR in series	12.5%	2
5. RTD studies in plug flow tubular reactors (coiled tube type)	12.5%	2
6. RTD in CSTR	12.5%	2
7. RTD studies in PFR followed by CSTR	12.5%	2
8. RTD in packed bed reactor	12.5%	2

List of Practical Tutorial	Weightage	Contact hours
Unit 1: Kinetics of homogeneous reaction.	20%	3
Unit 2: Interpretation of batch reactor data.	20%	3
Unit 3: Design for single and multiple reactions.	20%	3
Unit 4: Design of series reactions, Temperature and pressure effect.	20%	3
Unit 5: Distillation- Fractional distillation and basic design.	20%	3

Instructional Method and Pedagogy: Chalk board, PowerPoint presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Analyze the effect of temperature on reaction stoichiometry, equilibrium, and conversion using thermodynamic and kinetic principles.		Analyze
CO2: Formulate and solve chemical reactor engineering problems by applying mole balances, rate laws, and design equations for ideal reactors.		Apply
CO3: Determine kinetic parameters of homogeneous and heterogeneous reactions using experimental and reactor performance data.		Analyze
CO4: Evaluate non-ideal flow behavior in reactors using Residence Time Distribution (RTD) models and interpret their impact on reactor design and performance.		Evaluate
CO5: Design, assess, and optimize the performance of catalytic and non-catalytic reactors for single and multiple reaction systems under industrial constraints.		Create

Learning Resources

1.	**Reference Books:** 1. H. Scott Fogler 'Elements of Chemical Reaction Engineering', 5th Edition, Prentice Hall India, (2015). 2. Hougen O.A., Watson K. M., and Ragatz R.A., 'Chemical Process Principles', Part III, John Wiley, USA. 3. L Schmidt, 'The Engineering of Chemical Reactions', 2nd Edition, Oxford, (2008). 4. J. M. Smith, 'Chemical Engineering Kinetics', McGraw-Hill, USA. 5. Lyle Albright, 'Albright's Chemical Engineering Handbook', CRC Press.
2.	**Textbook:** O. Levenspiel "Chemical Reaction Engineering", 3rd Edition, John Wiley & Sons.

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
<tr><td>Theory: Mid semester Marks</td><td>20 marks</td></tr>
<tr><td>Theory: End Semester Marks</td><td>40 marks</td></tr>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
<tr><td>Article Review</td><td>10 marks</td></tr>
<tr><td>Total</td><td>40 Marks</td></tr>
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<tr><td>Practical Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
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Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	2	3
CO4	2	3	2
CO5	3	3	2
Avg.	2.8	2.6	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	0	0	0	0	0	0	0	0	1
CO2	3	3	3	1	1	0	0	0	0	0	1	1
CO3	2	3	2	2	1	0	0	0	0	0	0	2
CO4	2	3	2	3	1	0	0	0	0	0	0	2
CO5	3	3	3	2	2	0	1	0	0	0	2	2
Avg.	2.6	3	2.2	1.6	1	0	0.2	0	0	0	0.6	1.6

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTCH503	CHEMICAL ENGINEERING THERMODYNAMICS - II	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	1	4	3	-	1	4

Course Pre-requisites	Chemical Engineering Thermodynamics – I, Engineering Mathematics I, II, III
Course Category	Core
Course focus	
Rationale	
Course Revision/ Approval Date:	22/06/2026
Course Objectives (As per Blooms' Taxonomy)	To enable the student: 1. Apply thermodynamic property relations and fundamental equations to estimate properties of pure fluids and real systems. 2. Analyze and compute partial molar and excess properties of ideal and non-ideal mixtures for energy, volume, and entropy change calculations. 3. Evaluate chemical reaction equilibria by analyzing the effects of temperature, pressure, inert components, and multiple reactions. 4. Analyze vapor–liquid equilibrium behavior and estimate equilibrium compositions using thermodynamic models and correlations. 5. Interpret liquid–liquid and solid–liquid equilibrium diagrams to predict phase behavior in binary and multicomponent systems.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Thermodynamic Properties of Pure Fluid Classification of thermodynamic properties, Gibbs free energy, Relationship among thermodynamic properties, fugacity and activity.	20%	09
Unit 2: Properties of Solutions Fundamental Property Relation, Partial molar properties, Chemical potential, fugacity in solution, Ideal-Gas-State Mixture Model, Fugacity and Fugacity Coefficient: Pure Species, Generalized Correlations for the	22.2%	10

Fugacity Coefficient, The Ideal-Solution Model, Excess Property, activity and activity coefficient, Gibbs Duhem equation, property changes of mixing.		
Unit 3: Chemical Reaction Equilibria Reaction Coordinate, Criteria for chemical reaction equilibrium, Le- Chatelier's Principle, Evaluation of Equilibrium Constants, Relation of Equilibrium Constants to Composition, Equilibrium Conversions for Single Reactions Effect of temperature on equilibrium, Effect of pressure on equilibrium constant and composition, Effect of inert, Phase Rule and Duhem's Theorem for Reacting Systems, Multireaction Equilibria	26.6%	12
Unit 4: Phase Equilibria & Vapour – Liquid Equilibria (VLE) Criteria for phase equilibrium, Phase equilibria in single and multi- component system, Phase rule for non-reacting system, Vapour-liquid equilibria, constant temperature and pressure equilibria, Vapour-liquid equilibria in ideal solution, Azeotropes, Vapour-liquid equilibria at low and high pressure, Dew point and bubble point equilibria, Vapour-liquid equilibria for a system of limited miscibility. Excess Gibbs Energy and Activity, The Gamma/Phi Formulation of VLE, Simplifications: Raoult's Law, Modified Raoult's Law, and Henry's Law, Correlations for Liquid- Phase Activity Coefficients, Fitting Activity Coefficient Models to VLE Data, Flash Calculations	26.6%	12
Unit 5: Liquid – Liquid Equilibria (LLE) & Solid – Liquid Equilibria (SLE) Binary liquid–liquid equilibria, Ternary diagrams, Introduction to solid – liquid equilibria.	4.4%	02

Instructional Method and Pedagogy: Chalk-board, PowerPoint presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: **CO1:** Analyze thermodynamic property relations to determine chemical potential, fugacity, and partial molar properties of pure and multicomponent systems. **CO2:** Evaluate phase equilibrium data for solid–liquid and liquid–liquid systems and assess thermodynamic consistency using appropriate criteria. **CO3:** Apply Gibbs–Duhem relations and activity coefficient models to compute and analyze solution properties of non-ideal mixtures.	Cognitive	Analyze Evaluate Apply

CO4: Analyze and predict equilibrium compositions of reacting systems involving single and multiple simultaneous chemical reactions. **CO5:** Model vapor–liquid equilibrium behavior and perform bubble point, dew point, and flash calculations for ideal and non-ideal systems.		Analyse Apply

Learning Resources	
1.	**Reference Books:** 1. J. M. Smith, H. C. Van Ness & M. M. Abbot, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill, (2004). 2. Y. V. C. Rao, "Chemical Engineering Thermodynamics", Universities Press (1997). 3. P. K. Nag, "Engineering thermodynamics", Tata McGraw-Hill Education, (2005). 4. B. G. Kyle, "Chemical Process Thermodynamics", Prentice Hall India, (1994). 5. S. R. Turns, "Thermodynamics concepts and applications", Cambridge University Press, (2006).
2.	**Textbook:** K. V. Narayan, "A Textbook of Chemical Engineering Thermodynamics", 2nd Ed., Prentice Hall India Learning Private Limited; (2013)
3	**Journals & Periodicals** 1. The Journal of Chemical Thermodynamics, Elsevier. 2. Journal of Chemical Education, ACS Publications
4	**Other Electronic Resources** Chemical Engineering Thermodynamics, NPTEL Online Course.

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	3
CO3	3	1	3
CO4	3	2	2
CO5	3	3	2
Avg.	3	1.8	2.4

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	0	0	0	0	0	0	0	0	1
CO2	3	3	1	2	1	0	0	0	0	0	0	1
CO3	3	3	1	1	1	0	0	0	0	0	0	2
CO4	3	3	2	1	0	0	0	0	0	0	0	1
CO5	3	3	2	1	2	0	0	0	0	0	1	2
Avg.	3	3	1.4	1	0.8	0	0	0	0	0	0.2	1.4

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTCH504	INSTRUMENTATION & PROCESS CONTROL	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
4	2	0	6	4	1	0	5

Course Pre-requisites	Mathematics I,II,III, Numerical Methods in Engineering, Process Calculation
Course Category	Core
Course focus	Skill Development
Rationale	
Course Revision/ Approval Date:	23/06/2026
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. To explain the fundamentals of process control and analyze the need for control strategies in chemical process systems. 2. To develop mathematical models and transfer functions for dynamic analysis of process systems. 3. To apply P, PI, and PID control strategies for regulation and servo control of process variables. 4. To analyze frequency response techniques and evaluate stability criteria of control systems. 5. To identify and apply process control instrumentation for measurement and control in chemical industries.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Modeling for Process Dynamics Introduction to process control, process dynamics, mathematical tools for modeling (ODE, PDE, Laplace transform.)	16.6%	10
Unit 2: Linear Open – Loop Systems Response of first order systems, examples of first order systems, linearization. Interacting and non – interacting systems. Second order systems, transportation lag.	25%	15

Unit 3: Linear Closed – Loop Systems Control system, final control element and its mechanisms, controller and their mechanisms. Overall transfer function for single – loop and multi – loop systems. Servo problem, regulatory problem, transient response of control systems, stability and stability criteria.	25%	15
Unit 4: Frequency Response Introduction to frequency response, frequency response analysis, Nyquist stability criteria, Bode's stability criteria, gain margin, phase margin.	16.6%	10
Unit 5: Instrumentation Introduction to measurement, basic measurement devices and working principles for level, flow, pressure and temperature. Instrumentation symbols and labels. Types of control valves.	16.6%	10

List of Practical	Weightage	Contact hours
1: Air pressure trainer.	16.6%	2
2: Flow control trainer.	16.6%	2
3: Level control trainer.	16.6%	2
4: Heat exchanger temperature control trainer.	16.6%	2
5. Control valve characteristics.	16.6%	2
6. Cascade control trainer.	16.6%	2

Instructional Method and Pedagogy: Chalk-board, PowerPoint presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1:** To explain the principles and significance of process control in chemical process industries. **CO2:** To develop block diagrams and mathematical models for open-loop and closed-loop control systems. **CO3:** To analyze dynamic responses of first- and second-order systems and evaluate system performance parameters. **CO4:** To select appropriate instrumentation and control valves for efficient design of process control loops.	Cognitive	Understand Create Evaluate Apply

CO5: Identify, **analyse** and control multi-variable systems by using several techniques.		

Learning Resources	
1.	**Reference Books:** 1. Seborg, Edgar, Mellichamp, Doyle, "Process Dynamics & Control", 3rd Edition, John Wiley & Sons, Inc. 2. G. Stephanopoulos, "Chemical process control: An introduction to theory and practice", Prentice Hall of India Private Limited. 3. R.P. Vyas, "Process control and instrumentation", 7th Edition, Denett & Co. Publication. 4. R.P. Vyas, "Measurement and control", Denett & Co. Publication. 5. Donald P. Eckman, "Industrial instrumentation", 1st Edition, CBS. 6. William L. Luyben, "Process modeling, simulation and control for chemical engineers", McGraw Hill International Editions. 7. D. C. Sikdar, "Instrumentation and Process Control", Khanna Publishers.
2.	**Textbook:** D. R. Coughanowr, "Process system analysis and control", 3rd Edition, McGraw Hill Publication.
3	**Journals & Periodicals** 1. Journal of Process Control, Elsevier. 2. Industrial and Engineering Chemistry, ACS Publications.
4	**Other Electronic Resources** 1. Process Control and Instrumentation, NPTEL Online Course. 2. Process Control - Design, Analysis and Assessment, NPTEL Online Course. 3. Chemical Process Control, NPTEL Online Course.

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Practical Marks	

Attendance	05 marks
Practical Exam	20 marks
Viva	10 marks
Journal	10 marks
Discipline	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	0
CO2	3	2	0
CO3	3	2	0
CO4	3	2	0
CO5	3	2	0
Avg.	2	1.6	0.8

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	1	2	1	1	0	1	1	1
CO2	3	3	2	1	2	0	0	0	0	1	1	1
CO3	3	3	2	2	2	0	0	0	0	1	1	1
CO4	3	2	3	1	3	1	1	1	0	1	2	1
CO5	3	3	2	2	2	2	2	0	1	0	0	2
Avg.	3	2.6	2	1.2	2	1	0.8	0.4	0.2	0.8	1	1.2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

AECC 501	Disaster Risk Management	SEMESTER V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	0	2	2	0	0	2

Course Pre-requisites	Nil
Course Category	Ability Enhancement Compulsory Course
Course focus	Employability and Skill Development
Rationale	
Course Revision/ Approval Date:	23/06/2026
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. Explain fundamental concepts, terminology and types of disasters. 2. Explain disaster risks, vulnerability and impacts using representative case studies. 3. Explain disaster management cycle and frameworks adopted at national and international levels. 4. Explain disaster management policies, institutions and mechanisms in India. 5. Explain the role of science and technology in disaster mitigation, preparedness and response.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Disasters Understanding the Concepts and Definitions of Disaster, Hazard, Vulnerability Risk, Capacity Disaster and Development, and Disaster Management Fundamental of Disasters-Types, Trends, Causes, Consequences and Control: Geological Disasters, Hydro-Meteorological Disasters, Biological Disasters, Technological Disasters, and Man-made Disasters. Global Disaster Trends –Emerging Risks of Disasters – Climate Change and Urban Disasters.	20%	06
Unit 2: Disaster Management Cycle and Framework Disaster Management Cycle – Paradigm Shift in Disaster Management, Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, Zonation, Micro zonation, Prevention and Mitigation of Disasters, Early Warning System, Preparedness, Capacity Development; Awareness, During Disaster	20%	06

–Evacuation – Disaster Communication – Search and Rescue, Emergency Operation Centre– Incident Command System –Relief And Rehabilitation. Post -disaster Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action, Sendai framework.		
Unit 3: Disaster Management in India Disaster Profile of India Mega Disasters of India and Lessons Learnt, Disaster, Management Act 2005 – Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Intergovernmental Agencies. Disaster Management Act in relation to COVID 19 Pandemic.	20%	06
Unit 4: Role of Science and Technology in Disaster Management Geo-informatics in Disaster Management (RS, GIS, GPS and RS), Disaster Communication System (Early Warning and Its Dissemination), Land, Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters, S&T Institutions for Disaster Management in India.	20%	06
Unit 5: **Disaster Case Studies** Various Case Studies on Disaster and Development, Disaster Prevention and Control, Risk Analysis and Management. Case study relating to COVID -19 to be explored.	20%	06

Instructional Method and Pedagogy: Chalk-board and PowerPoint presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Explain disaster concepts, terminology and types.		Understand
CO2: Explain the disaster management cycle and international frameworks.		Understand
CO3: Explain disaster management policies, institutions and practices in India.		Understand
CO4: Analyze the role of science and technology in disaster mitigation.		Analyze
CO5: Analyze selected disaster case studies to understand risk, response and recovery.		Analyze

