COURSE CURRICULUM

B.Tech Chemical Engineering

Batch:2024-2025
Academic Year: 2024-25
Updated on: June, 2024

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. June 2024

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 life-long learning in the broadest context of technological change.	Cognitive domain	Understand

No.	Programme Specific Outcomes (PSOs)	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
PSO1	Apply the principles and practices of Chemical Engineering discipline along with the mathematics and basic sciences to solve the complex engineering problems concerning the issues of environment, safety and economics.	Cognitive domain	Apply

PSO2	To prepare students for a professional World in development, design, modelling, simulation, optimization and operation of chemical processes.	Cognitive domain	Create
PSO3	Graduates of chemical engineering will be able to communicate in a professional setting, including soft skills, technical writing, presentation, and management skills making them industry ready.	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
Avg.	2.33	2.00	2.67	2.00	2.33	1.33	1.00	2.00	1.67	2.00	2.67	1.33

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	27
4	Professional Core courses	74
5	Professional Elective courses	6
6	Open Elective courses	5
7	Project work, seminar and internship	26
	Total	178

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	AECC101	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	AECC301	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 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	BTCH404	Numerical Methods in Engineering	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: 10
(ii) Credits: 27

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	BTCS104	Computer Programming - I	I	3	2	0	5	3	1	0	4

3	BTME106	Workshop	I	0	2	0	2	0	1	0	1
4	BTFS108	Fundamental in Fire, Environment, health, Safety	I	2	0	0	2	2	0	0	2
5	BTME202	Engineering Graphics	II	2	4	0	6	2	2	0	4
6	BTME209	Engineering Mechanics	II	3	2	0	5	3	1	0	4
7	BTCS206	Computer Programming-II	II	0	2	0	2	0	1	0	1
8	BTME207	Auto CAD	II	0	2	0	2	0	1	0	1
9	BTCH405	Material Science and Engineering	IV	3	0	0	3	3	0	0	3
10	BTCH702	Plant Design and Economics	VII	3	0	0	3	3	0	0	3
		Total		**19**	**16**	**0**	**35**	**19**	**8**	**0**	**27**

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Professional Core Courses

(i) Number of Professional Core Courses: 18
(ii) Credits: 74

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	BTCH309	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	BTCH408	Industrial Pollution Control	IV	2	0	0	2	2	0	0	2
8	BTCH501	Mass Transfer Operations - I	V	4	2	0	6	4	1	0	5
9	BTCH502	Chemical Reaction Engineering - I	V	3	2	1	6	3	1	1	5
10	BTCH503	Chemical Engineering Thermodynamics - II	V	3	0	1	4	3	0	1	4
11	BTCH504	Instrumentation & Process Control	V	4	2	0	6	4	1	0	5

12	BTCH601	Mass Transfer Operations - II	VI	3	2	1	6	3	1	1	5
13	BTCH602	Chemical Reaction Engineering - II	VI	3	0	0	3	3	0	0	3
14	BTCH603	Process Equipment Design - I	VI	3	2	0	5	3	1	0	4
15	BTCH701	Process Modelling, Simulation and Optimization	VII	4	2	0	6	4	1	0	5
16	BTCH704	Chemical Process Safety	VII	3	0	0	3	3	0	0	3
17	BTCH708	Process Equipment Design - II	VII	2	0	1	3	2	0	1	3
18	BTCH709	Transport Phenomena	VII	3	0	0	3	3	0	0	3
		Total		**57**	**20**	**7**	**84**	**57**	**10**	**7**	**74**

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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									
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: 9
(ii) Credits: 26

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.	BTCH208	Industrial Internship	II	0	0	0	0	0	0	0	2
3.	BTCH307	Industrial Internship	III	0	0	0	0	0	0	0	2
4.	BTCH407	Industrial Internship	IV	0	0	0	0	0	0	0	2
5.	BTCH506	Industrial Internship	V	0	0	0	0	0	0	0	2
6.	BTCH606	Industrial Internship	VI	0	0	0	0	0	0	0	2
7.	BTCH707	Industrial Internship	VII	0	0	0	0	0	0	0	2
8.	BTCH801	Project	VIII	0	20	0	2	0	10	0	10
		Total									**26**

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Ability Enhancement Courses

(i) Number of Ability Enhancement 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	AECC101	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	AECC301	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 Constitution	VI	2	0	0	2	2	0	0	2
		Total									**12**

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Value Added Courses

(i) Number of Value-Added Courses: 1
(ii) Credits: 4

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
		Total									**4**

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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 networking, 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, 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	BTCS104	Computer Programming	3	2	0	5	3	1	0	4	20	40	40	100	50	150
4	BTPY105	Engineering Physics	3	2	0	5	3	1	0	4	20	40	40	100	50	150
5	BTME106	Workshop	0	2	0	2	0	1	0	1	0	0	0	0	50	50
6	BTFS108	Fundamentals in Fire & Environment, Health, Safety	2	0	0	2	2	0	0	2	0	0	0	0	0	P/F
7	AECC101	Fundamentals of English	2	0	0	2	2	0	0	2	20	40	40	100	0	100
8	VACC101	Foundation Course	0	0	0	0	0	0	0	4	0	0	0	0	100	100
		Total	**16**	**8**	**1**	**25**	16	**8**	**1**	**25**						**900**

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	2	4	0	6	2	2	0	4	20	40	40	100	50	150
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	Computer Programming-II	0	2	0	2	0	1	0	1	-	-	-	-	50	50
6	BTME207	AutoCAD	0	2	0	2	0	1	0	1	-	-	-	-	50	50
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
		Total	**13**	**12**	**1**	**26**	**13**	**6**	**1**	**22**	**100**	**200**	**200**	**500**	**250**	**850**

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.	BTCH309	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.	AECC301	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**

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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	BTCH404	Numerical Methods in Engineering	2	2	0	4	2	2	0	3	20	40	40	100	50	150
5	BTCH405	Materials 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	AECC401	Environmental Science	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
		Total	**19**	**6**	**2**	**27**	**19**	**6**	**2**	**26**						

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	BTCH704	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
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	BTCS104	Computer Programming	100	50	4
4	I	BTPY105	Engineering Physics	100	50	4
5	I	BTME106	Workshop	0	50	1
6	I	BTFS108	Fundamentals in Fire & Environment, Health, Safety	0	0	2
7	I	AECC101	Fundamentals of English	100	0	2
8	I	VACC101	Foundation Course	0	100	4
9	II	BTME202	Engineering Graphics	100	50	4
10	II	BTMA203	Mathematics - II	100	0	4
11	II	BTME209	Engineering Mechanics	100	50	4
12	II	BTCY205	Engineering Chemistry	100	50	4
13	II	BTCS206	Computer Programming-II	0	50	1
14	II	BTME207	AutoCAD	0	50	1
15	II	AECC201	Communication Skills in English	100	0	2
16	II	BTCH208	Industrial Internship	0	100	2
17	III	BTMA301	Mathematics-III	100	0	4
18	III	BTCH309	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	BTCH404	Numerical Methods in Engineering	100	50	3

29	IV	BTCH405	Materials Science & Engineering	100	0	3
30	IV	BTCH408	Industrial Pollution Control	100	0	2
31	IV	AECC401	Environmental Studies	100	0	2
32	IV	BTCH407	Industrial Internship	0	100	2
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	BTCH704	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			**178**

COURSE CODE BTEC101	COURSE NAME BASIC OF ELECTRICAL AND ELECTRONICS	SEMESTER 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: **Emphasize** the fundamental concepts and overview of Electrical Engineering & Electronics. 2: Imparting fundamental **knowledge** on electronic components 3: To provide **knowledge** about electrical machines 4: To **understand** about communication engineering concepts 5: To gain **knowledge** about test equipment of electrical and electronics.

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	**20%**	**10**

working of a transformer.		
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: **Apply** the concepts of limits, continuity and derivatives to solve problems.	Cognitive Cognitive	Apply Determine

CO2: **Determine** convergence or divergence of sequences and series.	Cognitive	Apply
CO3: **Use** Taylor and MacLaurin series to represent functions. Solve application problems.	Cognitive	Understand
CO4: **Understand** functions of several variables, limits, continuity, partial derivatives. Identify and solve some system of linear equations.	Cognitive	Apply
CO5: To deal with functions of several variables that is essential in most branches of engineering. The essential tool of matrices and linear algebra in a **comprehensive** manner.		