Learning Resources	
1.	**Reference Books:** 1. Goyal, S.L., Encyclopedia of Disaster Management (Vols. 1-3), Deep & Deeep, New Delhi 2. Gupta, A.K., Nair, S.S., Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi. 3. Ibrahimbegovic, A., Zlatar, M., Damage Assessment and Reconstruction after War or Natural Disaster, Springer. 4. Menshikov, V.A., Perminov, A.N., Urlichich, Y.M., Global Aerospace Monitoring and Disaster. 5. Modh, S., Introduction to Disaster Management, Macmillian Publishers India. 6. Srivastava, H.N., Gupta, G.D., Management of Natural Disasters in Developing Countries, Daya Publishers, NIDM AND NIDMA publications.
2.	**Textbook:** 1. Alexander, D., Natural Disasters, Kluwer Academic London. 2. Asthana, N. C., Asthana P., Disaster Management, Aavishkar Publishers. 3. Carter, N., Disaster Management: A Disaster Manager's Handbook, Asian Development Bank. 4. Collins, A.E., Disaster and Development, Routledge. 5. Coppola, D.P., Introduction to International Disaster Management, 2nd Edition, Elsevier Science.
3	**Journals & Periodicals** GSDMJ, disaster management act
4	**Other Electronic Resources** GIDM, NIDM

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous	

Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Article review	10 marks
	Open book	15 marks
	Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	2	2	3
CO3	1	2	3
CO4	2	3	3
CO5	2	3	3
Avg.	1.8	2.4	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	3	3	1	0	0	0	2
CO2	3	2	2	2	1	3	3	2	0	0	1	2
CO3	3	1	2	1	1	3	3	2	0	0	1	2
CO4	3	3	3	3	2	3	3	2	0	0	1	2
CO5	3	3	3	3	2	3	3	2	1	1	1	2
Avg.	3	2.2	2.2	2	1.4	3	3	1.8	0.2	0.2	0.8	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Chemical Engineering Course Curriculum Academic Year 2026-27

Course code BTCH601	**Mass Transfer Operations - II**	**Semester VI**

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	1	6	3	1	1	5

Course Pre-requisites	**Mass Transfer Operations - I**
Course Category	Professional core courses
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	18/01/2022

Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. To **develop** the ability to analyze and interpret mass transfer phenomena involved in humidification, drying, extraction, adsorption, leaching, crystallization, and membrane processes. 2. To **apply** vapor–liquid, liquid–liquid, and solid–fluid equilibrium principles for quantitative evaluation of industrial mass transfer operations. 3. To **enable** students to select and justify appropriate mass transfer equipment based on process requirements, operating conditions, and performance criteria. 4. To **formulate** and solve design-oriented problems related to staged and differential mass transfer operations using standard graphical and analytical methods. 5. To **build** foundational competence for industrial applications, internships, and advanced courses involving separation and purification processes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Humidification and Dehumidification Operations General principles, vapor-liquid equilibrium and enthalpy for a pure substance, absolute humidity, dry-bulb temperature, relative humidity, percentage absolute humidity, dew point, humid volume, humid heat, adiabatic saturation curves, wet-bulb temperature, gas- liquid contact operations, evaporative cooling. Types of cooling towers and their height calculations.	20%	12
Unit 2: Drying: and crystallization **Drying**: Introduction and principles of drying, equilibrium, mechanism of drying, types of moisture in drying, time for drying, Freeze drying, microwave drying, infrared drying, vacuum drying, batch and continuous drying equipment – tray dryer, rotary dryer, spray dryer, fluidized bed dryer etc. **Crystallization:** Crystallization fundamentals, solubility and saturation, Miers theory of crystallization, crystal nucleation, crystal growth, population balance, importance of crystal size, material balance, calculation of yield, melt crystallization, cryogenic crystallization, Reactive crystallization, equipment for crystallization.	20%	12
Unit 3: Liquid Liquid Extraction:	20%	12
Liquid-liquid equilibria, single stage extraction, multistage crosscurrent, counter-current and co-current extraction, stage efficiency, equipment for extraction. Design of extractors based on triangular diagrams.		
Unit 4: Adsorption and Ion Exchange **Adsorption:** Basic principles and equilibria in adsorption, types of adsorption-physical and chemical adsorption, adsorption adsorption, temperature swing adsorption, moving bed adsorber. **Ion exchange:** Principles of ion exchange, techniques and applications, equilibria and rate of ion exchange.	20%	12

Unit 5: Leaching and Membrane separation **Leaching:** General principles, continuous leaching, and ideal stage equilibrium, constant and variable underflow, equipment for leaching. Design based on right angle triangle diagram, Ponchon Savarit method. **Membrane separation:** Introduction to membrane separation processes	20%	12

List of Practical	Weightage	Contact hours
1: To study the humidification operation and calculate all the terminologies used for air water contact operation Calculate natural frequency for undamped free vibration of a spring-mass system.	10%	2
2: To measure tower characteristic parameters KaV/L for various liquid and air flow rates (L/G) for forced draft countercurrent cooling tower.	10%	2
3:To determine rate of drying curve for a given solid in a fluidized drier at constant drying conditions	10%	2
4: To determine % crystallization of Crystallization of Benzoic Acid in water.	10%	2
5: To prepare the ternary diagram for a system of three liquid one pair partially soluble i.e. acetic acid, benzene and water system.	10%	2
6. To determine the % extraction for the benzoic acid from dilute aqueous solution using toluene as solvent.	10%	2
7. To study the (cross current) liquid liquid extraction for extracting acetic acid from benzene using water as solvent and determine: 1. Efficiency stage wise & overall. 2. % of acetic acid removed per stage & overall removal of acetic acid. 3. Minimum & maximum solvent in 1 st stage.	10%	2
8. To study and verify the Freundlich's Adsorption Isotherm of adsorption of Oxalic Acid and Charcoal.	10%	2
9. To determine the efficiency of single stage leaching operation for leaching of NaOH aqueous solution & $CaCO_3$.	10%	2
10. To determine the stage efficiency and the overall recovery of NaOH for multistage cross current leaching operation for leaching NaOH from mixture of NaOH and $CaCO_3$ using water as a solvent.	10%	2

List of Tutorial	Weightage	Contact hours
Unit 1: 1. Problems based on various terminologies of psychrometry.	20%	2
2. Problems based on psychrometric chart 3. Problems based on size of cooling tower.		
Unit 2: 1. Problems based on drying time and moisture content. 2. Problem based on crystallization yield.	20%	2
Unit 3: 1. Problems based on triangular graphs. 2. Problem based on single stage extraction. 3. Problem based on multistage crosscurrent, counter-current and co-current extraction.	20%	2
Unit 4: 1. Problems based on crosscurrent/ countercurrent adsorption.	20%	2

Unit 5: 1. Problems based on design based on right angle triangle diagram, Problems based on the Ponchon Savarit method.	20%	2

Instructional Method and Pedagogy: Chalk-board, PowerPoint presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Analyze** industrial mass transfer operations such as humidification, drying, extraction, adsorption, leaching, and crystallization using fundamental transport principles. CO2: **Apply** phase equilibrium and mass balance concepts to solve quantitative problems in staged and continuous mass transfer processes. CO3: **Design** and evaluate mass transfer equipment (cooling towers, dryers, extractors, adsorbers, leaching units) using appropriate graphical and analytical methods under realistic constraints. CO4: **Interpret** and utilize equilibrium diagrams and performance correlations for the assessment and optimization of separation processes. CO5: **Demonstrate** practical competence in laboratory-scale mass transfer operations by conducting experiments, analyzing data, and validating theoretical models.	Cognitive	Understand Apply Apply Create Analyse

Learning Resources	
1.	**Reference Books:** 2. R.E. Treybal, Mass Transfer Operations, McGraw Hill, 3rd Edition. 3. W.L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, Tata McGraw Hill, 7th Edition. 4. B. K. Dutta, Principles of Mass Transfer and Separation Processes, 2nd edition, Prentice Hall of India, 2007. 5. Seader, Henley, Roper, 'Seperation Process Principles', 3rd edition, John Wiley and Sons.
2.	**Journals & Periodicals:**
3.	**Other Electronic Resources:**

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
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<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
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<tr><td>Practical Marks</td><td>
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<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
<tr><td>Total</td><td>50 Marks</td></tr>
</table>
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<tr><td>Project/ Industrial Internship Marks</td><td>
<table>
<tr><td>Quantity of the Project/Industrial in terms of Language, Presentation & format.</td><td>30 marks</td></tr>
<tr><td>Practical understanding of the subject on the Project/Industrial.</td><td>30 marks</td></tr>
<tr><td>Industry/ University mentor's feed-back on the Project/ Industrial.</td><td>30 marks</td></tr>
<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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</td></tr>
</table>

Mapping of PSOs

	PSO1	PSO2	PSO2
CO1	3	1	1
CO2	3	2	1
CO3	3	3	1
CO4	3	2	2
CO5	2	1	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	0	0	0	0	0	0	0	0	1
CO2	3	3	2	1	1	0	0	0	0	0	0	1
CO3	3	3	3	1	2	0	1	0	0	0	2	1
CO4	3	3	2	1	1	0	0	0	0	0	0	2
CO5	2	2	1	3	2	0	0	0	1	1	0	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Course code BTCH602	Chemical Reaction Engineering - II	Semester VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	3	3	0	0	3

Course Pre-requisites	**Chemical Reaction Engineering-I and Mass transfer operations - I**
Course Category	Professional core courses
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	18/01/2022
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. To **analyze** fluid–fluid reaction kinetics and apply mass-transfer-based rate equations for reactor design. 2. To **develop** kinetic models for fluid–solid reactions and design appropriate non-catalytic reactors. 3. To **explain** and evaluate physical and chemical properties of solid catalysts influencing reaction performance. 4. To **analyze** catalytic reaction mechanisms and derive rate expressions using surface kinetics models. 5. To **apply** catalytic reaction kinetics, transport effects, and effectiveness factors in the design of catalytic reactors.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Fluid - Fluid reaction kinetics and design: Introduction and rate equation of heterogeneous reaction. Fluid - Fluid reaction kinetics and design, The Rate Equation for Straight Mass Transfer (Absorption) of A, The Rate Equation for Mass Transfer and Reaction, Instantaneous reactions to slow reactions, Liquid film enhancement factor, Hatta number, gas - liquid reactors and its design.	**20%**	**9**
Unit 2: Fluid Particle Reaction kinetics and design: Selection of model, Progressive and shrinking core model for spherical particles, Diffusion through gas film control, diffusion through ash layer control, chemical reaction control, Determination of rate controlling step, Fluid particle reactor design.	**20%**	**9**

Unit 3: Catalysts and their Properties: Catalysts and their Properties Introduction to Catalysis, homogeneous and heterogeneous catalysis, water soluble catalyst. Preparation and Characterization of catalysts, Physical and chemical adsorption and metal dispersion, Adsorption isotherms, Physical properties of catalyst, surface area, void volume, solid density, pore analysis: pore size, pore volume distribution, catalyst promoters, Catalyst inhibitors, Catalyst poisons	**20%**	**9**

Unit 4: Solid-Catalyzed Reaction Kinetics: Nature and Mechanism of Catalytic reactions. Adsorption isotherms and rates of adsorption and desorption. Rate equations for surface kinetics, LHHW model, determining rate controlling step. Various types of reactors to determine kinetics of catalytic reaction.	**20%**	**9**
Unit 5: Introduction to Catalytic Reactors and basic design Heterogeneous Data analysis for Reactor Design. Effects of external mass transfer and heat transfer, Pore diffusion, Effectiveness factor. Designaspects of catalytic reactors, Catalyst deactivation. **Introduction to Catalytic Reactors:** Packed bed catalytic reactor, fluidized bed reactor, trickle bed reactor, slurry reactor.	**20%**	**9**

Instructional Method and Pedagogy: Chalk-board, PowerPoint, notes

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: To **analyze** fluid–fluid reaction kinetics incorporating mass transfer effects and design non-catalytic gas–liquid reactors. CO2: To **develop** rate expressions for fluid–solid reactions and design reactors based on the controlling resistance. CO3: To **explain** catalyst properties such as surface area, pore structure, and adsorption behavior and assess their impact on reaction rates. CO4: To **analyze** catalytic reaction kinetics and evaluate industrial catalytic reactor configurations. CO5: To **apply** kinetic models, effectiveness factor, and transport limitations in the design of catalytic reactors.	Cognitive	Develop Develop Understand Analyse Apply

Learning Resources

1.	**Reference Books:** 1. H. Scott Fogler 'Elements of Chemical Reaction Engineering', 5th Edition, Prentice Hall India, (2015). 2. Hougen O.A., Watson K. M., and Ragatz R.A., 'Chemical Process Principles', Part III, John Wiley, USA. 3. L Schmidt, 'The Engineering of Chemical Reactions', 2nd Edition, Oxford, (2008). 4. J. M. Smith, 'Chemical Engineering Kinetics', McGraw-Hill, USA.
2.	**Textbook:** **1.** O. Levenspiel "Chemical Reaction Engineering", 3rd Edition, John Wiley & Sons.
3.	**Journals & Periodicals:**
4.	**Other Electronic Resources:**

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Mapping of PSOs & COs

	PSO1	PSO2	PSO2
CO1	2	1	1
CO2	2	1	1
CO3	1	1	1
CO4	2	2	2
CO5	2	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	1	0	0	0	1	1
CO2	3	3	3	2	2	1	1	0	0	0	1	1
CO3	3	2	1	1	1	0	0	0	0	0	0	1
CO4	3	3	2	2	2	1	1	0	0	0	1	1
CO5	3	3	3	3	2	1	1	0	0	0	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Course code BTCH603	PROCESS EQUIPMENT DESIGN - I	Semester VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	2	0	5	3	1	0	4

Course Pre-requisites	**Heat transfer operations, Mass transfer operations**
Course Category	Professional core courses
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	18/01/2022
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. To **Design** integrated piping systems that comply with industrial codes, safety, and performance standards, and to develop innovative fluid transportation solutions using modern engineering tools and practices. 2. To **Analyze** and evaluate heat exchanger and condenser designs, and design efficient reboiler systems using industrial codes, safety standards, and relevant engineering software. 3. **Apply** the principles of distillation by selecting design variables, determining tray parameters, and utilizing the Fenske–Underwood–Gilliland (FUG) method for multi-component distillation system design in accordance with industrial standards and practices. 4. To **analyze** and design absorption systems by evaluating equipment selection, solvent use, and tower performance using advanced engineering principles and tools. 5. To **apply** extractor selection criteria, analyze solvent use, and evaluate industrial extraction applications.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Process design of piping systems and fluid transportation devices Introduction, process design of piping, piping colors and codes, NPSHA &NPSHR, selection criteria of pipes, fittings, valves, pumps, two phase flow system design	15.5%	7

Unit 2: Process design of Heat Exchangers Design method and criteria for selection of heat exchangers, design of condenser and selection criteria for horizontal and vertical condenser, process design of reboilers.	28.8%	13
Unit 3: Process design of Distillation Column Introduction, selection criteria of design variables for distillation, selection of tray and its design parameters, Multi – component distillation design using Fenskey – Underwood – Gilliland's (FUG) method.	26.6%	12