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	0	0
CO2	0	3	0
CO3	0	2	0
CO4	0	0	1
CO5	0	0	3
Avg	0.4	1	0.8

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	1	0	0	0	2	0	0	1	0	0	3
CO2	3	0	0	0	0	1	0	0	2	0	0	3
CO3	3	0	0	0	0	1	0	0	2	0	0	3
CO4	3	0	0	0	0	2	0	0	2	0	0	3
CO5	3	0	0	0	0	1	0	0	1	0	0	3
Avg	3	0.2	0	0	0	1.4	0	0	1.6	0	0	0

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: Gives a clear **understanding** of the ideas of calculus as a solid foundation for subsequent courses in mathematics and other disciplines. 2: **Comprehensive** focus on teaching calculus based on concepts as well as procedures. 3: Enables students to apply their **knowledge** and solve practical problems in physical sciences and engineering. 4: **Understanding** basic concepts of linear algebra (systems of linear equations, matrix calculus, vectors and basic vector operations) 5: **Solving** computational problems of linear algebra

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: **Apply** the concepts of limits, continuity and derivatives to solve problems.	Cognitive	Understand
CO2: **Determine** convergence or divergence of sequences and series	Cognitive	Understand
CO3: Use Taylor and MacLaurin series to represent functions. **Solve** application problems.	Cognitive	Apply
CO4: **Understand** functions of several variables, limits, continuity, partial derivatives. **Identify** and solve some system of linear equations.	Cognitive	Understand
CO5: To deal with functions of several variables that is essential in most branches of engineering. The essential tool of matrices and linear algebra in a **comprehensive** manner.	Cognitive	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 feedback 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
Avg.	2.4	0.8	0.6

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	2	3	1	1	0	0	0	0	1	0	2
CO2	2	1	1	0	0	0	0	0	0	1	0	0
CO3	2	1	2	1	0	0	0	0	0	1	0	1
CO4	3	2	2	2	1	0	0	0	0	1	0	2
CO5	3	2	3	3	1	0	0	0	0	1	0	2
Avg.	2.4	1.6	2.2	1.4	0.6	0	0	0	0	1	0	1.4

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

COURSE CODE BTCS104	COURSE NAME COMPUTER PROGRAMMING-I	SEMESTER 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	Learning C programming is essential due to its versatility, efficiency, and portability. It provides low-level control and high-level abstraction, making it suitable for a wide range of applications. Course offers access to system-level functions, enabling interaction with hardware and development of performance-critical software.
Course Revision/ Approval Date:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: To **provide** the basics of programming components. 2: To **develop** logics for array and string which will help them to create applications in C. 3: To **familiarise** students with functions and pointers. 4: To give **brief** idea about structures in C programming 5: To gain **knowledge** about file handling using C language.

Course Content (Theory)	Weightage	Contact hours
Unit 1: BASICS OF C PROGRAMMING Introduction to programming paradigms Structure of C program -C programming: Data Types, Storage Classes, Constants, Enumeration Constants, Keywords, Operators**,** Precedence and Associativity**,** Expressions, Input / Output statements, Assignment statements, Decision making statements, control structure	**20%**	**09**
Unit 2: ARRAYS AND STRINGS Theory: Introduction to Arrays: Declaration, Initialization, One dimensional array, two dimensional arrays. Addition scaling determinant	**20%**	**09**

and Transpose, stein operation: - length, compare, concatenate, copy, bubble sort, linear and binary search.		
Unit 3: FUNCTIONS AND POINTERS **Theory:** Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions), Recursion, Pointer, pointer operators, Pointer arithmetic: Arrays and pointers, Array of pointers, Parameter passing: Pass by value, Pass by reference	**20%**	**09**
Unit 4: STRUCTURES **Theory:** Structure: Nested structures, Pointer and Structures, Array of structures, Self-referential structures, type of, Dynamic memory allocation: malloc., calloc, realloc, free ()**.**	**20%**	**09**
Unit 5: FILE PROCESSING **Theory:** Files and file handling operations, types of file processing: Sequential access, Random access, Sequential access file, Command line argument.	**20%**	**09**

List of Practical	Weightage	Contact hours
1: (1) Program to print "Hello GSFC University". (2) Program to find the sum of the 2 numbers. (3) Program to find area and circumference of the circle. (4) Program to find simple interest. (5) Program to convert degree centigrade to Fahrenheit. (5) Program to calculate sum of 5 objects and print average. (6) Program to show swapping of 2 numbers without using the third variable. (7) Program to show swapping of 2 numbers using a third variable. B. Control Structures: IF, Switch, Loops (8) Program to show reverse of given number. (9) Program to find greatest among 3 numbers. (10) Repeat program10 with conditional operator. (11) Program to find that entered year is Leap year or not. (12) Program to find the given number is even or odd. (13) Program to use Switch statement, Display percentage of student. (14) Program to display arithmetic operations using Switch. (15) Program to display first 15 natural numbers and their sum using For Loop. (16) Program to print Patterns (17) Program to print Fibonacci series till 40. (18) Program to find factorial of given number. (19) Program to find whether a given number is prime or not.	**20%**	**6**
2: (20) Program to create an array of 10 elements. Show the sum and average of 10 elements entered by the user. (21) Program to find maximum number in given Array.	**20%**	**6**

(22) Program to display matrix. (23) Program to find sum of two Matrices. (24) Program to find subtraction of two matrices. (25) Program to find multiplication of two matrices.		
3: (26) Program to find factorial of given number using function. (27) Program to show table of given number using function. (28) Program to show call by value. (29) Program to show call by reference. 36. Program to find the largest among two using functions. (30) Write a program to show how similar name variables can be used in different functions. (31) Write a program to return more than one value from a function. (32) Program for passing array from main function to display function. (33) Write a program in C to show the basic declaration of pointer. (34) Write a program in C to demonstrate how to handle the pointers in the program. (35) Write a program in C to demonstrate the use of &(address of) and *(value at address) operator. (36) Write a program in C to add two numbers using pointers. (37) Write a program in C to add numbers using call by reference. (38) Write a program in C to store n elements in an array and print the elements using a pointer.	**20%**	**6**
4: (38) Write a program to demonstrate declaration of structures. (39) Write a program to store student information using Structure. (40) Write a program to add two distances. (41) Write a program to store 10 student's information using structures. (42) Write a program to demonstrate nested structures. (43) Write a program to demonstrate how pointers will be used to create and access structure	**20%**	**6**
5: (44) Write a program to create a file and store information. (45) Write a program to read contents from a file. (46) Write a program to append content at the end of file.	**20%**	**6**

Instructional Method and Pedagogy: C programming, an effective instructional method involves a combination of hands-on programming, step-by-step guidance, code review and feedback, collaborative learning, and real-world application. Engage students in practical coding exercises and projects, breaking down complex concepts into manageable steps.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1: Gain basic **understanding** of basic components of programming language.	Cognitive	Understand
CO2: **Understand** any other programming language with the knowledge of array and string.	Cognitive	Understand
CO3: **Apply** function concepts in real time applications.	Cognitive	Apply
CO4: **Analyse** working of structure in C or other programming language programs.	Cognitive	Analyse
CO5: Students will be able to **develop** applications using C Programming	Cognitive	Apply

Learning Resources	
1.	Reference Books: 1. "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie: 2. "C Programming Absolute Beginner's Guide" by Greg Perry and Dean Miller:
2.	Journals & Periodicals: 1. ACM Transactions on Programming Languages and Systems 2. IEEE Transactions on Software Engineering
3.	Other Electronic Resources: 1. https://www.gnu.org/software/libc/manual/ 2. https://www.learn-c.org/

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 feedback on the Project/ Industrial.: 30 marks Attendance: 10 marks **Total: 100 Marks**

Mapping of PSOs & COs

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

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	1	0	0	1	3	0	0	0	0	0	0	2
CO2	1	0	1	1	3	0	0	0	0	0	0	2
CO3	1	0	1	1	3	0	0	0	0	0	0	2
CO4	1	0	2	1	3	0	0	0	2	1	0	2
CO5	1	2	3	1	3	0	1	0	3	2	0	2
Avg.	1	0.4	1.4	1	3	0	0.2	0	1	0.6	0	2

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

COURSE CODE BTPY 105	COURSE NAME ENGINEERING PHYSICS	SEMESTER 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	Basic Science
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:	24-04-2017
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: To **familiarise** with basics of Noise, Vibrations and Oscillations 2: To inculcate fundamental **knowledge** of Electromagnetism and its engineering applications 3: To **develop** basic understanding for different applications of optical phenomena 4: To embrace optical technologies and **understand** their functioning 5: To **familiarise** with introductory quantum physics and its importance

Course Content (Theory)	Weightage	Contact hours
Unit 1: Noise and Vibrations Theory: Concept of Noise and its sources. Noise Terminology. Definition of Harshness, acceptable levels and perception. Sources of Vibrations. Simple harmonic motion. Damped harmonic oscillator and its energy decay, Quality factor. Forced harmonic oscillator and its steady-state motion. Power absorbed by the oscillator. Resonance. Analogy between	**25%**	**12**

electrical and mechanical oscillations. Mathematical modelling of vibrations.		
Unit 2: Electromagnetism Theory: Laws of Electrostatics. Polarisation and corresponding classification of materials Magnetization and corresponding classification of materials, Permeability and susceptibility. Hysteresis Maxwell's equations. Continuity equation	**20%**	**09**
Unit 3: Modern Optics - I **Theory:** Superposition of waves and Interference. Concept of Diffraction and types of Diffraction. Fraunhofer diffraction of single and multiple slits. Types and applications of Diffraction gratings. Bragg's law.	**20%**	**09**
Unit 4: Modern Optics – II **Theory:** Concept of Polarization and types of Polarization. Polarization using reflection, double refraction, and scattering. Optical activity. Concept of Lasers, working and different types of Lasers, safety aspects, using lasers as sensors.	**15%**	**07**
Unit 5: Unit 5: Quantum Physics **Theory:** Black body radiation and concept of Photons, Photoelectric effect, de Broglie hypothesis, wave-particle duality, Interpretation of wave-function, Uncertainty relations, Schrodinger's wave-equation, Particle in a box.	**20%**	**08**

List of Practical	Weightage	Contact hours
1: (1) To determine the frequency of vibrations on a string using Melde's experiment (2) To determine the frequency of the A.C. mains source using a Sonometer	**20%**	**8**
2: (3) To determine magnetic hysteresis Properties of ferromagnetic materials. (4) To find the horizontal component of earth's magnetic field using a tangent galvanometer (5) To determine the magnetic dipole moment of a bar magnet and horizontal intensity of a bar magnet and horizontal intensity of earth's magnetic field using a deflection magnetometer.	**20%**	**6**
3: (6) To determine the wavelength of Monochromatic source using diffraction gratings. (7) To determine the dispersive power of a grating. (8) To determine wavelength of light using Newton's rings setup. (9) To determine refractive index of liquids using Newton's Ring (Virtual Lab)	**20%**	**8**
4: (10) To determine the specific rotation of sugar using a polarimeter (using setup/virtual lab).	**20%**	**4**
5: (11) To determine Planck's constant using photoelectric effect setup. (12) To determine work function of the given material using photoelectric	**20%**	**4**

effect setup.		

Instructional Method and Pedagogy: The pedagogy should emphasize the integration of theory and practical applications, promote active learning through interactive discussions and collaborative projects, and provide opportunities for students to explore and analyze complex engineering systems.

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		
CO1: **Understanding** of the basic knowledge of harmonic motions.	Cognitive	Understand
CO2: Conceptualization of different electric and magnetic properties of materials	Cognitive	Analyse
CO3: **Understanding** different engineering applications of optical fundamentals.	Cognitive	Understand
CO4: Conceptualization of construction and working of lasers	Cognitive	Analyse
CO5: To embrace the concept of quantum physics and have a basic **understanding** of its principles.	Cognitive	Apply

Learning Resources	
1.	Reference Books: 1. Textbook of Engineering Physics by Dr. P. S. Aithal and Dr. H. J. Ravindra, ACME Learning 2. Engineering Physics by S K Nayak and K.P. Bhuvana, Tata McGraw-Hill Education.
2.	Journals & Periodicals: 1. IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control 2. Journal of Magnetism and Magnetic Materials:
3.	Other Electronic Resources: 1. phet.colorado.edu 2. openstax.org

<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>
</table>
</td></tr>
<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>
</table>
</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>
</table>
</td></tr>
</table>

Mapping of PSOs & COs

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

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	1	0	0	1	3	0	0	0	0	0	0	2
CO2	1	0	1	1	3	0	0	0	0	0	0	2
CO3	1	0	1	1	3	0	0	0	0	0	0	2
CO4	1	0	2	1	3	0	0	0	2	1	0	2
CO5	1	2	3	1	3	0	1	0	3	2	0	2
Avg.	2	0.6	0.2	0.2	0.6	2	0.6	0	1	1	0	1

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

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 give basic **training** on fitting, carpentry, sheet metal, machine shop, and black smithy 2: To enable students to **understand** and practice joining techniques. 3: To **train** students to handle various machine tools. 4: To enable students to **understand** basic mechanical engineering concepts. 5: **To enable** students to fabricate components with their own hands.

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: To give basic **knowledge** on fitting, carpentry, sheet metal, machine shop, and black smithy.	cognitive	Understand
CO 2: To enable students to **understand** and practice joining techniques	cognitive	Understand
CO 3: To give **knowledge** and train students to handle various machine tools.	cognitive	Understand
CO4: To enable students to **understand** basic mechanical engineering concepts.	cognitive	Understand
CO5: To **enable s**tudents to fabricate components with their own hands.		

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	1	1	1
CO4	1	1	1
CO5	1	1	1
Avg.	1	1	1

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	2	3	2	0	2	0	0	2	2	3
CO2	3	3	3	3	2	0	3	0	0	3	3	3
CO3	3	2	3	3	2	0	2	0	0	2	3	3
CO4	3	1	3	3	3	0	1	0	0	1	3	3
CO5	3	2	2	3	2	0	2	0	0	2	2	3
Avg.	3	2	2.6	3	2.2	0	2	0	0	2	2.6	3

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: **Understand** the fire, safety, health and environment challenges in the built and industrial environment and approaches to addressing the same. 2: Become **aware** of important past incidents causing major loss of life & property and damage to environment, and their impact with respect to safety legislation and environment 3: History and current role of Fire & EHS related legislation and role of agencies involved with **implementation** 4: **Understand** approaches for addressing fire and EHS challenges in the industrial environment. 5: Become **familiar** with current fire & safety engineering and management concepts and practices followed in the industry

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:	Cognitive	Understand
CO1: Students will **understand** the fire and EHS challenges faced in the built and industrial environment, and the current approaches taken to address the same.	Cognitive	Learn
CO2: Students will **learn** about major incidents which affected industrial and societal attitude towards safety.		
CO3: Students will become **familiar** with the history and development of fire & safety legislation, their current form and role of different agencies involved in their implementation.	Cognitive	Familiar
CO4: Students will be able to **understand** the different design approaches for addressing the fire & life safety challenges inbuilt and industrial environments	Cognitive	Analyse
CO5: Students will become **aware** of the different engineering and management concepts applied for addressing fire and safety risks in industrial scenarios.	Cognitive	Apply

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 feedback on the Project/ Industrial.: 30 marks Attendance: 10 marks **Total: 100 Marks**

Mapping of PSOs & COs

	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	2	1
CO3	1	1	0
CO4	1	2	0
CO5	0	2	0
Avg.	1.2	1.6	0.4

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	1	0	1	3	2	2	2	2	1	1	2
CO2	1	3	2	3	2	2	1	1	2	1	2	2
CO3	3	1	0	1	3	2	2	1	2	1	1	2
CO4	3	1	0	1	3	2	2	1	2	1	2	2
CO5	3	1	0	1	3	2	2	1	2	1	2	2
Avg.	2.6	1.4	0.4	1.4	2.8	2	1.8	1.8	2	1	1.2	2