Unit 4: Process design of gas – liquid and liquid – liquid equipment **Absorber**: Selection criteria from different available types of absorption equipment, amount of solvent utilized, determination of tower diameter, pressure drop calculation, NtoG, HtoG and height of packing.	17.7%	8
Unit 5: Extractor: Selection criteria from different types of available extractor, choice of solvent utilization, Application of extraction in industry.	11.1%	5

Instructional Method and Pedagogy: PowerPoint presentation, chalk-board

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Design** integrated industrial piping systems in compliance with applicable codes, safety regulations, and performance standards using modern engineering tools and practices. CO2: **Analyze** and evaluate heat exchanger and condenser configurations, and design efficient reboiler systems in accordance with industrial codes, safety requirements, and professional design software. CO3: **Apply** the principles of multicomponent distillation by selecting appropriate design variables, determining tray parameters, and implementing the Fenske–Underwood–Gilliland (FUG) method as per industrial standards. CO4: **Analyze** and design absorption systems by evaluating equipment selection, solvent characteristics, and tower performance using advanced chemical engineering principles and computational tools. CO5: **Analyze** and evaluate industrial extraction systems by applying extractor selection criteria, solvent suitability, and process performance for practical industrial applications.	Cognitive	Create Analyse Understand Apply Apply

Learning Resources

1.	**Reference Books:** 1. Coulson and Richardson's Chemical Engineering Design (Volume 6), R. K. Sinnot, Elsevier Butterworth-Heinemann. 2. Brownell and Young, Process Vessel Design, Wiley Eastern. 3. Ludwig, E. E., Applied process design for chemical and petrochemical plants, volume 1,2 & 3, Third Edition, Butterworth- Heinemam. 4. Perry's Chemical Engineers Handbook, Don Green and Robert H. Perry, McGraw Hill. 5. Applied Process Design of Chemical and Petrochemical Plants, E.E. Ludwig, Gulf Professional Publications. Volume 1, 2 & 3
	Textbooks: **1.** Introduction to Process Engineering and Design, S. B. Thakore and B. I. Bhatt, Tata McGraw Hill.
2.	**Journals & Periodicals:**
3.	**Other Electronic Resources:**

<table>
<tr><th>Evaluation Scheme</th><th>Total Marks</th></tr>
<tr><td>Theory: Mid semester Marks</td><td>20 marks</td></tr>
<tr><td>Theory: End Semester Marks</td><td>40 marks</td></tr>
<tr><td>Theory: Continuous Evaluation Component Marks</td><td>
<table>
<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>MCQs</td><td>10 marks</td></tr>
<tr><td>Open Book Assignment</td><td>15 marks</td></tr>
<tr><td>Open Book Assignment</td><td>10 marks</td></tr>
<tr><td>Total</td><td>40 Marks</td></tr>
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<tr><td>Practical Marks</td><td>
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<tr><td>Attendance</td><td>05 marks</td></tr>
<tr><td>Practical Exam</td><td>20 marks</td></tr>
<tr><td>Viva</td><td>10 marks</td></tr>
<tr><td>Journal</td><td>10 marks</td></tr>
<tr><td>Discipline</td><td>05 marks</td></tr>
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</td></tr>
<tr><td>Project/ Industrial Internship Marks</td><td>
<table>
<tr><td>Quantity of the Project/Industrial in terms of Language, Presentation & format.</td><td>30 marks</td></tr>
<tr><td>Practical understanding of the subject on the Project/Industrial.</td><td>30 marks</td></tr>
<tr><td>Industry/ University mentor's feedback on the Project/ Industrial.</td><td>30 marks</td></tr>
<tr><td>Attendance</td><td>10 marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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</td></tr>
</table>

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4
CO1	3	0	0	1
CO2	3	0	0	1
CO3	2	0	0	1
CO4	3	0	0	1
CO5	3	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	0	3	2	2	1	0	1	0	1
CO2	3	3	3	0	3	2	2	1	0	1	0	1
CO3	3	3	2	0	2	0	0	0	0	1	0	1
CO4	2	3	3	0	3	2	2	1	0	1	0	1
CO5	3	3	2	0	2	2	2	1	0	1	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Professional Electives

COURSE CODE BTCH605 A	COURSE NAME Petroleum Engineering	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	3	3	0	0	3

Course Pre-requisites	Nil
Course Category	Professional Elective
Course focus	
Rationale	
Course Revision/ Approval Date:	14/4/2017 25/03/2022
Course Objectives **(As per Blooms' Taxonomy)**	1. To **explain** petroleum terminology, properties, and classification with respect to chemical composition and usage. 2. To **analyze** theories of petroleum origin and relate them to petroleum composition and occurrence. 3. To **explain** petroleum refining concepts and evaluate major refining processes and product specifications. 4. To **analyze** modern petroleum fractionation techniques and associated equipment used in crude oil processing. 5. To **apply** knowledge of petroleum products and refining processes to industrial and energy-related applications.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction: History and Terminology, Introduction to petroleum, important properties of petroleum, historical and modern perspectives, Indian Scenario Petroleum, important terminology and definition, composition and classification of petroleum.	**20%**	**8**

Unit 2: Origin and Occurrence: Origin of petroleum: Abiogenic origin, biogenic origin. Basic difference between origin theories, Petroleum composition and properties. Kerogen: Introduction to kerogen, properties of kerogen, composition and classification of kerogen. Isolation of kerogen methods, structural models for kerogen, kerogen maturation, methods for probing kerogen structure	**20%**	**10**
Unit 3: Introduction to Refining Processes: Introduction to refining of petroleum, Historical developments, Indian scenario of petroleum refining. Important products from petroleum, important test methods for the petroleum fractions, blending process for petroleum products etc. Catalysis And Refining Processes: Introduction to catalysis, importance of catalytic processes, various catalyst used in catalytic processes.	**20%**	**9**
Unit 4: Overview of Refining Processes: Various refining processes such as thermal methods, cracking processes, hydro processes, isomerization process, alkylation process, reforming process, polymerization process.	**20%**	**8**
Unit 5: Petroleum Fractionation: Primary Treatments Of Petroleum/crude oil: Settling and sedimentation of petroleum, dewatering and desalting processes. Importance of desalting process, heating and pumping of wax petroleum/crude oil. **Fractionation Process of Petroleum**: Historical development of fractionation of petroleum, modern processes of fractionation such as atmospheric distillation, vacuum distillation and azeotropic and extractive distillation etc. arrangement of reflux type. Equipment used for petroleum fractionation such as columns, packing and trays etc.	**20%**	**10**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**

After successful completion of the above course, students will be able to: CO1: To **explain** petroleum terminology, properties, and classification based on chemical composition and end-use. CO2: To **analyze** abiogenic and biogenic theories of petroleum origin and relate them to petroleum composition and kerogen for mation. CO3: To **explain** petroleum refining operations, test methods, and blending processes used in refineries. CO4: To **analyze** modern petroleum fractionation processes including atmospheric, vacuum, and special distillation techniques. CO5: To **apply** knowledge of petroleum products and re fining processes to industrial, energy, and environmental contexts.	Cognitive	Understand, Apply

Learning Resources	
1.	Reference Books: James Speight, "The Chemistry and technology of petroleum", 2ndEdition, Marcel Dekker,(1991). W.L.Nelson ,Petroleum Refinery Engineering, McGrawHill, Newyork, (1958). R.A. Meyers, 'Handbook of Petroleum refining processes',3rd Edition, McGraw Hill, (2004)
2.	Journals & Periodicals:
3.	Other Electronic Resources:

Evaluation Scheme	**Total Marks**		
Theory: Mid semester Marks	20 marks		
Theory: End Semester Marks	40 marks		
Theory: Continuous Evaluation Component Marks			
	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Open Book Assignment	10 marks	
	Total	**40 Marks**	

Mapping of PSOs & Cos

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	1	1
CO5	3	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	1	1	1	0	0	0	0	1
CO2	3	3	1	1	1	1	1	0	0	0	0	1
CO3	3	2	2	1	2	1	1	0	0	1	1	1
CO4	3	3	2	2	2	1	1	0	0	1	1	1
CO5	2	3	2	1	2	3	1	0	0	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH605 B	COURSE NAME POL-YMER SCIENCE & TECHNOLOGY	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	Nil
Course Category	Professional Elective
Course focus	Employability
Rationale	international relevance
Course Revision/ Approval Date:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	1. To **explain** and classify polymers based on molecular structure, properties, and applications. 2. To **analyze** polymerization mechanisms and processing techniques used in polymer industries. 3. To **evaluate** the mechanical and viscoelastic behavior of polymeric materials through structure–property relationships. 4. To **apply** principles of polymer technology for selection of suitable materials and manufacturing processes in engineering applications. 5. To **assess** polymer recycling and plastic waste management practices with respect to sustainability and societal responsibility.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Fundamentals of polymers Theory: Introduction Introduction to polymers, Basic Concepts, Polymer based industries and feed stocks. Indian scenario of polymer industries. Classification of Polymers. State of polymer, structure property relations and transition temperatures. Polymer solutions, polymer characterization, Molecular weight & its determination techniques, polymer fractionation.	**20**	**10**
Unit 2: Classification of polymerization processes Theory: Introduction to polymerization process, Types of polymerization processes	**20**	**10**

with their mechanism and kinetics: Chain polymerization, co- polymerization, addition polymerization, Condensation polymerization, coordination polymerization, Techniques of polymerization.		
Unit 3: Types of polymers and their properties Plastics materials & some typical manufacturing process of some polymers: Polyolefins, Polycarbonates, Poly Vinyl Chloride (PVC), Polystyrene, PMMA etc.), Rubbers and fibre materials with typical manufacturing process. Mechanical properties: Elasticity, visco-elasticity, factors affecting mechanical behaviour etc.	**30**	**15**
Unit 4: Recycling of polymers/plastics Theory: Recycling of polymers/ plastics, Importance of recycling, Recycling codes.	**15**	**5**
Unit 5: Plastic Waste Management: Theory Necessity and importance, social responsibilities towards plastic waste management.	**15**	**5**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomess:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Analyze** polymer structures and molecular characteristics to correlate with material properties. CO2: **Evaluate** polymerization mechanisms, kinetics, and rheological behavior for polymer processing applications. CO3: **Interpret** data from polymer characterization techniques to assess molecular, thermal, and mechanical properties. CO4: **Assess** polymer recycling and plastic waste management strategies considering sustainability and regulatory frameworks. CO5: **Select** and justify polymeric materials for engineering applications based on performance, processing, and environmental constraints.new products.	Cognitive	Understand, Analyse, Evaluate, Apply

Learning Resources	
1.	Reference Books: Premamoy Ghosh, "Polymer science and Technology: Plastic, rubbers, blends and composites, 3rd Edition, Mc Graw Hill Education, (2011). Vasant R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar "Polymer Science", New age international, New Age International Pvt. Ltd Publishers, (2015). George Odian, "Principle of polymerization", 4th Edition, WileyBlackwell publication (2004).
2.	Journals & Periodicals: Reactive and Functional Polymers, Polymer Journal, Journal of Polymer Science
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	2	2
CO4	2	2	3
CO5	3	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

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

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH605E	COURSE NAME GREEN TECHNOLOGY	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	0	0	3	3	0	0	3

Course Pre-requisites	Nil
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	25-07-2024
Course Objectives **(As per Blooms' Taxonomy)**	1. To **introduce** the principles of green technology, green chemistry, and green engineering for sustainable industrial development. 2. To **explain** clean and cleaner production concepts aimed at pollution prevention and resource efficiency. 3. To **familiarize** students with waste minimization and waste-to-wealth approaches for sustainable energy and material recovery. 4. To **apply** green technology concepts in green buildings, organic farming, and eco-friendly system design. 5. To **highlight** recent developments in green industrial processes with environmental and societal relevance.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Green Technology The twelve Principles of Green Chemistry and Green Engineering with examples. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling. Pollution – types, causes, effects and abatement. Environmentally benign processes alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy efficient design of processes- photo, electro and sonochemical methods, microwave assisted reactions.	**20%**	**8**

Unit 2: Clean Energy production Cleaner Production Concept: Theory of cleaner production, Effect of Cleaner Production on industrial economy, Need for Cleaner Production, Barriers to Cleaner Production. Cleaner Production Methodology: Six step methodology for Cleaner Production, Total quality management concepts, Cleaner Production Options, Cleaner Production Programme Indicators,	**20%**	**10**
Ecologically friendly products, environmental designation, concept of eco-design, Case Studies on Cleaner Production: Cleaner production case study in following Industries Textile processing, Paper mill, Dye manufacturing **Renewable Energy Production:** Solar Energy, SPC, Fuel Cell Technology, clean hydrogen production, nuclear fuel, wind energy, wave energy, hydrogen energy, ocean thermal energy, Bio ethanol, Bio- diesel, Fuel economy, Innovation in electric equipment.		
Unit 3: Waste to energy Waste as a Renewable Energy Source, Waste-to Energy Conversion: Thermo-chemical Conversion, Biochemical Conversion, Physico-chemical Conversion, Factors affecting Energy Recovery from waste, Agricultural Residues, Animal Waste, Industrial Wastes, Forestry Residues, Converting Waste Heat to Electricity, Bio energy as by product of waste processing, Environmental significance, Introduction to anaerobic digestion, Methane production, Bio-methanation from sludge digestion	**20%**	**10**
Unit 4: Green Farming and Concept of Green Building Organic farming: Soil quality index, soil quality improvement, organic farming, organic fertilizer: its types and production, green pesticide, crop rotation, Organic farming , Need of Organic Farming, Benefits of Organic Farming, Social aspects of Organic Farming, Market aspects of Organic Farming, Organic Fertilizer, Benefits of Organic Fertilizer, Preparation of Organic Fertilizer, Sources of nutrients for Organic Agriculture: Organic Manure – Farmyard manure(FYM) Rural compost, City compost, Oil cakes, Animal wastes, Vermicomposts, etc; Characterization and Nutrients content of the above sources Concept of Green Building: Need of energy in buildings, Role of building design and building services to evaluate the energy performance in buildings. Study of Climate and its influence in building design for energy requirement, Principles of energy conscious design of buildings, Passive Cooling.	**20%**	**10**
Unit 5: Development of Green Industrial processes Pollution statistics from various industries, General Characteristics of Industrial Effluents, Effects on Environment - ISI tolerance limits for discharging industrial effluents into surface water, into public sewers and onto land for irrigation - Toxic chemicals from industry. Pretreatment of Industrial effluents	**20%**	**7**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomess:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**

After successful completion of the above course, students will be able to: CO1: **Analyze** green chemistry and green engineering principles for environmentally sustainable chemical processes. CO2: **Evaluate** cleaner production strategies and green process modifications for pollution prevention in industries.	Cognitive	Understand, Apply, Explain
CO3: **Assess** waste-to-energy and waste-to-wealth technologies for sustainable resource utilization. CO4: **Apply** green technology concepts to minimize environmental impact in industrial operations and unit processes. CO5: **Evaluate** green building and organic farming practices with respect to energy efficiency and environmental sustainability.		