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

COURSE CODE AECC101	COURSE NAME FUNDAMENTALS OF ENGLISH	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	Ability Enhancement
Course focus	Soft Skills
Rationale	English is recognized as the most widely spoken language around the world. It serves as a common language for international communication, business, diplomacy, and tourism. By studying English, individuals gain the ability to connect with people from diverse cultures and backgrounds, facilitating effective global communication.
Course Revision/ Approval Date:	24-04-2017
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: To **emphasize** the development of listening and reading skills among learners 2. To **equip** them with writing skills needed for academic as well as workplace context 3. To **enable** learners of Engineering and Technology develop their basic communication skills in English 4. To **strengthen** the fundamentals in English Language. 5. To **build up** the confidence to communicate with the world.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Language Basics Parts of speech, word formation, prefix-suffix, synonyms, antonyms, homophones and standard abbreviations.	**20%**	**8**
Unit 2: Elementary Reading/Writing Skills Types of the sentences, structures of the sentences, use of phrases and clauses, punctuation, creative writing and coherence, comprehension, essay/paragraph writing, precise writing.	**20%**	**05**
Unit 3: Elementary Spoken Skills		

Greetings, farewell and introduction, making an apology, accepting an apology, making an appointment, JAM, group discussion, debate, public speaking.	**20%**	**04**
Unit 4: Practicing and Identifying the Common Error Tense, subject-verb agreement, noun-pronoun agreement, articles, prepositions, modal auxiliaries, voice, reported speech.	**20%**	**05**
Unit-5: 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%**	**08**

Instructional Method and Pedagogy: PPT +Video+ Chalk Board

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:	Cognitive	
CO1: To **emphasize** the development of listening and reading skills among learners	Cognitive	Analyse
CO2. To give them **knowledge** of writing skills needed for academic as well as workplace context		Apply
CO3. To **enable** learners of Engineering and Technology develop their basic communication skills in English	Cognitive	Understand
CO4. To make them **apply** fundamentals of in English Language in daily life.	Cognitive	Create
CO5. To **make** them confident to communicate with the world.	Cognitive	Create

Learning Resources	
1.	**Reference Books:** 1. Thorpe, Edgar and Showick Thorpe "Basic Vocabulary" Pearson Education India, 2012. 2. Green, David. "Contemporary English Grammar Structures and Composition" MacMillan Publishers, New Delhi, 2010. 3. Wren &Martin (2001), English Grammar & Composition, New York. Essential English Grammar Raymond Murphy (2000) Cambridge
2.	**Journals & Periodicals:** **Journals:** 1. 'The Journal' Basic English Grammar

	2. 'Fluent U' English Language and Cultural Journal 3. 'The Journal of English Academics' 4. 'Elsevier' The research on language **Periodicals:** 1. Index Noedicus: A Cumulative Index to English Language **Periodicals** 2. The Illustrated English Language Periodicals
3.	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
Open Book Assignment	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

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	2	3	2	0	0	0	0	0	0	0
CO2	3	3	3	3	2	0	0	0	0	0	0	0
CO3	3	2	3	3	2	0	0	0	0	0	0	0
CO4	3	1	3	3	3	0	0	0	0	0	0	0
CO5	3	2	2	3	2	0	0	0	0	0	0	0
Avg.	3	2	2.6	3	2.2	0	0	0	0	0	0	0

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

BTME202	ENGINEERING GRAPHICS	SEMESTER II

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

Course Pre-requisites	Zeal to learn the subject
Course Category	Engineering Science Courses
Course focus	Employability
Rationale	The subject of Engineering Graphics is of utmost importance as it serves as a universal language for engineers, facilitating clear communication and understanding of technical information on a local, national, and international scale.
Course Revision/ Approval Date:	06/07/2023
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Understand** the importance of engineering graphics in various engineering disciplines and its role in effective communication of design and technical information. 2: **Develop** proficiency in using drawing instruments and applying BIS - SP46 standards for engineering drawings, ensuring accuracy and adherence to industry norms. 3: **Acquire** skills in projection techniques for points, lines, planes, and solids, including determining projections with different inclinations to reference planes. 4: **Demonstrate** the ability to create accurate orthographic projections, sectional views, and isometric drawings, ensuring clear and concise representation of objects in different views. 5: **Apply** geometric construction methods for precise creation and manipulation of shapes, enhancing problem-solving and design skills.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Engineering Graphics & Engineering Curves:	20%	06

Introduction, Drawing Instruments and Their Uses, BIS - SP46, Sheet Layout, Types Of Lines And Its Applications, Lettering, Dimensioning Methods, Scales, And Geometric Construction. Introduction, Classification of Engineering Curves, Conic Curves (Ellipse, Parabola, And Hyperbola), Cycloid, Involute, And Spiral.		
Unit 2: Projection of Points and Lines Introduction to Point and Lines Tracing of Lines, Projections Of The Points Located In Same Quadrant And Different Quadrants, Types Of Plane, Projections Of Line With Its Inclination To One Reference Plane And With Two Reference Planes, True Length Of The Line And Its Inclination With The Reference Planes.	20%	06
Unit 3: **Projections of Planes, Solids, & Section of Solids.:** Introduction, Projections of planes (polygons, circle and ellipse) with its inclination to one reference plane and with two reference planes, Concept of auxiliary plane method for projections of the plane Introduction, Classification of Solids, Projections of Solids Like Cylinder, Cone, Pyramid and Prism with Its Inclination to One Reference Plane and With Two Reference Planes. Section of Solids: Introduction, Section of Prism, Pyramid, Cylinder, And Cone, The True Shape of The Section.	20%	06
Unit 4: Development of Lateral Surfaces: Introduction, Concept of Development of The Different Surfaces, Parallel Line Development and Radial Line Development.	20%	06
Unit 5: Orthographic Projection & Isometric Projection: Introduction, Principle of Projection, Method of Projection, Planes of Projection. First and Third Angle Projection Methods, Sectional Views, Orthographic Reading. Introduction, Isometric Axis, Isometric Scale, Isometric Drawing and Isometric View. Conversion of Orthographic Views to Isometric Projection/Drawing.	20%	06

List Of Practical	Weightage	Contact hours
1: **Introduction** of dimensioning methods, various scales, different types of line, construction of different polygon, etc..	12 %	06
2: **Solve** problems on dimensioning methods, various scales, etc. and draw them on A2 size drawing sheet	12 %	06
3: **Solve** problems on conic section and draw them on A2 size drawing sheet	12 %	06
4: **Solve** problems on engineering curves and draw them on A2 size drawing sheet	12 %	06
5: **Solve** problems on Projection of line and draw them on A2 size drawing sheet	12 %	06
6: **Solve** problems on Projection of plane and draw them on A2 size drawing sheet	12 %	06
7: **Solve** problems on Projection of solid and draw them on A2 size drawing sheet	12 %	06
8: **Solve** problems on Development of surface.	12 %	06
9: **Solve** problems on Orthographic projection and draw them on A2 size drawing sheet	12 %	06

10: **Solve** problems on Isometric projection and draw them on A2 size drawing sheet	12 %	06

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 the subject's local, national, and international relevance.

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO 1: **Understand** and apply fundamental principles of engineering graphics, including drawing techniques, dimensioning methods, and use of scales, for accurate and standardized representation of engineering designs. CO 2: **Develop** proficiency in projection techniques for points, lines, planes, and solids, enabling the creation of accurate orthographic projections and sectional views. CO 3: **Acquire** skills in geometric construction to solve complex design problems and accurately create and manipulate various shapes and objects. CO 4: **Demonstrate** proficiency in interpreting and creating isometric drawings, allowing for clear visualization and communication of three-dimensional objects. CO 5: **Apply** engineering graphics concepts in real-world contexts, including the use of industry-standard, to effectively communicate designs and collaborate with other engineering professionals.	Cognitive	Understand Understand Apply Analyz Apply

Learning Resources	
1.	**Reference Books:** ➢ P.J. Shah, "A Textbook of Engineering Graphics", S. Chand& Company Ltd. N. D. Bhatt, "Engineering drawing", Charotar publication. ➢ Arunoday Kumar, "Engineering Graphics", Tech – Max Publication, Pune. ➢ T. Jeyapoovan, "Engineering Drawing & Graphics using Auto CAD 2000", Vikas Publishing House Pvt. Ltd., New Delhi

	➢ P.S. Gill, "A textbook of Engineering Drawing", S.K. Kataria& sons, Delhi. ➢ D.A. Jolhe, "Engineering Drawing with an Introduction to Auto CAD", Tata McGraw-Hill Publishing Co. Ltd., New Delhi. ➢ R.K. Dhawan, "A textbook of Engineering Drawing", S. Chand& Company Ltd., New Delhi. ➢ Shah, M.B., Rana, B.C., Engineering Drawing, 2ndEdition, Pearson Education, (2009). ➢ French, T.E., Vierck, C.J., Foster, R.J., Graphic Science and Design, 4thEdition, McGraw Hill, (1984). ➢ Venugopal, K., Engineering Drawing and Graphics, 3rdEdition, New Age International, (1998).
2	**Journals & Periodicals** ➢ Computer-Aided Design ➢ Computers & Graphics ➢ Journal of Engineering Design ➢ Computer-Aided Geometric Design ➢ International Journal of Computer Integrated Manufacturing ➢ Journal of Visualization ➢ Engineering Computations
3	**Other Electronic Resources** ➢ NPTEL-Engineering Drawing, IIT Guwahati ➢ NPTEL-Engineering Graphics and Design, IIT Delhi ➢ Engineering Toolbox ➢ Autodesk Knowledge Network

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	2	3
CO2	1	1	1
CO3	1	1	2
CO4	1	2	1
CO5	3	3	3
Avg.	1.4	1.8	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	1	0	0	1	3	0	0	0	0	1	0	2
CO2	1	0	1	1	3	0	0	0	0	1	0	2
CO3	1	0	1	1	3	0	0	0	0	1	0	2
CO4	1	0	2	1	3	0	0	0	2	1	0	2
CO5	1	2	3	1	3	0	1	0	3	1	0	2
Avg.	1	0.4	1.4	1	3	0	0.2	0	1	1	0	2

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 **evaluating** vector calculus and their usage like Work, Circulation and Flux. 2. **used** to solve differential equations and Fourier integral representation. 3. **apply** effective mathematical tools for the solutions of first order ordinary differential equations. 4. **apply** effective mathematical methods for the solutions of higher order ordinary differential equations. 5. **use** series solution methods and special functions like Bessels' functions.

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: **Knowledge** of Identifying and solve some ordinary differential equations.		**Knowledge**
CO2: To **evaluate** some experiments, form ordinary differential equations.		**Evaluate**
CO3: **Analyse** and solve engineering problems using Statistics	Cognitive	Understand
CO4: **Apply** the multiple integration in the area of engineering.		Apply
CO5. **Evaluate** vector valued function in the area of vector calculus.		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	2	3	2
CO2	2	3	1
CO3	1	2	1
CO4	2	1	1
CO5	1	1	3
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	2	0	0	1	0	0	1	0	1
CO2	3	2	1	2	2	0	0	1	0	1	0	0
CO3	3	2	2	2	1	0	0	1	1	1	0	3
CO4	3	2	3	3	0	0	0	1	0	1	0	2
CO5	2	1	0	0	0	1	1	0	1	1	0	1
Avg.	2.8	2	1.6	1.8	0.6	0.2	0.4	0.6	0.4	1	0	1.4

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: **Apply** systematic engineering synthesis and design processes 2: **Understand** theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. 3: **Understand** theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. 4: **Apply** established engineering methods to complex engineering problem solving. 5: **Evaluate** the beam related problems

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: **Understand** and apply the principles of rigid body statics, including vector algebra, moment calculations, and equilibrium analysis, to solve problems in two and three dimensions.	Cognitive	Understand
CO2: **Determine** the centroid of lines, plane areas, and volumes, and apply the concept of centroid to solve problems involving composite geometries.		Understand
CO3: **Calculate** moments of inertia for various shapes and composite bodies, using the first and second moments of area and mass, and apply the parallel axis theorem and rotation of axes.		Apply
CO4: **Apply** the laws of friction to analyze problems involving impending motion, including those with large and small contact surfaces, as well as problems related to wedge friction.		Apply
CO5: **Demonstrate** an understanding of particle dynamics, including kinematics and kinetics, in rectangular coordinates, cylindrical coordinates, and in terms of path variables, and solve related problems.		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	3	2
CO2	2	3	1
CO3	1	2	1
CO4	2	1	1

CO5	1	1	3
Avg.	1.6	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	1	0	1	0	0	0	0	0	1	1	2
CO2	3	1	0	2	0	0	0	0	0	1	1	1
CO3	3	2	1	1	0	0	0	0	0	2	1	3
CO4	3	0	0	1	0	0	0	0	0	0	1	2
CO5	3	1	3	1	0	0	0	0	0	2	1	2
Avg.	3	1	0.8	1.2	0	0	0	0	0	1.2	1	2

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: To **build** a basic knowledge of the structure of chemistry. 2. To **analyse** scientific concepts and think critically. 3. To **review** the importance and relevance of chemistry in our everyday life. 4. To be able to **utilize** the methods of science as a logical means of problem solving.

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: To **understand** hardness of water, its analysis and treatment along with its calculation. CO2: To **understand** various types of corrosion and its prevention techniques. CO3: To **understand** fuels, its analysis, combustion and calculation of calorific value. CO4: To **apply** knowledge of various types of lubricants and its property determination. CO5: To **understand** the instrumental techniques for chemical analysis	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	0	0
CO2	2	1	0
CO3	1	0	1
CO4	2	1	1
CO5	1	2	0
Avg.	1.6	0.8	0.4

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	1	0	0	0	0	1	0	1	0	0	0	1
CO2	1	2	2	0	0	1	0	1	0	0	0	1
CO3	1	2	0	0	0	1	1	1	0	0	0	0
CO4	1	2	2	0	0	1	0	0	1	0	0	0
CO5	1	0	2	0	0	0	0	0	0	0	1	1
Avg.	1	1.2	1.2	0	0	0.8	0.2	0.6	0.2	0	0.2	0.6

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

BTCS206	COMPUTER PROGRAMMING-II	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:	26/4/2021
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Design** algorithm and flowchart for the given Problem. 2: **Develop** C programs using control structures. 3: **Develop** C programs using arrays and pointers. 4: **Implement** user defined functions. 5: **Use** structure and union in C programs.

List Of Practical	Weightage	Contact hours
1. Introduction	10%	2
2. git Hub, Functions, Booleans and Modules	10%	2
3. Sequences, Iteration and String Formatting	10%	2
4. Dictionaries, Sets, and Files	10%	2
5. Exceptions, Testing, Comprehensions	10%	2
6. Advanced Argument Passing, Lambda -- functions as objects	10%	2
7. Object Oriented Programming	10%	2
8. More OO -- Properties, Special methods	10%	2
9. Iterators, Iterables, and Generators	10%	2

10. Decorators, Context Managers, Regular Expressions, and Wrap Up	10%	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: CO 1: **Identify**/characterize/define a problem. CO 2: **Design** a program to solve the problem. CO 3: **Create** executable code. CO 4: Read most Python code and **apply** it. CO 5: **Apply** knowledge of the subject to write basic unit tests.	Cognitive	Understand Create Create Understand Apply

Learning Resources	
1.	**Reference Books:** ➢
2.	**Textbook:** ➢ Publication Head-First Python (2nd edition), Paul Barru, OREILLY
3	**Journals & Periodicals** ➢
4	**Other Electronic Resources** ➢ The Python Tutorial — Python 3.8.2 documentationdocs.python.org › tutorial

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	2	3
CO2	1	2	3
CO3	1	2	3
CO4	1	2	3
CO5	1	2	3
Avg.	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	1	0	0	1	3	0	0	0	0	0	0	2
CO2	1	0	1	1	3	0	0	0	0	0	0	2
CO3	1	0	1	1	3	0	0	0	0	0	0	2
CO4	1	0	2	1	3	0	0	0	2	1	0	2
CO5	1	2	3	1	3	0	1	0	3	2	0	2
Avg.	1	0.4	1.4	1	3	0	0.2	0	1	0.6	0	2

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

BTME207	AUTOCAD	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:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Use** scales, dimensioning, drawing standards and drafting instruments as per BIS codes. 2: **Construct** polygons, circles and lines with different geometric conditions. 3: **Draw** orthographic views from isometric views of simple objects and vice versa 4: **Use** computer aided drafting software to draw 2D and 3D entities