Learning Resources	
1.	Reference Books: 1. Green Chemistry – An introductory text - M. Lancaster, RSC 2. Green chemistry metrics - Alexi Lapkin and David Constable (Eds) , Wiley publications. 3. Numersorn, N.L., Liquid Waste from Industry – Theories, Practice and Treatment, Addison-Wesley. 4. Patwardhan, A.D., Industrial WasteWater Treatment, PHI Learning, 2009 Rao, M.N., and Dutta, A.K., Wastewater Treatment, IBH Publications. 5. Misra Krishna B. , Cleaner Production: Environmental and Economic Perspectives, Springer, Berlin, Latest edition. 6. Dr. Ruth Hillary , Environmental Management Systems and Cleaner Production Wiley, New York, Latest edition.
2.	Journals & Periodicals: Green Technology Journal
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	2	3	3
CO3	1	3	3
CO4	2	3	3
CO5	1	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	0	0	1	3	2	0	0	0	1
CO2	2	3	2	1	1	2	3	2	0	0	1	1
CO3	1	2	2	1	1	2	3	2	0	0	1	1
CO4	2	3	2	1	1	2	3	2	0	0	1	2
CO5	1	2	1	0	0	2	3	2	0	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH605F	COURSE NAME INDUSTRIAL ENGINEERING PRACTICES	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	3	3	0	0	3

Course Pre-requisites	Nil
Course Category	Professional Elective
Course focus	Employability
Rationale	International relevance
Course Revision/ Approval Date:	14/4/2017 21/03/2023
Course Objectives **(As per Blooms' Taxonomy)**	1. To **analyze** structures and apply management functions, roles, competencies, POLCA, and Six M's. 2. To **apply** OR tools, solve optimization problems, and interpret statistical data for decisions. 3. To **evaluate** work study methods and design efficient processes using time–motion and flow charts. 4. To **analyze** project phases, apply EVM, and develop resource management strategies. 5. To **apply** financial principles and evaluate costing methods for sound industrial decisions.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Principles of Management Theory: Organization, POLCA, Management Functions, Management Roles and skills, Management competency's, Six M's of Management.	**20%**	**9**
Unit 2: Operation Research, Statistics Operation research Tools & Techniques, Linear Programming Transportation, Queuing , Decision theory Statistics parameters, Qualitative & Quantitative data, Quartile, Measures of Variation	**20%**	**11**

Unit 3: Industrial Engineering Industrial Engineering, Work study, Techniques of Works study, Time and Motion Study, Flow process chart	**20%**	**8**
Unit 4: Project Management, Operation Management Phases of Project and Operation Management, Constraints, EVM, Resource Management	**20%**	**7**
Unit 5: Financial and Cost Management Time value of money, Compounding, Discounting, IRR, NPV, Payback period, Discounted payback period, Balance sheet, P&L, Cash flow Cost classifications, Costing methods	**20%**	**10**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Objectives:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Analyze** organizational structures and apply management functions, roles, competencies, POLCA, and the Six M's framework to improve operational effectiveness. CO2: **Apply** operations research techniques to formulate and solve optimization problems, and interpret statistical data to support managerial decision-making. CO3: **Evaluate** work study methodologies and design efficient processes using time study, motion study, and flow charting techniques. CO4: **Analyze** project life-cycle phases and apply Earned Value Management (EVM) techniques to develop effective resource planning and control strategies. CO5: **Apply** and evaluate financial management principles and costing methods to support sound and economically viable industrial decisions.	Cognitive	Understand, Analyse, Evaluate, Apply, create

Learning Resources	
1.	Text books and Reference Books: ➢ Principles of management by Gupta and Meenakshi, ➢ Cost and Management Accounting by M N Arora, ➢ Financial Management by C. Paramasivan, T. Subramanian, ➢ Project Management by Dr. Sapna Bansal ➢ Operations Research: An Introduction Book by Hamdy A. Taha ➢ Principles and Practice by S K Mandal
2.	Journals & Periodicals: 1. S Rohith, N Mohan, Vinayak Malik, Kuldeep K Saxena, M Akshay Prasad,Modelling and optimization of selective laser melting parameters using Taguchi and super ranking concept approaches,International Journal on Interactive Design and Manufacturing (IJIDeM) , Published: 27 August 2022 2. A multi-objective mathematical planning model for a multi-level sustainable supply chain considering market boom and downturn Ali Goodarzi; Ali Mostafaeipour; Hasan Hosseini Nasab; Yahia Zare Mehrjerdi JIEMS, Volume 10, Issue 2 , December 2023, Pages 19-41 3. An intelligent hybrid model for forecasting the stock price index volatility: The case of Tehran stock exchange Mojtaba Sedighi; Mahdi Madanchi Zaj JIEMS, Volume 10, Issue 2 , December 2023, Pages 116-130 https://doi.org/10.22116/jiems.2024.352402.1496 4. Just-in-time parallel job scheduling: A novel algorithm Javad Behnamian JIEMS, Volume 9, Issue 2 , December 2022, Pages 1-12 https://doi.org/10.22116/jiems.2022.346243.1491 5. ORGANIZATIONAL THEORY, SYSTEMIC THINKING AND SYSTEM MANAGEMENT, AIMI Journals, 2012 6. CUSTOMER RELATIONSHIP MANAGEMENT AND BUSINESS STRATEGIES Profile image of AIMI Journals Industrial Management Institute AIMI Journals Industrial Management Institute 2012

3.	Other Electronic Resources: 1. A state of the art of Lean Six Sigma in the Indian context – 21st century: a bibliometric analysis, G. Citybabu and S. Yamini 2. An investigation and implementation framework of Lean Green and Six Sigma (LG&SS) strategies for the manufacturing industry in India Jaivesh Gandhi, Shashank Thanki and Jitesh J. Thakkar 3. The role of big data for Supply Chain 4.0 in manufacturing organisations of developing countries Vaibhav S. Narwane, Rakesh D. Raut, Vinay Surendra Yadav, Naoufel Cheikhrouhou, Balkrishna E. Narkhede and Pragati Priyadarshinee 4. Strategic planning to investigate the decision index of organization for effective total quality management implementation – in context of Indian small and medium enterprises Lalit K. Toke and Shyamkumar D. Kalpande

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	1
CO2	0	2	2	1
CO3	0	2	2	1
CO4	0	2	2	1
CO5	1	2	2	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	0	1	2	1	1	2	1	2	1
CO2	3	3	2	0	3	0	0	0	0	1	0	1
CO3	2	2	3	0	2	0	0	0	1	1	0	1
CO4	2	2	2	0	2	0	0	0	1	1	3	1
CO5	2	2	2	0	2	0	0	1	0	1	3	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH605G	COURSE NAME ADVANCED SEPARATION TECHNIQUES	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	Mass Transfer Operations
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	12-06-2018 21-03-2023
Course Objectives **(As per Blooms' Taxonomy)**	1. To **explain** the principles, mechanisms, and configurations of advanced separation techniques used in chemical engineering applications. 2. To **analyze** membrane separation processes, including gas separation, pressure-driven, electrically driven, and membrane-assisted systems. 3. To **evaluate** supercritical extraction and membrane-based separations in comparison with conventional separation methods. 4. To **assess** osmotic distillation, short-path distillation, reactive distillation, catalytic distillation, and pressure swing distillation for specific process requirements. 5. To **apply** appropriate advanced separation techniques based on process efficiency, energy consumption, operational limitations, and sustainability considerations.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to membranes and membrane processes Principles, mechanisms, membrane materials and various membrane modules used in membrane separation processes, classification, application & advantages of membrane separation processes. Membrane Separation Processes Gas separation processes, reverse osmosis, ultrafiltration.	**20%**	**9**
Unit 2: Membrane separation Processes Pervaporation, dialysis and electrodialysis, membrane reactor	**20%**	**9**

Unit 3: Super Critical Extraction Working Principle of supercritical extraction, advantage & disadvantages of supercritical solvents over conventional liquid solvents, advantage & disadvantages of supercritical extraction over liquid-liquid extraction, applications of supercritical extraction	**20%**	**9**
Unit 4: Osmotic and Short Path Distillation Osmotic Distillation: Concept, working and application of osmotic distillation	**20%**	**9**

Short Path Distillation: Concept & working of short path Distillation Unit (SPDU), Difference between short path distillation & molecular distillation, applications of SPDU		
Unit 5: Reactive, Catalytic and pressure swing distillation **Reactive and Catalytic Distillation:** Concept, advantages and disadvantages, applications. **Pressure Swing Distillation:** Concept & Working of pressure swing distillation (PSD), Advantage & Disadvantages of PSD over azeotropic and Extractive Distillation, Applications of PSD	**20%**	**9**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomess:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Analyze** the role and industrial significance of advanced separation techniques in modern chemical process industries. CO2: **Evaluate** the applicability of membrane-based and non-conventional separation techniques for specific industrial processes. CO3: **Apply** advanced separation techniques to solve separation problems where conventional methods are technically or economically infeasible. CO4: **Compare** and assess advanced and conventional separation techniques based on efficiency, energy consumption, and operational limitations. CO5: **Select** and justify appropriate separation techniques using technical, economic, and sustainability-based criteria.	Cognitive	Understand Apply Evaluate

Learning Resources

1.	Reference Books: 1. S. B. Thakore and B. I. Bhatt, Introduction to Process Engineering and Design, Tata Mc-Graw Hill 2. W.L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, Tata McGraw Hill. 3. Membrane separation Processes, by Kaushik Nath, PHI pvt. Ltd., 2008

	4. Perry Chemical Engineers Handbook' 8th Edition by R.H Perry and D. Green
2.	Journals & Periodicals:
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	2	2	2
CO5	2	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

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

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTOE01	COURSE NAME PLANT UTILITIES	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	NIL
Course Category	Professional Elective
Course focus	Employability
Rationale	international relevance
Course Revision/ Approval Date:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	1. **Provide** students with a conceptual understanding of utility systems required for chemical process industries. 2. **Enable** students to analyze water and air utility requirements for industrial operations. 3. **Develop** the ability to analyze steam generation and distribution systems used in chemical plants. 4. **Equip** students to evaluate refrigeration and insulation systems for industrial utility applications. 5. **Prepare** students to apply principles of vacuum and venting systems for various process operations.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Water Raw water storage and treatment, Treatment of water for soft water and D.M. water and RO water, Cooling water system, Fire water system.	**20%**	**10**
Unit 2: Air Compressed air for blowers and compressors. Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Air drying system for instrument air and plant air. Humidification and dehumidification of air, operational, maintenance and safety aspects as	**20%**	**10**

utilities.		
Unit 3: Steam Properties of steam, steam generation by boilers, types of boilers and their operation, Steam generation by using process waste heat, Distribution of steam in plant, Steam distribution including appropriate mechanical valves and instrumentation, Steam traps.	**20%**	**10**
Unit 4: Refrigeration Refrigeration mechanisms like compression refrigeration, absorption refrigeration and vacuum ejector system, Types of refrigerants, Importance of insulation, insulation material and their effect on various materials of equipment piping, fitting and valves.	**20%**	**10**
Unit 5: Vacuum & Venting Systems Selection of vacuum system for various process operations, Introduction to vacuum systems and types of vents.	**20%**	**5**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Analyze** water utility systems including treatment, storage, cooling, and fire water systems for industrial use. CO2: **Evaluate** compressed air generation and distribution systems for plant and instrument air applications. CO3: **Analyze** steam generation and distribution systems to assess efficiency and operational suitability. CO4: **Evaluate** refrigeration systems and insulation practices for industrial process requirements. CO5: **Apply** principles of vacuum and venting systems to select suitable utilities for chemical process operations.	Cognitive	Understand, Analyse, Remember, Apply

Learning Resources	
1.	Reference Books: Perry R. H., Green D., Perry's Chemical engineering handbook. Jack Broughton; Process utility systems; Institution of Chem. Engineers U.K.

2.	Journals & Periodicals:
3.	Other Electronic Resources:

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	2	3	3
CO3	2	3	3
CO4	2	3	3
CO5	1	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	0	0	0	2	1	1	3
CO2	3	3	3	2	1	0	0	0	2	1	1	3
CO3	2	3	3	3	1	0	0	0	2	1	1	3
CO4	2	2	3	3	2	0	0	0	2	1	1	3
CO5	2	2	2	2	2	0	1	1	2	2	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTOE02	COURSE NAME CORROSION SCIENCE	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	NIL
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	1. To **develop** a systematic understanding of corrosion phenomena and electrochemical principles governing material degradation in engineering systems. 2. To **explain** thermodynamic and kinetic aspects of corrosion processes for predicting corrosion behavior under diverse service conditions. 3. To **familiarize** students with various forms of corrosion and their underlying mechanisms in industrial environments. 4. To **introduce** corrosion prevention, monitoring, and control strategies used in chemical and process industries. 5. To **highlight** the economic, safety, and environmental implications of corrosion-related failures in industrial operations.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Basics of Corrosion, Anodic and Cathodic Reactions, Corrosion Cells, Mechanism of corrosion of iron, Gibbs Free Energy And Electrode Potential, Cell Potential and EMF, Nernst Equation, Pourbaix diagram	**20%**	**9**
Unit 2: Kinetics of corrosion, Corrosion rate, Electrochemical Polarization, Exchange current density, Tafel Equation for anodic and cathodic polarization, Mixed Potential Theory, Passivation	**20%**	**9**

Unit 3: Forms of Corrosion, Uniform Corrosion, Crevice Corrosion, Intergranular Corrosion, Pitting corrosion, Stress corrosion cracking, Erosion Corrosion, Corrosion control: Anodic and Cathodic Protection and Monitoring, Coatings, Paint, Failure of paints and coatings	**20%**	**9**
Unit 4: Material Selection: Use of Iron, Carbon Steel, low Alloy steels, Titanium alloy, Zirconium alloy Tantalum alloy, Copper alloys, Aluminium Alloys in different Chemical Environments, Corrosive environments: Sodium chloride, hydrochloric acid, phosphoric acid, hydrofluoric acid, sulfuric and nitric acid, Alkalies, Organic acids and halogens	**20%**	**9**
Unit 5: Corrosion control methods in process industries, Case Studies on Economic appraisals of corrosion control measures and major industrial hazards due to corrosion/metal failure.	**20%**	**9**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Analyze** corrosion phenomena using electrochemical principles, thermodynamic criteria, and potential–pH relationships. CO2: **Evaluate** corrosion mechanisms of engineering materials under different chemical and process environments. CO3: **Differentiate** and analyze various forms of corrosion and associated failure modes in industrial systems. CO4: **Select** and justify appropriate corrosion prevention and control techniques for given industrial applications. CO5: **Assess** corrosion-related risks, material failures, and economic implications to recommend effective corrosion management strategies.	Cognitive	Understand, Analyse, Remember, Apply

Learning Resources

1.	Principles and Prevention of Corrosion, Denny A. Jones, second edition, Prentice Hall, Upper Saddle River, NJ 07458 Principles of corrosion Engineering and corrosion control, Zaki Ahmad, Elsevier Science & Technology Books ISBN: 0750659246 H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley (NY), (1985). Corrosion Engineering by Mars G. Fontana, McGraw-Hill, (1986) Introduction to Corrosion Science by By E. McCafferty, Springer Publication (2010)
	L. L. Shreir, Corrosion. Vol I and II, Butterworths, Kent, (1976)
2.	Journals & Periodicals: Corrosion Science, Elsevier publication Anti Corrosion Methods and Materials, Emerald Publications NACE Newsletter : EAPA NEWS and NACE international Corrosion Press
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	1
CO3	2	1	1
CO4	2	3	2
CO5	1	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	0	1	1	1	0	0	0	1
CO2	3	3	1	1	0	1	1	1	0	0	0	1
CO3	2	3	1	1	0	2	1	1	0	0	0	1
CO4	2	2	2	1	1	2	2	1	0	0	1	1
CO5	1	2	1	0	0	3	3	2	0	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTOE08	COURSE NAME EN- ERGY TECHNOLOGY	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	NIL
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	1. To **analyze** conventional and alternative energy resources and evaluate global and Indian energy production–consumption trends. 2. To **classify** solid, liquid, and gaseous fuels, apply analytical methods, and evaluate fuel processing and utilization systems. 3. To **apply** principles of solar and wind energy conversion, design collection systems, and assess industrial applications. 4. To **analyze** biomass conversion technologies and ocean energy systems, and design sustainable energy solutions. 5. To **evaluate** hydrogen, methanol, nuclear, geothermal, and MHD power systems, and integrate energy conservation strategies.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction Conventional (fossil energy) and non-conventional (alternative energy) resources & reserves. Global Energy production & consumption pattern. Production & consumption pattern in India.	**20%**	**5**