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction to Auto CAD Starting with AutoCAD, AutoCAD dialog boxes, Co-ordinate Systems, drawing lines, circle, arcs, rectangle, ellipse, polygons, etc. [Exercises]	20%	6
Unit 2: Editing sketched objects Editing sketches, moving, copying, pasting, offsetting, scaling, chamfering, trimming, mirroring. Filleting, sketched objects. [Exercises]	20%	6
Unit 3: Basic dimensioning Geometric dimensioning and Tolerance: Dimensioning AutoCAD, creating linear, rotated, angular aligned base line Dimensions, Modifying dimensions.	20%	6
Unit 4: Plotting: Plotting the drawings in AutoCAD, plotting drawing using the plot dialog box, adding plotters and using plot styles, plotting sheets.	20%	6

Unit 5: Basics of 3D Modelling Generation of Primitive Solids, Boolean Operations, Region, Boundary Layer operations, Extrude, Subtract, Union, Explode, Exercises, Exercises	20%	6

List of Practical	Weightage	Contact hours
1. Introduction to Auto CAD.	10%	2
2. Perform various editing operations in AutoCAD.	10%	2
3. Apply various dimensioning methods to a machine component in AutoCAD.	10%	2
4. Perform various plotting operations in AutoCAD.	10%	2
5. Perform 3D Modelling in AutoCAD	10%	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:	Cognitive	
CO1: **Understand** the basic commands of AutoCAD software.		Understand
CO 2: **Understand** the concept of Computer Aided Drafting using AutoCAD software.		Create
CO 3: **Apply** basic concepts to develop construction (drawing) techniques		Create
CO 4: **Apply** basic concepts of the AutoCAD software		Apply
CO 5: **Understand** and demonstrate dimensioning concepts and techniques		Create

Learning Resources	
1.	**Reference Books:** ➢ Finkelstein Ellen et. al., "AutoCAD 2012 and AutoCAD LT 2012 Bible" Wiley India, New Delhi

2.	**Textbook:** ➢ Sham Tickooet. al., "AutoCAD 2012 for engineering and designers "Dream tech press, New Delhi
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	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	3	2	2	3	2	0	0	0	0	0	0	0
CO2	3	3	3	3	2	0	0	0	0	0	0	0
CO3	3	2	3	3	2	0	0	0	0	0	0	0
CO4	3	1	3	3	3	0	0	0	0	0	0	0
CO5	3	2	2	3	2	0	0	0	0	0	0	0
Avg.	3	2	2.6	3	2.2	0	0	0	0	0	0	0

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 **know** the process of communication and its components. 2: To **improve** the language skills i.e. Listening Skills, Speaking Skills, Reading Skills and Writing Skills. 3: **Construct** basic and intermediate skills in English language. 4: To **enhance** phonetic competence, comprehension skills, presentation skills, group discussion skills etc. 5. To **build** confidence for communicating in English and create interest for the life-long learning of English language.

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: To enable learners, **develop** their basic communication skills in English.		Understand
2: To make them **understand** with writing skills needed for academic as well as workplace context.		Understand
3: To **apply** the subject knowledge for professional communication at world level.	Cognitive	Apply
4: To **create** corporate communicational attitude in students.		Create
5: To **apply** digital communication using technological modules and expertise.		Apply

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	3	2	2	3	2	0	0	0	0	0	0	0
CO2	3	3	3	3	2	0	0	0	0	0	0	0
CO3	3	2	3	3	2	0	0	0	0	0	0	0
CO4	3	1	3	3	3	0	0	0	0	0	0	0
CO5	3	2	2	3	2	0	0	0	0	0	0	0
Avg.	3	2	2.6	3	2.2	0	0	0	0	0	0	0

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: S**tudy** 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: ● Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill,New Delhi, 2008. ● Kreyszig, E., Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, (1999). ● 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	1	0	0
CO2	2	0	0
CO3	1	0	0
CO4	2	1	0
CO5	2	1	0
Avg.	1.6	0.4	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	1	2	1	0	0	0	1	0	0	1	0	2
CO2	1	1	0	0	1	0	0	0	0	1	0	1
CO3	2	1	0	0	0	0	0	0	0	1	0	1
CO4	2	2	2	1	2	0	1	1	1	1	0	2
CO5	3	2	2	2	2	0	0	1	1	1	0	2
Avg.	1.8	1.6	1	0.6	1	0	0.4	0.4	0.4	1	0	1.6

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

COURSE CODE BTCH309	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
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.	20%	8

Unit 2: Basic Equations of Fluid Flow 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.	20%	8
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 tubes – velocity meters - anemometers, turbine flow meter, current meters, hot wire anemometer, laser doppler anemometry, flow visualization. Fans, Blowers, ejectors & compressors. Introduction to compressible flow through pipes and nozzles, isothermal, isentropic & adiabatic flow	20%	11
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.	20%	10
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.	20%	8

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

List of Practical	Weightage	Contact hours
1: To study Reynolds Experiment to identify the type of flow	**10**	**2**
2: To measure the viscosity using Ostwald viscometer.	**10**	**2**
3. To study and verify Bernoulli Theorem	**10**	**2**
4. To find the minor losses in pipes.	**10**	**2**
5. To study friction through straight pipe.	**10**	**2**
6: To obtain the coefficient of discharge of Venturi meter.	**10**	**2**
7. To obtain the coefficient of discharge of Orifice meter.	**10**	**2**
8. To study the characteristics of centrifugal pump	**10**	**2**
9. To study local velocity using Pitot tube	**10**	**2**
10. To study friction through packed bed.	**10**	**2**

Course Outcomes:*	**Blooms' Taxonomy Domain***	**Blooms' Taxonomy Sub Domain***
After successful completion of the above course, students will be able to:	Cognitive	
CO1: **Understand** the fundamentals of fluid flow phenomena.		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: ● W. L. Mc Cabe, J. C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, (2006). ● J. M. Coulson & J. F. Richardson, "Chemical Engineering Vol. I", 6th Edition, Butterworth Heinemann Publications, (2004). ● 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	2	0	0
CO2	2	2	1
CO3	2	2	1
CO4	1	1	0
CO5	1	1	0
Avg.	1.6	1.2	0.4

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	0	0	0	0	1	1	1	0	0	0	1
CO2	2	2	2	1	0	0	0	1	1	0	0	1
CO3	2	2	1	1	1	1	0	0	0	0	0	1
CO4	2	0	1	0	1	0	0	1	0	0	0	0
CO5	2	0	1	0	1	0	0	1	0	0	0	0
Avg.	2	0.8	1	0.4	0.6	0.4	0.2	0.8	0.2	0	0	0.6

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

Learning Resources	
1.	**Reference Books:** ● Essential of Physical Chemistry, B.S.Bahl, G.D. Tuli and Arun Bahl, S. Chand and Co. Ltd. ● Inorganic Chemistry, P. L. Soni, S. Chand & Sons ● Instrumental Methods of Analysis by Willard, Merritt and Dean EWP ● Principles of Physical Chemistry, B.R.Puri, L.R.Sharma and M.S.Pathnia, Vishal Pub. Co. ● Instrumental Methods of Analysis, B. K. Sharma
2.	Journals & Periodicals: Asian Journal of green chemistry.
3.	Other Electronic Resources:

	NPTEL courses

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	0
CO2	2	1	0
CO3	2	1	0
CO4	2	1	0
CO5	2	1	0
Avg.	2	1	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	1	2	1	0	0	0	1	0	0	1	0	2
CO2	1	1	0	0	1	0	0	0	0	1	0	1
CO3	2	1	0	0	0	0	0	0	0	1	0	1
CO4	2	2	2	1	2	0	1	1	1	1	0	2
CO5	3	2	2	2	2	0	0	1	1	1	0	2
Avg.	1.8	1.6	1	0.6	1	0	0.4	0.4	0.4	1	0	1.6

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 to 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 Excel/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:	Cognitive	
CO1: **To understand** different system of units and dimensions with conversion		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: ● 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). ● Basic Principles & Calculations in Chemical Engineering", David M. Himmelblau, James B. Riggs, PHI Learing Pvt. Ltd, 7th edition, 2006. ● 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	3	2	3
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
Avg.	3	2.6	2.8

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	2	1	2	1	1	1	2	3	3	3
CO2	3	3	2	2	2	2	1	1	2	2	2	3
CO3	2	2	3	3	3	2	2	1	2	2	2	3
CO4	2	2	3	3	3	3	3	3	3	2	2	3
CO5	1	1	2	2	3	3	3	2	2	3	2	3
Avg.	2.2	2.2	2.4	2.2	2.6	2.2	2	1.6	2.2	2.4	2.2	3

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 Practicals	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: ● W. L. Mc Cabe, J. C. Smith, P. Harriot, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, (2006). ● J.M. Coulson & J.F. Richardson 'Chemical Engineering' Vol. - 2, 6th Ed. Elsevier, (2003). ● G.G. Brown Ed. 'Unit Operations' John Wiley & Sons, (1950).
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	1	1
CO2	2	2	0
CO3	2	2	0
CO4	2	1	0
CO5	2	1	0
Avg.	2	1.4	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

COURSE CODE AECC301	COURSE NAME ENTREPRENEURSHIP DEVELOPMENT	SEMESTER III

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	**Knowledge and skills of entrepreneurship**
Course Category	**Humanities and Social Sciences**
Course focus	26-04-2021
Rationale	
Course Revision/ Approval Date:	
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student to: 1: **Develop** skills for evaluating, articulating, refining, and pitching a new product or service offering. 2: **Identify** the elements of success of entrepreneurial ventures. 3: **Analyze** Feasibility of the project (Financial and Non-Financial) and interpret business plan. 4: **Demonstrate** and present successful work, collaboration and division of tasks in a multidisciplinary and multicultural team. 5: **Demonstrate** understanding and application of the tools necessary to create sustainable and viable Businesses.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Entrepreneurship Concept, knowledge and skills requirement; characteristic of successful entrepreneurs; role of entrepreneurship in economic development; entrepreneurship process; factors impacting emergence of entrepreneurship; managerial vs. entrepreneurial approach and emergence of entrepreneurship. Entrepreneurial Motivation.	20%	6

Unit 2: Starting the Venture Creativity and Entrepreneurship, Steps in Creativity; Product Design & Influencing Factors (Legal, Ethical & Environmental); Generating business idea –sources of new ideas, methods of generating ideas, creative problem solving, opportunity recognition; environmental scanning, competitor and industry analysis	20%	6
Unit 3: Feasibility Study (Non-financial Aspects) Market feasibility, Technical feasibility, operational feasibility, Legal feasibility, Human Resource Feasibility, Supply Feasibility.	20%	6
Unit 4 Feasibility Study (Financial Aspects) Cost classification- Fixed vs. Variable; Cost Determination- Material, Labour, Overheads; Product Profitability- Concepts of Break-even, Margin of Safety, Angle of Incidence, Key-factor, Profit-Volume ratio; Balance Sheet & Profit & Loss Account- Concepts & Structure; Budgeting; Financing Schemes from Government, specially schemes for women; Venture Capital & Angel Investing	20%	6
Unit 5 Detailed Project Report & Business Plan Project Report- components; Preparation of Business Plan; Pitching the Business Plan, Attracting Angel Investors. (A group of THREE students will prepare a DPR, and Business Plan on selected product or service in the course as a Project/Assignment)	20%	6

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: **Develop** skills for evaluating, articulating, refining, and pitching a new product or service offering.	Cognitive	Create
CO2: **Analyze** the elements of success of entrepreneurial ventures.		Anlayse
CO3: **Analyze** Feasibility of the project (Financial and Non-Financial) and interpret business plan.		Anlayse

CO4: **Develop** present successful work, collaboration and division of tasks in a multidisciplinary and multicultural team.		Create
CO5: **understand** the application of the tools necessary to create sustainable and viable Businesses.		Understand

Learning Resources	
1.	Reference Books: ● Holt DH. Entrepreneurship: New Venture Creation. ● Kaplan JM Patterns of Entrepreneurship. ● Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.
2.	Journals & Periodicals: International Journal of Entrepreneurship.
3.	Other Electronic Resources: https://innovation-entrepreneurship.springeropen.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**

Mapping of PSOs & COs

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

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	2	1	2	1	1	1	2	3	3	3
CO2	3	3	2	2	2	2	1	1	2	2	2	3
CO3	2	2	3	3	3	2	2	1	2	2	2	3
CO4	2	2	3	3	3	3	3	3	3	2	2	3
CO5	1	1	2	2	3	3	3	2	2	3	2	3
Avg.	2.2	2.2	2.4	2.2	2.6	2.2	2	1.6	2.2	2.4	2.2	3

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:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	To **understand** the basic concepts of thermodynamics in chemical engineering so that students can solve chemical engineering problems. To **analyse** the energy balances for steady state and unsteady state processes. To **examine** the solve energy transformation problems To **evaluate** the thermodynamic properties of real gases using various PVT relationships and heat capacities data To **apply** knowledge of liquefaction and refrigeration using different power cycles

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:	**20%**	**10**

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		
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 Practical 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 non-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: **Understand** the thermodynamic properties and heat capacities data. CO2: **Understand** liquefaction and refrigeration cycles. CO3: **Analyse** energy transformation problems. CO4: **Analyse** chemical engineering problems CO5: **Understand** the energy balances for Chemical Engineering Operations and Processes.	Cognitive	Understand, Analyse

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:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	To **Understand** practical importance of heat transfer in industries Able to **analyse** applications of different heat exchanger in chemical industries. **Apply** heat transfer concepts with heat transfer equipment used in industries Students would be able to **evaluate** the problems in the engineering field related to chemical aspects. **Apply** different dimensionless numbers pertaining to heat transfer

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: 1. Problems related to convection 2. problems related to internal forced convection 3. problems related to external forced convection 4. problems related to natural convection 5. problems related to phase change, boiling & condensation.	**20%**	**4**
Unit 3: 1.Problems related to thermal radiation & Blackbody. 2 2.Problems related to radiative properties & view factor.	**20%**	**2**
Unit 4: 1. Problems related to LMTD 2. Problems related to NTU effectiveness method.	**20%**	**2**
Unit 5: 1. Problems related to single effect evaporators 2. Problems related to multiple effect evaporators 3. 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: **Understand** the mechanisms of heat transfer under steady and transient conditions. CO2: **Understand** the basic modes of heat transfer	Cognitive	Understand, Apply

CO3: **Apply** principles of heat transfer to predict transfer coefficients CO4: **Apply** heat transfer concepts with heat transfer equipment used in industries CO5: **Apply** the knowledge and **design** heat transfer equipment.		

Learning Resources	
1.	Reference Books: S. B. Thakore and B. I. Bhatt, Introduction to Process Engineering and Design, McGraw Hill Publication House, 2nd Edition. Y.V.C. Rao, HeatTransfer, 2nd Edition. J. M. Coulson & J. F. Richardson, Chemical Engineering, Vol.1, 6 th Edition, Elsevier. Yunus .A.Cengel, heat transfer – a practical approach, second edition
2.	Journals & Periodicals: International Journal of Heat and MassTransfer, 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	1.4	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

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:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	**Knowledge** of various production methods of most industrial chemicals **Understanding** of process conditions and its effect on conversion. **Understanding** of economical balance and factors affecting it. **Understanding** of various problems associated with process and troubleshooting **Understanding** of suitable materials of construction for various types of process environment.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Industrial Gases, Acids & Chlor-Alkali Industry Industrial gases: Manufacture, properties and uses of Hydrogen, Oxygen, nitrogen, Carbon dioxide, carbon monoxide and rare gases. 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 & electricfurnace, advantages & disadvantages, Nitric Acid engineering problems involved. Material of construction of piping etc.	**25%**	**15**

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.		
Unit 2: Cement, Glass and Soap Industries Cement Industries: Introduction to cement industries, Types of cement, manufacture by wet process & dry process, engineering problems. Glass Industry: Types of glass, properties, special types of glass, preparation method batch & continuous method. Soap Industries: Types of soaps, Soap manufacture, recovery and purification	**20%**	**10**
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.** Nitration of salicylic acid by green method	**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: 5. To determine Chemical Oxygen Demand (COD) of given effluent sample. 6. Preparation of azo dye. 7. Preparation of Indigo dye. 8. Preparation of urea formaldehyde resin	**30%**	**8**
Unit 5: 9. 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: **CO1: Understand** the basic concepts of unit operations, unit processes, schematic representation and applications for unit operations and unit processes. **CO2: Understand** process aspects like yield, byproducts formed, generation of waste **CO3: Understand** Sugar- Starch, Paper – Pulp and Fermentation Industry **CO4: Understand** major engineering problems encountered in chemical process industries **CO5: Draw and explain** process flow diagrams for a given process	Cognitive	Understand