Unit 2: **Classification of Fuels** **Solid Fuels:** Biomass, Wood and Charcoal. Classification & Rank of Coal, Peat, Lignite, Sub Bituminous coal, Bituminous coal, Anthracite coal, Cannel & boghead coal. Physical Properties of coal, Proximate & Ultimate Analysis of Coal, Cleaning, washing & Storage of coal. Theory of coal Pyrolysis and Carbonization: Low Temperature Carbonization (LTC), High Temperature Carbonization (HTC), Horizontal & Vertical Gas Retorts, Coke Ovens- Beehive & By product slot type. Recovery of by-products. Details of Structural configuration and Operating principles. **Liquid Fuels:** Constitution of petroleum, theory of formation of crude petroleum oil.Characterization of crude oil & petroleum fuels. Process of a typical Indian refinery. Liquid fuel from coal. Other Synthetic Liquid fuels (Benzol, shale oil, Gashol, power alcohol Colloidal fuel). **Gaseous Fuels:** Classification of gaseous fuel; Physico-chemical principles, Calorific Value, Wobbes index, and flame speed. Flow sheet & operation of Producer gas, Water gas, Carburetted water gas, oil gas, cokeoven gas, blast furnace gas, Natural Gas and LPG. Coal Bed Methane. **Bio Gas:** Principles and Operation of Aerobic & Anaerobic digestors, Biogas generation and management & flowsheet with special reference to waste utilization.	**20%**	**15**
Unit 3: **Solar Energy:** Devices for measurement of solar flux. Different types of Solar collectors : Flat plate, parabolic, concentric & heliostat, Utilization of Solar Energy- For room heating, water heating other industrial uses -solar Pond, Photovoltaic cells, Chemical storage etc. **Wind Energy:** Basic principles, power in wind, force on blades & turbines, wind energy conversion, site selection, basic components of wind energy conversion systems (WECS), classification of WECS, wind energy collectors, applications of wind energy	**20%**	**10**
Unit 4: **Energy from Biomass:** Introduction, energy plantation, biomass conversion technologies, photosynthesis, biogas generation, factors affecting biogas	**20%**	**10**

generation, classification of biogas plants & their comparisons, types of biogas plants (including those used in India), biogas from plant wastes, community plants & site selection, digester design considerations, design calculations, methods of maintaining & starting biogas plants, properties & utilisation of biogas, thermal gasification of biomass, pyrolysis, alternative liquid fuels **Energy from Oceans:** OTEC, methods (open cycle & close cycle) energy from tides, components of tidal power plants, operation, methods of utilisation of tidal energy, storage, ocean waves, wave energy conversion devices.		
Unit 5: **Hydrogen & Methanol:** Properties of Hydrogen, production of hydrogen, thermochemical methods, fossil fuel methods, solar methods, storage & transportation, safety & management, fuel cell introduction. **Nuclear Energy:** Fission, fusion, fuel for nuclear fission reactor (exploration, mining, milling concentrating, refining, enrichment, fuel fabrication, fuel use, reprocessing, waste disposal), storage & transportation, fast & slow neutrons, multiplication factors & reactor control, Uranium enrichment process, nuclear reactor power plant, fast breeder reactor, boiling water reactor, pressurized heavy & light water reactor. Introduction to geothermal energy, Magneto Hydro- Dynamic (MHD) Power Generation. Recovery of low level energy and energy conservation.	**20%**	**5**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: **Analyze** and evaluate conventional and alternative energy resources by examining global and Indian energy production–consumption patterns and sustainability indicators. CO2: **Classify**, analyze, and evaluate solid, liquid, and gaseous fuels by applying standard analytical techniques and assessing fuel processing and utilization systems. CO3: **Apply** the principles of solar and wind energy conversion to design energy collection systems and assess their suitability for industrial and utility-scale applications.	Cognitive	Understand, Analyse, Remember, Apply

CO4: **Analyze** biomass conversion technologies and ocean energy systems, and design sustainable energy solutions considering environmental and techno-economic constraints. CO5: **Evaluate** and integrate hydrogen, methanol, nuclear, geothermal, and MHD power systems with appropriate energy conservation and efficiency-improvement strategies.		

Learning Resources	
1.	➢ Energy Sources 2nd Ed. by G. D. Rai, Khanna Publications, New Delhi ➢ Fuels & combustion by Samir Sarkar, Orient Longmans (1974) ➢ Solar Energy by Sukatame, Tata McGraw Hill, New Delhi ➢ Energy Technology by Rao & Parulaker
2.	Journals & Periodicals: Energy and fuels, energy and environment, International Journal of Energy research, Renewable Energy Journal
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PS04
CO1	3	0	0	1
CO2	2	0	0	1
CO3	3	0	0	1
CO4	3	0	0	1
CO5	3	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	0	2	2	3	1	0	1	0	1
CO2	3	3	2	0	2	1	2	1	0	1	0	1
CO3	3	2	3	0	3	2	3	1	0	1	0	1
CO4	3	3	3	0	3	2	3	1	0	1	0	1
CO5	3	3	2	0	2	2	3	1	0	1	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

BTOE06	SOFT SKILLS & INTERPERSONAL COMMUNICATION	L	T	P	C
		3	0	0	3
Total Credits: 3	**Total Hours in Semester: 45**	**Total Marks: 100**			

1.	**Course Pre-requisite: NIL**
2.	**Course Category: Open Elective**
3.	**Course Revision/Approval Date:**
4.	**Course Objective:**
4.1.	To understand and develop the soft skills
4.2.	To understand the importance of communication
4.3.	To develop interpersonal communication

Course Content	Weightage	Contact Hours	Pedagogy
Unit 1: Self-Analysis & Creativity Introduction – self & others, SWOT analysis, JAM, Question link, Agreeing & disagreeing, persuasion	25%	12	Chalk – Board, Presentation, Video & Language lab
Unit 2: Leadership & Teamwork Importance, Skills required, teamwork, relationship between leadership & teamwork – personally, socially and professionally	25%	11	Chalk – Board, Presentation, Video & Language lab
Unit 3: Decision Making & Conflict resolution Importance and necessity of decision making, Process, Weighing positives and negatives, Conflict resolution, Importance, techniques & approaches	25%	11	Chalk – Board, Presentation, Video & Language lab
Unit 4: Stress Management& Emotional Intelligence Causes of stress, Impact, Mitigation, Circle of control, Emotional intelligence, Scales & approaches	25%	11	Chalk – Board, Presentation, Video

Learning Resources	
Textbook:	➢ An Introduction to Professional English and Soft Skills by B K Das
Reference Book:	➢ The Functional Aspects of Communication Skills Prasad
Journals & Periodicals:	

Other Electronic Resources:	

Evaluation Scheme	**Total Marks**	
Mid Semester Marks	30 marks	
End Semester Marks	50 marks	
Continuous Evaluation Marks	Attendance	5 marks
	Quiz	5 marks
	Skill enhancement activities / case study	5 marks
	Presentation/ miscellaneous activities	5 marks

Course Outcome	1.	At the end of the day students will be able to have the knowledge of soft skill
	2.	Students will be able to have the knowledge of interpersonal Communication

AECC 601	Indian Constitution	SEMESTER VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	0	2	2	0	0	2

Course Pre-requisites	Nil
Course Category	Ability Enhancement Compulsory Course
Course focus	Employability and Skill Development
Rationale	
Course Revision/ Approval Date:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. To **introduce** the philosophy, structure, and salient features of the Indian Constitution. 2. To **explain** Fundamental Rights, Fundamental Duties, and Directive Principles as guiding values of Indian democracy. 3. To **describe** the functioning and distribution of powers among the Union, State, and local governments. 4. To **familiarize** students with the structure and role of the Indian judiciary and constitutional bodies. 5. To **develop** awareness of constitutional provisions related to governance, citizenship, and public accountability.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Constitution – Strategies and Principles: 1. Meaning and important of constitution 2. Making of Indian constitution – sources 3. Salient Features of Indian constitution.	20%	06

Unit 2: Fundamental Rights and Directive Principles 1. Fundamental Rights 2. Fundamental Duties 3. Directive Principles	20%	06
Unit 3: Government of the Union 1. President of India – Election and powers 2. Prime Minister and council of ministers 3. Lok Sabha – composition and Powers	20%	06
4. Rajya Sabha – Composition and Powers		
Unit 4: Government of the States & The Judiciary 1. Governor – Powers 2. Chief Minister and Council of ministers 3. Legislative Assembly – Composition and Powers 4. Legislative Council – Composition and Powers 5. Features of judiciary system in India 6. Supreme Court – Structure and Jurisdiction	20%	06
Unit 5: Administrative Organization and Constitution 1. Federalism in India – features 2. Local Government – Panchyats and Powers and functions 73rd and 74th Amendments 3. Election Commission – Organization and functions 4. Citizen Oriented Measure – RTI and PIL – Provisions and Significance.	20%	06

Instructional Method and Pedagogy: Chalk-board and PowerPoint presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1 To **introduce** the philosophy, structure, and salient features of the Indian Constitution. CO2 To **explain** Fundamental Rights, Fundamental Duties, and Directive Principles as guiding values of Indian democracy. CO3: To **describe** the functioning and distribution of powers among the Union, State, and local governments. CO4: To **familiarize** students with the structure and role of the Indian judiciary and constitutional bodies. CO5: To **develop** awareness of constitutional provisions related to governance, citizenship, and public accountability.	Cognitive	Understand Analysis

Learning Resources	
1.	**Reference Books:** ➢ Introduction to the constitution of India, Durga Das Basu LexisNexis
2.	**Textbook:** ➢ India's Constitution by M.V. Pylee , New Delhi S. Chand Publication ➢ The Constitutional Law of India by J.N. Panday Allahabad Central Law Agency ➢ Constitution of India by National Portal of India

3	**Journals & Periodicals**
4	**Other Electronic Resources**

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Article review	10 marks
Open book	15 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	2	1	1
CO3	2	1	1
CO4	2	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	0	0	0	3	2	3	1	1	0	2
CO2	1	1	0	0	0	3	2	3	1	2	0	2
CO3	1	1	0	1	0	3	2	2	2	2	1	2
CO4	1	1	0	1	0	3	2	2	2	2	1	2
CO5	1	1	0	1	0	3	2	3	2	2	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

	Carbon Cap-ture,Utilization & Storage (CCS)	**SEMESTER VI**

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	-	3

Course Pre-requisites	Energy and sustainability concepts ,Chemical process Industries
Course Category	Program elective / Open elective
Course focus	Sustainability and Environmental Engineering
Rationale	Carbon Capture and Storage (CCS) is an important technology for reducing greenhouse gas emissions from industrial sources and power plants. This course introduces students to the science of carbon emissions, technologies for capturing CO_2, transportation methods, and geological storage. The course also explores the role of CCS in global climate mitigation strategies and sustainable development.
Course Revision/ Approval Date:	
Course Objectives (As per Blooms' Taxonomy)	To enable the student: 1. To explain the fundamentals of carbon emissions and climate change. 2. To describe the principles and technologies of CO_2 capture. 3. To explain CO_2 transportation and geological storage mechanisms. 4. To analyze the role of CCS in climate mitigation strategies. 5. To evaluate sustainable practices and reduction of CO_2 emissions in society.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit 1: Introduction to Carbon Capture and Storage Definition and Scope of CCS, Historical development of CCS technologies, Role of CCS in climate change mitigation, Global initiatives and policies supporting CCS, Climate before the Industrial Revolution, Natural CO_2 cycles and balance, Greenhouse gases: types, sources and natural roles, Pre-industrial climate stability and ecosystems, Transition to Industrial emissions and disruption of natural balance	20%	9

Unit 2: CO_2 Emissions and Climate Impact Sources of CO_2 emissions (natural vs anthropogenic), Greenhouse gases and cumulative effects, Impact of CO_2 on climate systems, Global warming causes and consequences, Case studies: glaciers, sea level rise, extreme weather	10%	5
Unit 3: CO_2 Capture and Overview of Storage Carbon capture fundamentals, Benefits of carbon capture, Carbon storage concepts, Integration of capture and storage in energy systems, CO_2 capture techniques, Pre-combustion capture, IGCC(Integrated Gasification Combined Cycle) systems, Post-combustion capture, Oxy-fuel combustion, Technology comparison (cost, efficiency), Emerging technologies (Direct air capture, Bio energy with CCS)	25%	11
Unit 4: CO_2 Transportation and Geological Storage CO_2 transportation methods (pipeline, ship, truck), Infrastructure and challenges, Safety and risk management, Transport case studies, Geological storage types, Storage conditions, Underground CO_2 behavior, CO_2 trapping mechanisms, Site selection and characterization, Injection technologies, Monitoring techniques, Long-term storage safety	25%	12
Unit 5: Reducing CO_2 in Daily Life Energy efficiency, Sustainable transport, Lifestyle changes and consumption, Renewable energy adoption, Community awareness programs, CCS adoption scenarios, CCS with circular economy, Policy and global cooperation, Vision for sustainable planet	20%	8

Instructional Method and Pedagogy:

1. Chalk and board teaching
2. PowerPoint presentations
3. Multimedia animations of CCS technologies
4. Case study discussions
5. Simulation demonstrations of carbon capture processes
6. Group discussions on environmental policies and sustainability strategies

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		

CO1: Explain the fundamentals of carbon emissions, greenhouse gases and climate change. CO2: Describe various carbon capture technologies such as pre-combustion, post-combustion and oxy-fuel combustion. CO3: Apply concepts of CO_2 transportation systems and geological storage mechanisms. CO4: Analyze environmental, technical and economic aspects of carbon capture and storage systems. CO5: Evaluate strategies for reducing CO_2 emissions and achieving sustainable development.	Cognitive	Understand, Apply, Analyze, Evaluate

Learning Resources	
1.	**Reference Books:** 1. Steve Rackley - Carbon Capture and Storage. 2. IPCC Climate Change Reports. 3. University of Edinburgh – Carbon Capture and Storage course material. 4. Relevant NPTEL lectures on climate change and CCS technologies.
2.	**Textbook:** • Howard J. Herzog - Carbon Capture. • IPCC Special Report - Carbon Dioxide Capture and Storage.

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	2	1
CO5	3	2	2
Avg.	3	1.4	1.2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	0	1	0	1	3	0	0	1	0	1
CO2	3	2	1	1	1	1	3	0	0	1	0	1
CO3	3	2	1	1	1	1	3	0	0	1	0	1
CO4	2	2	1	1	0	1	3	0	0	1	0	1
CO5	2	1	0	1	0	1	3	1	1	1	0	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BTCH701	COURSE NAME PROCESS MODELLING, SIMULATION AND OPTIMIZATION	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	2	0	6	4	1	0	5

Course Pre-requisites	Knowledge of unit operations, material & energy balances.
Course Category	Core
Course focus	Employability and Skill Development
Rationale	
Course Revision/ Approval Date:	18/01/2022
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1. Formulate mathematical models for chemical processes using mass, energy, and component balances. 2. Analyze and simulate chemical processes using appropriate numerical and computational techniques. 3. Evaluate process performance using optimization concepts for design and operational decision-making. 4. Apply suitable linear and nonlinear optimization techniques to improve efficiency of chemical engineering systems. 5. Utilize professional simulation and optimization software to model, simulate, and optimize industrial chemical processes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Modelling, Simulation & Optimization and applications in Chemical Engineering.	5%	4
Unit 2: Modelling Role of modelling in chemical engineering, classification of process models, model building, characteristics of mathematical models, formulation of dynamic models with various case studies based on mass, component, momentum and energy balances, Fluid flow, heat transfer, mass transfer and reaction engineering phenomena.	25%	13
Unit 3: Simulation Role of simulation in chemical engineering, partitioning and tearing, sequential and modular approaches to process simulation, analytical and numerical methods for solving model equations, accuracy and error analysis, commercial simulators, introduction to role of computation in simulation.	25%	13

Unit 4: Optimization Introduction to optimization, types of optimizations, optimization problem and its formulation, general approach for solution, objective functions, classification of optimization problems and methods.	15%	12
Unit 5: Optimization Techniques Conditions for maxima/minima; analytical methods: direct search (without constraints), lagrangian multiplier (with constraints), gradient method of optimization; single and multivariable search linear (LP) and nonlinear (NLP) programming with constraints and their applications; examples of optimization in chemical processes like: optimizing recovery of waste heat, optimal shell and tube heat exchanger design, optimal design and operation of binary distillation column, chemical reactor design and operation.	30%	18

List of Practical	Weightage	Contact hours
1: Introduction to Software Packages	10%	2
2: Introduction to simulation using, flow sheeting concepts (sequential modular, equation oriented) by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
3: To perform pure component property analysis by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
4: To perform property analysis of mixture by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
5: Simulation of Flash Distillation by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
6. Compute the bubble point by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
7. Compute the dew point by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
8. Produce Txy and Pxy diagram by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
9. Simulation of binary distillation column by using CHEMCAD/ASPEN Plus/DWSIM.	10%	2
10. Simulation of reactor and to estimate the %conversion using CHEMCAD/ASPEN Plus/DWSIM.	10%	2

Instructional Method and Pedagogy: Chalk-board, industrial visit, activities, PowerPoint

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able: CO1: To understand computational techniques to solve the process models. CO2: To understand computational techniques to solve the process models. CO3: Evaluate process performance using optimization concepts for design and operational decision-making. CO4: Apply suitable linear and nonlinear optimization techniques to improve efficiency of chemical engineering systems. CO5: Utilize professional simulation and optimization software to model, simulate, and optimize industrial chemical processes	Cognitive	Understand Apply Apply Create Analyse

Learning Resources	
1.	**Reference Books:** 1. Wayne Bequette, "Process Dynamics: Modeling, Analysis and Simulation", Prentice Hall International Inc. 2. William L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", McGraw Hill International Editions. 3. Ramiez, 'Computational methods for process simulation', Butterworth, (1992).
2.	**Textbook:** 1. B. V. Babu, "Process Plant Simulation". Oxford, (2005). 2. Edgar, Himmelblau, and Lasdon "Optimization of Chemical Process" McGraw-Hill, (1990)
3.	**Journals & Periodicals:** 1. International Journal of Modeling, Simulation, and Scientific Computing. 2. International Journal of Modeling and Simulation. 3. International Journal of Modeling, Simulation and Applications, Simulation Modelling Practice and Theory
4.	**Other Electronic Resources:** NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	
Practical Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Attendance	05 marks
Practical Exam	20 marks
Viva	10 marks
Journal	10 marks
Discipline	05 marks
Total	**50 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	2	3	1
CO4	2	3	1
CO5	2	3	3

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	2	0	0	0	0	0	0	1
CO2	3	3	1	2	2	0	0	0	0	0	0	2
CO3	2	3	2	1	2	0	0	0	0	0	2	1
CO4	2	3	2	1	2	0	0	0	0	0	2	2
CO5	2	3	2	1	3	0	0	0	1	1	2	2

COURSE CODE BTCH702	COURSE NAME PLANT DESIGN & ECO-NOMICS	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	Basic knowledge of chemical processing plant
Course Category	Core
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	18/01/2022
Course Objectives (As per Blooms' Taxonomy)	To enable the student: 1: To analyze process flow sheets, evaluate design tools and selection factors, and apply safety considerations in plant design. 2: To design piping layouts and control systems, and apply utility management for efficient plant operations. 3: To select appropriate equipment and materials, and design plant layouts considering location factors and scale models. 4: To interpret financial statements, apply cost concepts and budgeting, and evaluate investment decisions using NPV, IRR, and payback methods. 5. To develop project schedules using WBS, Gantt charts, and CPM, and integrate resource, cost, and risk management strategies.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction Introduction to Plant Design, Process flow sheets development, Types of flow sheets, Tools of the process design, Selection of process, Factors affecting process selection, Types of project design, Pilot plant, Safety Factors.	17.7%	8
Unit 2: Process Auxiliaries and Utilities Theory **Process Auxiliaries:** Piping design, layout, support for piping insulation, types of valves, process control & instrumentation control system design **Process Utilities:** Process water, boiler feed water, water treatment & disposal, steam, compressed air and vacuum system.	20%	9

Unit 3: Optimum Design Strategy for Process Equipment and Plant Layout Standard and special equipment, Material of construction for equipment, Specification sheet, Choice of equipment such as reactor, Mass transfer equipment, Heat transfer equipment, Factors affecting plant location, Principle of plant layout, Use of scale models	20%	9
Unit 4: Finance for Non-finance Basics of Finance and Accounting **Understanding Financial Statements** -Balance Sheet: assets, liabilities, and	22.2%	10
equity, Profit and Loss Account (Income Statement),Cash Flow Statement **Cost Concepts and Budgeting-**Types of costs: fixed, variable, direct, indirect, Break-even analysis, Budgeting basics and types of budgets **Working Capital and Business Finance -** Working capital management, Basics of capital structure, Sources of finance: equity, debt, internal accruals, Time value of money and simple investment appraisal (NPV, IRR, Payback Period)		
Unit 5: Project Planning Introduction to Project Planning, Work Breakdown Structure (WBS), Introduction to Gantt Charts and timelines,Critical Path Method (CPM) basics,Project scheduling tools , Resource and Cost Planning, Risk and Contingency Planning.	20%	9

Instructional Method and Pedagogy: Chalk-board, PowerPoint presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Analyze process flow sheets and evaluate plant design tools and selection criteria, while applying safety and statutory considerations in chemical/industrial plant design. CO2: Design piping layouts and instrumentation/control systems, and apply utility management principles to ensure efficient and reliable plant operations. CO3: Select appropriate equipment and construction materials, and design plant layouts by considering location factors, capacity requirements, and scale-model principles. CO4: Interpret financial statements, apply engineering cost concepts and budgeting techniques, and evaluate investment alternatives using NPV, IRR, and payback period methods. CO5: Develop comprehensive project schedules using WBS, Gantt charts, and CPM techniques, and integrate resource allocation, cost control, and risk management strategies.	Cognitive	Understand Create Create Analyse Analyse

Learning Rsources	
1.	**Reference Books:** 1. Perry R. H., "Chemical Engineering Handbook", McGraw Hill, 7th Edition. 2. F. C. Vibrandt and C. E. Dryden, "Chemical Engineering Plant Design", McGraw Hill, 5th Edition. 3. Ernst E. Ludwig, "Applied Project Engineering & Management", Gulf Pub. Co., (1988). 4. R Turton, R Balie, WB Whiting, J Shaeiwitz, D Bhattacharya Prentice Hall (4th Edition) Analysis, Synthesis, and Design of Chemical Processes 2013 5. Douglas J McGraw-Hill Sciences (1 st Edition) Conceptual Design of Chemical Processes
2.	**Textbook:** 1. M. S. Peters and Timmerhaus, "Plant Design & Economics for Chemical Engineers", McGraw Hill, 5th Edition.
3	**Journals & Periodicals:** 1. International Journal of Production Research, Taylor & Francis Online
4	**Other Electronic Resources:** 1. Process Design Decisions & Project Economics, NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Article Review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	0	0
CO2	2	0	0
CO3	3	0	0
CO4	1	2	2
CO5	0	2	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	0	2	2	2	1	0	1	0	1
CO2	3	2	3	0	3	2	2	1	0	1	0	1
CO3	3	2	3	0	2	2	2	1	0	1	0	1
CO4	2	2	2	0	2	0	0	1	0	1	3	1
CO5	2	2	2	0	2	0	0	0	1	1	3	1

COURSE CODE BTCH708	COURSE NAME PROCESS EQUIPMENT DE-SIGN - II	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	1	3	2	0	1	3

Course Pre-requisites	Engineering Mechanics, Process Equipment Design - I
Course Category	Core
Course focus	Employability and Skill Development
Rationale	
Course Revision/ Approval Date:	18/01/2022 21/03/2023
Course Objectives (As per Blooms' Taxonomy)	To enable the student: 1. To analyze stress–strain relationships, select appropriate construction materials, and apply design codes in pressure vessel fabrication. 2. To design vessel shells and heads, determine L/D ratios, and evaluate compensation methods for openings. 3. To classify supports and flanges, and design mechanical support systems ensuring structural integrity and reliability. 4. To apply analytical and graphical methods for shell and head design, and evaluate criteria for selecting vessel components. 5. To analyze vessels under vacuum and external pressure, apply elastic failure theories, and evaluate limitations of monobloc designs.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Stress and Strain relationship, Terminologies Selection of materials of construction for piping, Stress & strain relationships. Fabrication and finishing techniques for process equipment. Design codes and terminologies associated with pressure vessel design.	13.34%	4

Unit 2: Design of Shell, Design of Heads, L/D ratio of vessel & Compensation for Opening Design of different components of pressure vessels like Shell, Heads, L/D ratio & compensation for the openings.	13.34%	4
Unit 3: Design of supports and flanges Different types of supports, mechanical design of bracket support, skirt, support & saddle support, classification of flanges, their important features & selection criteria.	20%	6
Unit 4: Mechanical design of pressure vessel: Unit 4: Mechanical design of pressure vessel: Classification of pressure vessel, mechanical design of shell and head: shell	26.67%	8
and head subjected to internal pressure, Graphical & analytical method for Shell, different types of head, their selection criteria, Mechanical design of heads.		
Unit 5: Vessel under external pressure, Vessel under very high pressure Design of vessels with Inside vacuum, high pressure outside & combination of both. Design of external pressure vessel with elastic & plastic failures, Theories of elastic failure for design of high pressure vessels, Monobloc & its limitations.	26.67%	8

Instructional Method and Pedagogy: Chalk-board, PowerPoint presentation, tutorials

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able: CO1: Analyze stress–strain behavior of pressure vessel materials, select suitable construction materials, and apply relevant design codes and standards for pressure vessel fabrication. CO2: Design pressure vessel shells and heads by determining appropriate L/D ratios and evaluating reinforcement and compensation methods for openings. CO3: Classify and design pressure vessel supports and flanges by applying mechanical design principles to ensure structural integrity, stability, and operational reliability. CO4: Apply analytical and graphical design methods for shells and heads, and evaluate selection criteria for pressure vessel components in accordance with code requirements. CO5: Analyze pressure vessels subjected to vacuum and external pressure conditions, apply elastic failure theories, and evaluate the design limitations of monobloc pressure vessels.	Cognitive	Understand Understand Create Create Understand

Learning Resources

1.	**Reference Books:** 2. Brownell and Young, 'Process Equipment Design', 1st Edition, Wiley Publication, (2009). 3. S. B. Thakore and B. I. Bhatt, 'Introduction to Process Engineering and Design', 2nd Edition, McGraw-Hill Education (India) Pvt. Ltd., (2015). 4. Perry's Chemical Engineers Handbook, 8th Edition, Don Green and Robert H. Perry, Mc- Graw Hill.
2.	**Textbook:** 1. V.V. Mahajani and S. B. Umarji, 'Joshi's Process Equipment Design', 5th Edition, Trinity Press, (2017). 2. B.C. Bhattacharya, 'Introduction to chemical equipment design –Mechanical aspects'. CBS Publishing Co., (2008).
3	**Journals & Periodicals:** 1. IS:2825-1969, Design Codes for Unfired Pressure Vessels **2.** International Journal of Pressure Vessels and Piping, Elsevier
4	**Other Electronic Resources:**

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open book	15 marks
Article review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	0	0
CO2	3	0	0
CO3	3	0	0
CO4	3	0	0
CO5	3	0	0

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	0	2	2	1	1	0	1	0	1
CO2	3	3	3	0	2	2	1	1	0	1	0	1
CO3	3	2	3	0	2	2	1	1	0	1	0	1
CO4	3	3	2	0	2	2	1	1	0	1	0	1
CO5	3	3	2	0	2	2	1	1	0	1	0	1

COURSE CODE BTCH710	COURSE NAME CHEMICAL PROCESS SAFETY	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	3	3	0	0	3

Course Pre-requisites	Knowledge about chemical process equipment
Course Category	Core
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/07/2017 18/01/2022
Course Objectives (As per Blooms' Taxonomy)	To enable the student: 1. To develop a comprehensive understanding of process, plant, and environmental safety principles relevant to chemical industries. 2. To analyze causes and consequences of major industrial accidents for fostering a risk-aware engineering approach. 3. To introduce systematic hazard identification and risk assessment methodologies used in process industries. 4. To familiarize students with engineering controls, safety instrumentation, and safety management practices for loss prevention. 5. To integrate environmental regulations, sustainability concepts, and safety considerations in chemical plant operations.

Course Content (Theory)	Weightage	Contact hours
Unit I: Process Safety Fundamental **Definitions & Concepts: Risk and hazard definitions, goals of process safety management (PSM),**Overview of **Major Incidents, Definitions-** Toxicity classes, exposure thresholds (TLVs), routes of exposure and control methods, Flammability limits, fire triangle, types of explosions (deflagration, detonation, BLEVE), Runaway reactions and self-accelerating decompositions; introduction to reaction hazard assessment.	22.2%	10
Unit II: Hazard Identification and Risk Analysis **Hazard Analysis Techniques-** HAZOP studies, What-If, FMEA, Fault Tree Analysis (FTA), **Quantitative Risk Assessment-** Consequence and frequency analysis; risk matrices; Layer of Protection Analysis (LOPA), **Release & Dispersion Models-**Source terms; plume modeling of gases and vapors, Development of Risk Management Plan/Emergency response procedures.	26.6%	12

Unit III: Plant Safety • **Engineering Controls:** Design of pressure relief devices, rupture disks, flare systems, and alarms for overpressure protection. • **Instrumentation & Control:** Overview of Safety Instrumented Systems (SIS), interlocks, and shutdown systems. • **operating Procedures:** Standard operating procedures, lockout/tagout, confined space entry protocols. • **Personal Safety:** Work rules, PPE (gloves, respirators, etc.), hazard communication (labels and Safety Data Sheets) • **Electrical & Static Safety:** Grounding, bonding, and controls to prevent ignition. • **Emergency Systems:** Fire protection (sprinklers, extinguishers), spill containment, evacuation plans. • **Safety Audits & Culture:** Plant safety audits, training programs, and fostering a proactive safety culture. • **Emergency Response:** Onsite and offsite emergency planning and drills; liaising with local authorities.	22.2%	10
Unit IV: Environmental Safety **Regulations & Standards-** Overview of major environmental regulations (EPA, EU, ISO 14000) and their implications for chemical plants, **Environmental Risk Assessment, Sustainable Design, Safety/Environment Interface-** Case studies on incidents with environmental release (e.g. Seveso dioxin release) and remediation, **Corporate Responsibility-** Integration of safety and environmental goals (e.g. UN SDGs for Clean Air, Clean Water)	15.5%	07
Unit V: Safety Management and Case Studies **Regulatory Compliance:** OSHA PSM elements, **Safety Management Systems-** Hierarchy of controls, management of change (MOC), incident investigation, near-miss reporting. **Organizational Culture-** Training and competence; leadership accountability; **Case Studies:** In-depth analysis of major accidents to identify root causes, systemic failures, and preventive measures.	13.3%	06

Instructional Method and Pedagogy: Chalk-Board, Presentation, videos, notes

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Analyze fundamental process, plant, and environmental safety principles applicable to chemical industries. CO2: Identify and classify chemical process hazards and assess associated risks using standard safety methodologies CO3: Analyze and assess process risks using tools like HAZOP,	Cognitive	Understand Apply Apply Apply Understand

FMEA, Fault Tree, and LOPA. CO4: Select and justify appropriate engineering controls, safety systems, and protective measures for hazard prevention and mitigation. CO5: Assess environmental safety regulations and recommend suitable pollution prevention and control strategies. CO6: Critically analyze industrial accident case studies to propose effective preventive and corrective safety strategies.		

Learning Resources	
1.	**Reference Books:** 1. Environmental Pollution Control Engineering By C. S. Rao 2. Sanders, 'Chemical process safety' 3rd Ed, Elsevier, (2005). 3. Environment Engineering by Metcalf and Eddy 4. Alarm Management: A Comprehensive Guide, 2nd Ed., By Bill R. Hollifield and Eddie Habibi. 5. HAZOP guide to best practice by Frank Crawley& Brian Tayler 3rd ed., Elsevier.
2.	**Textbook:** 1. Crowl and Louver 'Chemical Process applications:' 3rd Ed., Prentice Hall, (2011)
3	**Journals & Periodicals:**
4	**Other Electronic Resources:**

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open book	15 marks
Article review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	2	3	2
CO3	1	3	3
CO4	2	3	2
CO5	1	2	3
CO6	2	3	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	0	0	2	3	2	0	0	0	1
CO2	2	3	1	1	1	3	3	2	0	0	0	1
CO3	1	3	1	3	2	3	2	2	0	0	0	2
CO4	2	2	3	1	2	3	2	2	0	0	1	1
CO5	1	2	1	0	0	3	3	2	0	0	0	1
CO6	1	3	2	3	1	3	2	3	1	1	0	2

COURSE CODE BTCH709	COURSE NAME TRANSPORT PHENOMENA	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	3	3	0	0	3

Course Pre-requisites	**Fluid Flow Operations, Heat Transfer Operations and Mass Transfer operations**
Course Category	Core
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	18/01/2022 21/03/2023
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1: To explain the fundamental conservation laws governing mass, momentum, and energy transport. 2: To derive and solve ordinary and partial differential equations arising from conservation laws for transport processes. 3: To formulate and solve mathematical models describing momentum, heat, and mass transport phenomena. 4: To analyze transport models and apply them to real engineering systems. 5: To analyze fluid motion mechanisms under different flow and boundary conditions.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Transport Phenomenon: Classification of Transport Processes, Conservation Laws, Vector and Tensor Calculus Concept of Viscosity, Newton's Law of Viscosity, Thermal conductivity and mechanism of energy transport, Equation of Molecular Mass Transport, Molecular Diffusion in Gases.	11%	5
Unit 2: Principles of Momentum Transport: Shell Momentum Balance, Application of Shell Momentum Balance (Unidirectional flow): Flow of Falling Film, Flow Through Circular Pipe, Flow Through annulus, Flow Over Moving Plate	33%	15
Unit 3: Principles of Heat Transport: Steady State Condition and Fourier's Law, Shell Energy Balance and temperature distributions in solids and laminar flow, Applications of Shell Energy Balance: Heat Conduction with Electrical Source, Heat Conduction with Chemical Heat Source, Introduction to Governing equations of Forced & Natural Convention Heat Transfer.	33%	15
Unit 4: Principles of Mass Transport:	22%	10

Equimolar Counter Diffusion, Diffusion of A through Non-Diffusing B, introduction of diffusion with homogeneous reaction & heterogeneous chemical reaction		

Instructional Method and Pedagogy: PowerPoint presentation, chalk-board

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: To explain the unified formulation of conservation laws for mass, momentum, and energy using vector and tensor notation. CO2: To analyze fluid flow behavior using shell momentum balance for different geometries and boundary conditions. CO3: To analyze and apply analogies among momentum, heat, and mass transfer phenomena. CO4: To apply solutions of transport balance equations to determine engineering quantities such as velocity, temperature, and concentration profiles. CO4: To apply transport models to predict fluid flow, heat transfer, and mass transfer in engineering systems.	Cognitive	Understand Understand Apply Apply Understand

Learning Resources	
1.	**Reference Books:** 2. Christie John Geankoplis, "Transport Processes and Separation Process Principles", 4th Edition, PHI Learning Private Limited., New Delhi 3. Incropera, "Fundamentals of Heat and Mass Transfer", 6th Edition, John Wiley & Sons (Asia) pvt. Ltd. 4. W.J.Thomson, "Introduction to Transport Phenomena", Pearson Education Asia, NL.S.Sissom, and D.R.Pitts, "Elements of Transport Phenomena", McGrawHill, New York, 1972. 5. R.W.Fahien, "Elementary Transport Phenomena", McGraw-Hill, New York, 1983. 6. J.R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", V Edn. John Wiley, New York, 2007.
2.	**Textbook:** 1. R. Byron Bird, "Transprt Phenomena", 2nd Edition, John Wiley &Sons (Asia) pvt. Ltd.
3	**Journals & Periodicals:** **1.** International Journal of Transport Phenomena
4	**Other Electronic Resources:**

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open book	15 marks
Article review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	2	1	1
CO5	2	1	1

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	0	0	0	0	0	0	1
CO2	3	3	2	2	1	0	0	0	0	0	0	1
CO3	3	3	2	1	2	0	0	0	0	0	0	1
CO4	3	3	2	3	2	0	0	0	0	0	0	1
CO5	3	3	3	2	2	1	1	0	0	0	1	1

COURSE CODE BTCH706A	COURSE NAME PETRO-LEUM REFINING PRO-CESSES	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	3	3	0	0	3

Course Pre-requisites	Mass Transfer Operations, Process Technology
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/07/2017 18/01/2022
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1: To explain processes associated with cracking of petroleum. 2: To understand and justify the need for catalysts in petroleum cracking processes. 3: To identify and analyze important process parameters in petroleum refining operations. 4: To explain auxiliary refinery processes such as deasphalting, dewaxing, hydrotreating, and desulphurization. 5: To recognize and evaluate environmental issues and regulations related to petroleum refining.

Course Content (Theory)	Weightage	Contact hours
Unit 1: **Thermal Cracking:** Introduction to thermal cracking, importance of thermal cracking processes, early processes used for thermal cracking. **Commercial processes:** Visbreaking process, coking process, Processes for heavy feedstock etc.	17.7%	8
Unit 2: **Cracking:** Introduction to catalytic cracking, importance of catalytic cracking processes, early processes used for catalytic cracking. Difference between thermal cracking and catalytic cracking. **Commercial processes:** Fixed bed process, fluid bed process (FCC), moving bed process and processes for heavy feedstock. Catalysts used for catalytic processes, important process parameters for catalytic cracking.	22.2%	10
Unit 3: Catalysts, Deasphalting and Dewaxing processes: Introduction to deasphalting and dewaxing process, Importance of the deasphalting and dewaxing process. Deasphalting process, process options for heavy feedstocks, Dewaxing process.	20%	9

Unit 4: Hydrotreating and Desulphurization: Introduction to hydrotreating and desulphurization, importance of hydrotreatment and desulphurization process, commercial processes, catalyst used for hydrotreatment and desuphurization, processes for heavy feedstocks for hydrotreatment and desuphurization. Gasoline and Diesel Fuel Polishing.	22.2%	10
Unit 5: **Environmental Aspects of Refining:** Environmental rules and Regulations. **Refinery Wastes:** Types of refinery wastes, their processing techniques. Environmental Analysis.	17.7%	8

Instructional Method and Pedagogy: PowerPoint presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Explain the principles and applications of thermal and catalytic cracking processes used in petroleum refining. CO2: Explain the role of catalysts and their characteristics in catalytic cracking and related refining processes. CO3: Analyze the important operating and process parameters involved in petroleum refining operations. CO4: Explain and analyze hydrotreating, desulphurization, deasphalting, and dewaxing processes for upgrading heavy petroleum fractions. CO5: Explain environmental regulations, identify refinery wastes, and describe their treatment and environmental management techniques.	Cognitive	Understand Understand Apply

Learning Resources	
1.	**Reference Books:** 1. James Speight, "The Chemistry and technology of petroleum", 2nd Edition, Marcel Dekker,(1991). 2. W.L.Nelson, Petroleum Refinery Engineering, McGrawHill,Newyork, (1958). 3. R.A. Meyers, `Handbook of Petroleum refining processes', 3rd Edition, McGraw Hill, (2004).
2.	**Textbook:** 1. B.K.Bhaskar Rao, "Modern Petroleum Refining Processes", Oxford and IBH,(2007).
3	**Journals & Periodicals:**
4	**Other Electronic Resources**

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open book	15 marks
Article review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	2	1	1
CO3	3	2	2
CO4	1	1	1
CO5	2	2	1

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	1	1	1	0	0	0	0	1
CO2	3	3	2	1	2	1	1	0	0	0	0	1
CO3	3	3	3	2	2	2	3	1	0	1	1	1
CO4	3	3	2	1	2	2	2	1	0	0	0	1
CO5	2	2	1	1	1	3	3	2	0	0	0	1

COURSE CODE BTCH706B	COURSE NAME POLY- MER PROCESSING	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	**Basic knowledge of Polymer and its associated properties**
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/07/2017
Course Objectives (As per Blooms' Taxonomy)	To enable the student to: 1: To explain the structure–property–processing relationships and rheological behavior of polymeric materials. 2: To analyze heat transfer, mass transfer, and mixing phenomena involved in polymer processing operations. 3: To evaluate polymer processing techniques such as extrusion, moulding, thermoforming, and fibre forming with respect to equipment, process parameters, and product quality. 4: To assess mechanical, thermal, electrical, and environmental properties of polymers using standard testing methods. 5: To apply engineering principles for selection of polymer materials and processing techniques considering performance, safety, and sustainability.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Basic aspects of Polymers Functionality, types, structure-property relationship, processing fundamentals, processing aids and additives and their purpose (e.g. antioxidants, plasticizers, antistatic agents, blowing agents etc.), Morphology, Rheology and flow of polymers.	20%	9
Unit 2: Chemical Engineering aspects of Polymer Processing Heat and mass transfer in polymer systems, mixing of polymers, mixing equipment.	6.6%	3
Unit 3: Polymer Processing Techniques **Extrusion of polymers:** Extrusion equipment, calendaring-equipment, manufacturing and analysis **Thermoforming:** Types, various techniques-equipment, manufacturing and analysis **Moulding of polymers:** Blow moulding, compression moulding, transfer moulding, rotational moulding, and injection moulding techniques, insert mouldingequipment, manufacturing and analysis	40%	18

Unit 4: Other processing techniques Sheet forming, fibre spinning, pultrusion, techniques and Equipment.	6.6%	3

Unit 5: Polymer Properties and determination **Mechanical Properties:** Different types of Impact tests: Determination of impact tests for different polymeric materials. Study of creep, relaxation, set and fatigue **Electrical Properties:** Their importance and significance, effect of temperature and humidity on electric properties. **Thermal Properties:** Determination of melting point and softening point for different polymers **Environmental Resistance Properties:** Effect of liquids and chemicals. Study of weathering resistance. Study of weathering property. Study of fire resistance.	26.6%	12

Instructional Method and Pedagogy: Industrial visits, activities, animated presentations/videos

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Analyze the role of polymer additives and melt flow behavior in relation to processing performance and product quality CO2: Formulate and apply additive systems and polymer compositions to achieve desired processing and end-use properties. CO3: Interpret and evaluate mechanical, thermal, electrical, and environmental characterization data of polymers for performance assessment. CO4: Compare and assess polymer processing techniques to select appropriate methods for manufacturing specific polymer products. CO5: Select and justify process-specific equipment and die designs based on material behavior, processing requirements, and engineering constraints	Cognitive	Understand Apply Analyse Understand Evaluate

Learning Resources	
1.	**Reference Books:** 1. Vasant R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar "Polymer Science", New age international, New Age International Pvt. Ltd Publishers, (2015). 2. George Odian, "Principle of polymerization", 4th Edition, Wiley Blackwell Publication (2004). 3. Principle of Polymer Processing, R.T. Fenner, Maxwell McMillan International Edn, London. 4. Middleman S, Fundamentals of Polymer Processing, McGraw-Hill Engineering with Polymers - Powell, (1977).

2.	**Textbook:** 1. Premamoy Ghosh, "Polymer science and Technology: Plastic,rubbers, blends and composites, 3rd Edition, Mc Graw Hill Education, India, (2011). 2. Polymer Processing, Morton & Jones, Chapman & Hall.
	3. Fundamentals of Polymer Processing, S. Middleman, HoughtonMifflin Company, 1997.
3	**Journals & Periodicals:** 1. International Polymer Processing, Progress in Polymer Science,Polymer Degradation and Stability
4	**Other Electronic Resources:** 1. NPTEL

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open book	15 marks
Article review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	2	2
CO4	3	3	2
CO5	2	3	3

Mapping of POs & COs

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

COURSE CODE BTCH706C	COURSE NAME BIOPRO-CESS ENGINEERING	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	Basic knowledge of bio chemistry
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/07/2017
Course Objectives **(As per Blooms' Taxonomy)**	1. Introduce and explain fundamental concepts of life sciences to engineering students with minimal prior biological background, enabling them to comprehend biological systems relevant to biotechnology. 2. Apply engineering principles to analyze biological processes, with emphasis on biotechnology applications and bioprocess engineering fundamentals. 3. Analyze key bioprocess engineering issues including enzyme kinetics, microbial and cell growth, product formation, and transport phenomena in biological systems. 4. Explain and evaluate the principles of bioreactors, including bioreactor design, media formulation, sterilization techniques, and bioseparation processes. 5. Integrate and correlate engineering concepts with bioprocessing techniques to assess the influence of biological factors on reaction mechanisms and process performance

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Bio process Basic microbiology: Cell growth, factors affecting cell growth, metabolism, cell growth models, kinetics of thermal death of cells & spores. Design of Fermentation Media, batch and continuous culture, multistage culture.	**20%**	**6**
Unit 2: Kinetics Enzyme Kinetics: Principles of catalysis, introduction to enzyme kinetics, enzyme inhibition, stability, mass transfer in immobilized enzyme **Fundamental of genetics and recombinant DNA technology:** site directed mutagenesis	**20%**	**9**

Unit 3: Sterilization Sterilization: concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods & Mechanism and filter design. Radiation and chemical sterilization. Problems on calculation of sterilization time	**20%**	**9**
Unit 4: Bioreactors Introduction to Fermenter Design Types of bioreactors. Ideal Reactor Operation: Batch, Fed Batch & Continuous operation of mixed bioreactors, Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor. Solid state Fermentations and it's applications. Mass Transfer in Bioreactors, Role of diffusion, Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor. Introduction to bioreactor control mechanism and basic concepts of computer modeling and optimization in bio-process	**20%**	**15**
Unit 5: Downstream Processing Filtration, ultrafiltration, precipitation of proteins, chromatography, electrophoresis and crystallization.	**20%**	**6**
Instructional Method and Pedagogy: Chalk-board, Power point presentation		

Course Outcomess:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: To analyze cell growth and metabolism, apply growth models, and design fermentation media for batch and continuous cultures. CO2: To evaluate enzyme kinetics and inhibition, apply mass transfer principles in immobilized enzymes, and integrate recombinant DNA techniques for bioprocess innovation. CO3: To classify sterilization techniques, calculate sterilization efficiency and time, and design systems for liquid, air, radiation, and chemical sterilization. CO4: To design and optimize bioreactors for various modes of operation, analyze mass transfer and oxygen uptake, and apply control and modeling strategies for efficient bioprocesses. CO5: To apply separation techniques such as filtration, chromatography, and crystallization, and evaluate methods for efficient recovery and purification of bioproducts.	Cognitive	Understand, Apply, Learn

Learning Resources	
1.	Reference Books: 1. Biochemical Engineering- S. Aiba , A.E. Humphray, University of Tokyo Press 2. Bioprocess Engineering Principles – P. M. Doran, 5th ed 3. Bioprocess Engineering: Basic Concepts by Shular & Kargi 4. Hand Book Of Bioengineering- Skalak R & Shu Chien, 4th ed.
2.	Journals & Periodicals:
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open Book Assignment	15 marks
Open Book Assignment	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PS04
CO1	3	0	0	1
CO2	3	0	0	1
CO3	3	0	0	1
CO4	3	0	0	1
CO5	3	0	0	1

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	0	2	2	2	1	0	1	0	1
CO2	3	3	2	0	3	2	2	1	0	1	0	1
CO3	3	2	3	0	2	3	2	1	0	1	0	1
CO4	3	3	3	0	3	2	2	1	0	1	0	1
CO5	3	3	2	0	2	2	2	1	0	1	0	1

COURSE CODE BTCH706E	COURSE NAME PROCESS INTEN-SIFICATION	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	3	3	0	0	3

Course Pre-requisites	Knowledge of chemical engineering operations & processes.
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/07/2017
Course Objectives **(As per Blooms' Taxonomy)**	1. Explain the fundamentals, principles, and drivers of process intensification and its role in modern chemical industries. 2. Analyze conventional chemical processes and identify opportunities for intensification to improve efficiency, safety, and sustainability. 3. Apply process intensification techniques for enhancing heat transfer, mass transfer, and reaction performance. 4. Analyze energy utilization in chemical processes and propose energy-efficient and resource-optimized intensified solutions. 5. Evaluate and transform batch and semi-batch processes into continuous intensified processes using industrial case studies.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Process Intensificatio Definition of PI, History; Principles of PI, Objectives of PI in detail, Techniques of PI applications, Sustainability in process industry	**20%**	**8**
Unit 2: Process intensification of different Processes Fluid Flow Processes, Heat & mass transfer processes, Mixing, Separation, Reactor Design, Thermodynamic Processes, Mechanical Operations Etc.	**20%**	**10**
Unit 3: Pinch Technology Pinch Technology	**20%**	**9**
Unit 4: Network system Heat Exchanger Network Synthesis, Mass Exchange Network Synthesis.	**20%**	**10**
Unit 5: Case studies Case studies based on Microreactors, Microfabrication, Scale-up mixing, Compact heat exchangers, Sonocrystallization, Transformation Batch/semi-batch continuous process etc	**20%**	**8**

Instructional Method and Pedagogy: Chalk-board, Power point presentation

Course Outcomess:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: To identify limitations, inefficiencies, and safety concerns in conventional chemical processes requiring intensification. CO2: To analyze and select appropriate process intensification strategies to improve process performance and sustainability. CO3: To apply intensified equipment and techniques for enhanced heat transfer, mass transfer, and reaction engineering problems. CO4: To evaluate energy and resource utilization in chemical processes and recommend energy-efficient intensified alternatives. CO5: To analyze industrial case studies and propose batch-to-continuous process transformations using intensified technologies.	Cognitive	Remember, Understand

Learning Resources	
1.	Reference Books: 1. Reay D., Ramshaw C., Harvey A., Process Intensification, Butter worth Heinemann, 2008. 2. Innovations for process intensification in the process industry by S.V. Shivakumar, N.Kaistha, D.P.Rao., IIT Kanpur.
2.	Journals & Periodicals:
3.	Other Electronic Resources: NPTEL

Evaluation Scheme	**Total Marks**

Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks

Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Open Book Assignment	10 marks
	Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	2	2
CO3	3	2	2
CO4	2	1	1
CO5	3	2	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	1	1	2	0	0	0	0	1
CO2	3	3	3	2	3	1	2	1	0	0	1	2
CO3	2	3	3	2	2	1	3	1	1	1	2	2
CO4	3	3	2	2	1	1	3	1	0	0	1	2
CO5	2	3	3	2	2	1	2	0	1	1	2	2

COURSE CODE BTCH706F	COURSE NAME INDUSTRIAL MANAGEMENT PRACTICES	SEMESTER VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	3	3	0	0	3

Course Pre-requisites	**Industrial Management Fundamentals**
Course Category	Professional Elective
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	18/01/2022 21/03/2023
Course Objectives (As per Blooms' Taxonomy)	To enable the student: 1. Provide students with a conceptual foundation in materials management and resource optimization for industrial systems 2. Enable students to analyze quality management principles and tools used for process and organizational improvement. 3. Develop understanding of business laws and legal frameworks governing industrial operations. 4. Equip students to analyze industrial relations issues and conflict resolution mechanisms in organizations. 5. Introduce students to lean management concepts and industrial best practices for efficiency and competitiveness.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Materials Management Materials Management, Inventory control, ABC analysis, EOQ, Resource Optimization, Logistics, Logistics relationships.	26.6%	12
Unit 2: Quality Management and Tools Six Sigma, Six Sigma Methodology And Tools Elements of TQM, Tools of TQM , Total Quality Management and Analytical Tools.	22.2%	10
Unit 3: Business Laws Business Legal aspects, Types of firms, Types of Business Law.	17.7%	8
Unit 4: Industrial Relations Industrial Relations, Employer Rights, Misconduct, Harassment & Discrimination, Industrial Conflicts & Resolutions Process and Case studies	15.5%	7
Unit 5: Lean Management, Industrial Practices. Lean Thinking, Mudi, Mura, 7 Wastes, Concepts and Tools of LEAN, Industrial Practices, Brand Value	17.7%	8

Instructional Method and Pedagogy: PowerPoint presentation, videos, chalk-board

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able: CO1: Introduce students to lean management concepts and industrial best practices for efficiency and competitiveness. CO2: Apply quality management tools and data analysis techniques to support continuous improvement initiatives. CO3: Interpret business laws and legal provisions relevant to industrial and managerial decision-making. CO4: Interpret business laws and legal provisions relevant to industrial and managerial decision-making. CO5: Interpret business laws and legal provisions relevant to industrial and managerial decision-making.	Cognitive	Understand Aanalyse Apply Evaluate Create

Learning Resources	
1.	**Reference Books:** 1. Management: Principles and Practice by S K Mandal.
2.	**Textbook:** 1. The Lean Six Sigma Pocket Toolbook: by Michael L. George, John Maxey, David Rowlands,Mark Price 2. Principles of management by Gupta and Meenakshi, Project Management by Dr. Sapna Bansal 3. Operations Research: An Introduction Book by Hamdy A. Taha.
3	**Journals & Periodicals:**
4	**Other Electronic Resources:**

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous Evaluation Component Marks	

Attendance	05 marks
MCQs	10 marks
Open book	15 marks
Article review	10 marks
Total	**40 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	1	2	3
CO3	1	1	1
CO4	1	2	2
CO5	1	1	2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	0	1	0	0	3	1	3	3	1	3	3
CO2	2	2	0	1	1	1	0	3	1	2	2	2
CO3	1	1	0	1	1	1	0	2	2	1	1	1
CO4	2	1	1	1	0	0	0	1	2	1	2	3
CO5	1	1	1	1	1	2	0	1	2	1	3	3

COURSE CODE BTCH801	COURSE NAME PROJECT	SEMESTER VIII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
0	20	0	20	0	20	0	10

Course Pre-requisites	All courses studied till 7th semester
Course Category	Project
Course focus	
Rationale	
Course Revision/ Approval Date:	14/07/2017
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: Integrate all the subjects that they have learnt and design plants/processes. 2: Gather scientific information on a particular topic, analyse the information from scientific principles, and present a written and oral summary on the topic. 3: Develop the ability to identify clear and achievable objectives and plan the project to achieve them. 4: Make students understand how to work in the group, achieve targets as a team under the mentor-ship of faculty members. 5: Develop writing and presentation skills among students and to be able to contribute with their work in the field of chemical engineering.

Course Outcomes:	**Blooms' Taxonomy Domain***	**Blooms' Taxonomy Sub Domain***
After successful completion of the above course, students will be able to: CO1: **Identify** clear and achievable objectives and plan the project to achieve them.	Understand	List
CO2: **Demonstrate** the ability to pick the right methodology for the project and should be able to justify it.	Apply	Apply
CO3: **Demonstrate** the personal abilities and skills required to produce and present an extended piece of work.	Apply	Apply
CO4: **Demonstrate** the ability for analysis of the process and outcome.	Apply	Apply
CO5: **Show** initiative, enthusiasm and commitment to the task.	Apply	Apply

Evaluation Scheme		
PARTICLUARS	**MARKS DISTRIBUTION**	**COMMITTEE**
First Review: Problem identification, objective, motivation, scope, work plan.	15%	Internal
Second Review: Methodology, procedure, primary design, primary calculation.	15%	Internal
Third Review: Detailed design, detailed calculation.	15%	Internal
Project Report	15%	Internal
Final Presentation	25%	External
Continuous Evaluation	15%	Internal

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	1	1
CO3	2	2	2
CO4	3	3	1
CO5	3	3	1
Avg.	2.4	2.2	1.4

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	0	1	0	1	3	3	2	3	0	1
CO2	1	1	2	0	0	1	2	2	3	3	0	1
CO3	3	2	1	0	2	1	1	2	3	3	2	3
CO4	3	3	3	2	1	3	2	3	3	3	3	2
CO5	3	3	3	2	1	3	2	3	3	3	3	2
Avg.	2.4	2.2	1.8	1	0.8	1.8	2	2.6	2.8	3	1.6	1.8

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Chemical Engineering Course Curriculum Academic Year 2026-27

VAC 201	Tinkering & Mentoring	L	T	P	C
		0	0	2	1
Total Credits: 1	**Total Hours in semester : 30**	**Total Marks: 100**			

1	**Course Pre-requisites: NA**
2	**Course Category:** **Value Added Course**
3	**Course Revision/ Approval date**
4	**Course Objectives**

4.1 To provide hands-on experience in problem-solving and prototyping through group-based tinkering projects.
4.2 To develop entrepreneurial, creative, and critical thinking skills among students.
4.3 To enhance students' understanding of industry standards, intellectual property rights, and ethical practices.
4.4 To foster collaboration, teamwork, and communication skills through multidisciplinary group projects.
4.5 To expose students to real-world case studies, expert insights, and best practices in innovation and sustainability

Course Content	Weightage	Contact hours	Pedagogy
Unit 1 Introduction to Entrepreneurship: Understanding the concept, need, myths, and types of entrepreneurship. Importance of entrepreneurship in innovation and problem-solving.	10%	3	Expert talks, brainstorming sessions, and case studies.
Unit 2 Idea Generation and Feassibility Study: Identifying opportunities, developing Minimum Viable Products (MVP), assessing product-market fit, and pricing strategies.	20%	6	Interactive mentoring sessions, group brainstorming, and discussions.
Unit 3 Intellectual Property Rights (IPR): Overview of patents, copyrights, trademarks, and technology transfer. Importance of IPR in securing innovation.	10%	3	Expert talks and group discussion on real-life case studies.

Unit 4 Values, Ethics, and Standards: Importance of values in professional and personal growth. Sustainable solutions, eco-friendly systems, and understanding of BIS standards and their role in innovation	10%	3	Expert talks and group discussion
and industry.			
Unit 5: Tinkering and Prototyping: Hands-on project work in groups to develop solutions for identified problems. Projects will include: Physical Prototypes for engineering and science students. Conceptual Modules (e.g., software, programs) for IT students. Business Cases or Models for management students. Students will work closely with faculty mentors to brainstorm, design, and create functional prototypes or models.	50%	15	Practical tinkering sessions, faculty mentoring

Learning Resources	
1.	Textbook: N/A – The course relies on expert experiential learning and practical activities.
2.	Reference books 1. "The Lean Startup" by Eric Ries 2. "Zero to One" by Peter Thiel 3. "Intellectual Property Rights: Unleashing the Knowledge Economy" by Prabuddha Ganguli
3.	Journal Articles from Harvard Business Review and MIT Sloan Management Review.
4.	Periodicals Business Standard, Economic Times, and Forbes articles on entrepreneurship and innovation.
5.	Other Electronic resources TED talks, and online courses on prototyping and entrepreneurship.

Sr No	Evaluation Component	Marks
1	**Continuous Evaluation Component**	**50**
A	Attendance	10

B	Progress Report Presentation - Problem identification, Ideation & Initial Design	15
C	Progress Report Presentation - Progress Review and Prototype Development	15
D	Expert Session Takeaway Report	10
2	**End Semester Component**	**50**
A	Final Project Presentation and Demonstration	30
B	Viva-Voce	20

Course Outcomes	1. Students will understand entrepreneurial concepts, including business plans, feasibility studies, and product-market fit.
	2. Students will gain insights into intellectual property rights, ethical practices, and sustainability in innovation.
	3. Students will work effectively in teams, demonstrating collaboration, communication, and leadership skills.
	4. Students will connect theoretical knowledge with practical applications through expert talks and hands-on tinkering activities
Additional Information to enhance learning	**Expert Talks**: Delivered by professionals and industry leaders on topics such as entrepreneurship, IPR, and sustainability. **Hands-On Tinkering Projects:** Guided by faculty mentors, with resources provided by GUIITAR.