Learning Resources	
1.	Reference Books: Shukla S. D. and G. N. Pandey, a Text Book of Chemical Technology, Vikas Publishing House, 1986. Kirk and Othmer, 'Encyclopedia of Chemical Technology', 5th Ed, 24 volumes, (2006) P. H. Groggins, "Unit Processes in Organic Synthesis", McGraw-Hill; Second Edition 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 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	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 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	Numerical Methods
Course Category	Core
Course focus	Employability
Rationale	International relevance
Course Revision/ Approval Date:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	Demonstrate **understanding** of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems. **Apply** numerical methods to obtain approximate solutions to mathematical problems. **Analyse** and evaluate the accuracy of common numerical methods. **Apply** numerical methods in Matlab **Apply** efficient, well-documented Matlab code and present numerical results in an informative way.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Solution Algebraic and Transcendental Equations: Bisection, False position, Newton Raphson Method, Secant Method.	**20%**	**5**
Unit 2: Solution of system of Linear Equations: Gauss Elimination method, LU decomposition method, Gauss Seidel method. Interpolation: Newton's forward and backward interpolation	**20%**	**6**

Unit 3: Newton's divided difference interpolating polynomials, Lagrange Interpolating polynomials. Numerical Differentiation: First and second order differentiation Equations of Equally Spaced Data. Solution using Matlab. Numerical Integration: Trapezoidal rule, Simpson's one third and 3/8th rule. Solution using Matlab.	**20%**	**7**
Unit 4: Numerical methods for Solution of ordinary differential equation: Taylor's series method, Euler's method, Modified Euler's method, Runge Kutta forth ordered method, Milne's Predictor Corrector Method. Solution using Matlab.	**20%**	**6**
Unit 5: Finite element method to solve second order ODE. Curve Fittings: General Linear Least Squares, Fitting of quadratic and exponential curves. Solution using Matlab.	**20%**	**6**

List Of Practical	Weightage	Contact hours
Unit 1: . Matlab Introduction and Programs of Bisection, False position, Newton Raphson Method, Secant Method	**20%**	**4**
Unit 2: Matrices in Matlab and Solution of System of linear equations in Matlab, Eigen Value and eigen vectors using Matlab. Programs of Difference Table, newtons forward and Backward Interpolations.	**20%**	**4**
Unit 3: Matlab Programs of Newton's divided difference interpolation	**20%**	**4**
Unit 4: Matlab Programing of Lagrange's Interpolation, Trapezoidal rule, Simpson's one third and 3/8th rule. Curve plot and Graphs in Matlab	**20%**	**4**
Unit 5: Curve fitting in Matlab	**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**: **Analyse** the approximation techniques to formulate and **apply** appropriate strategy to solve numerical problems. **CO2: Understand and apply** computer programs for solving the numerical problems. **CO3: Apply** the knowledge and skills of numerical methods to solve different equations. **CO4: Apply** appropriate numerical methods to solve the problem with most accuracy. **CO5: Analyse/Compare** different methods in numerical analysis with accuracy and efficiency of solution.	Cognitive	Understand, Apply, Analyse

Learning Resources	
1.	Reference Books: Grewal. B.S., and Grewal. J.S., " Numerical Methods in Engineering and Science " 9th Edition, Khanna Publishers, New Delhi, 2007.
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**

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	3	2	2
CO3	2	1	2
CO4	3	2	2
CO5	3	2	2
Avg.	2.6	1.8	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	1	2	2	0	1	1	1	1	0	2
CO2	2	3	1	0	0	0	0	1	0	1	0	2
CO3	3	2	0	2	3	0	1	2	1	0	0	2
CO4	3	2	0	0	3	0	0	0	2	1	0	2
CO5	2	0	0	1	3	1	1	2	2	1	0	2
Avg.	2.4	1.8	0.4	1	2.2	0.2	0.6	1.2	1.2	0.8	0	2

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

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:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	**Understanding** of various NDT techniques **Apply** microstructures of ferrous – nonferrous metals. **Analyse** different corrosion control techniques. **Evaluate** different material testing methods **Understanding** of different composite materials.

Course Content (Theory)	Weightage	Contact hours
Unit 1: 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: 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: 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**

requirements, etc.		
Unit 4: Corrosion, control & mitigation of metals & alloys. Material selection and design consideration, materials and industrial design, material property charts, material selection, strategy and procedure	**20%**	**6**
Unit 5: 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: **CO1: Understand** the properties of various materials and their applications in various field **CO2: Gain knowledge** of different types of ceramic and composite materials **CO3: Understand the** importance of materials in materials science and engineering field. **CO4: Apply** new developments in materials application field. **CO5: Apply** the fundamental science and engineering principles, relevant to materials	Cognitive	Understand, Apply

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

	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
Avg.	2.2	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	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:	14/4/2017 21/03/2023
Course Objectives **(As per Blooms' Taxonomy)**	**Analyze** the characteristics of solid waste and its handling & management. **Understand a**nd select the design of air pollution control devices. **Design** of suitable treatment for wastewater. **Apply** the abatement technologies in industries in the near future. **Apply** applications of controlling technology in their particular field.

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 of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry, Pollution laws and limits. **Methods of secondary treatment:** Suspended growth processes v/s Attached growth processes, Rotary drum filters. **Methods of tertiary treatment:** Brief studies of Carbon absorption, Ultra filtration, Chlorination, Ozonation.	**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: **CO1: Analyse** the industrial activities and identify the environmental problems **CO2:** Understand and **design** the air pollution control devices. **CO3: Apply** the strategies to control and reduce pollution **CO4: Analyse and design** the suitable treatment techniques for wastewater **CO5: Analyse** the characteristics of solid waste and its handling & management.	Cognitive	Understand, Apply, Analyze, Create

Learning Resources	
1.	Reference Books: Masters, G.M., Introduction to Environmental Engineering and Science, Prentice Hall off India, (2008). ➢ De Nevers, N., Air Pollution Control Engineering, McGraw-Hill (2000). ➢ 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**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	2	2	0	0	2

Course Pre-requisites	Basics of Science
Course Category	Ability Enhanced Compulsory Course
Course focus	Employability
Rationale	
Course Revision/ Approval Date:	14/4/2017
Course Objectives **(As per Blooms' Taxonomy)**	**Remember:** To acquire an awareness of and sensitivity to the total environment and its allied problems. **Apply**: To make educated judgments about environmental issues. **Create:** Develop skills and a commitment to act independently and collectively to environment sustainability **Apply & Analysis**: Students can able to debate environmental science with use of appropriate scientific information **Apply & Understand**: Engaging with students of all disciplines to think critically, ethically, and creatively when evaluating environmental issues.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Introduction Introduction of Ecology Ecology-Objectives and Classification Concepts of an ecosystem-structure & function of ecosystem components of ecosystem, Hydrological cycle, carbon cycle, oxygen cycle, Nitrogen cycle, Sulphur cycle	**20%**	**2**
Unit 2: Ecological Pyramids Ecological pyramids of various ecosystems Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic ecosystem, Estuarine Ecosystem.	**20%**	**1**

Unit 3: Air Pollution and control Introduction, Classification of air pollutants, air pollutants and their effects, acid rain, photochemical smog, particulates. Characteristics and biochemical effects of some important air pollutants, Effect of air pollutants on man and environment, Air quality standard, air monitoring and control of air pollution.	**20%**	**12**
Unit 4: Water Pollution and control Introduction, Classification of water pollutants, physical, chemical and biological characteristics of waste water, wastewater treatment: Primary treatment- Sedimentation, coagulation, equalization, neutralization, secondary treatment-aerobic treatment-aerated lagoons, trickling filter, activated sludge process, oxidation ditch process, oxidation pond, anaerobic treatment-anaerobic sludge digestion, sludge treatment and disposal and tertiary treatment-evaporation, ion exchange, adsorption, chemical precipitation, Electrodialysis, reverse osmosis.	**20%**	**8**
Unit 5: Solid and Hazardous Waste Introduction, Classification and origin, characteristics of solid wastes, objectives and considerations in solid waste management, methods of solid waste treatment and disposal - composting, land filling, thermal processes-incineration, pyrolysis, recycling and reuse of solid waste-co-disposal, bioconversion.	**20%**	**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: CO1: **Understand** the environmental issues with a focus on sustainability. CO2: **Understand** the physical, chemical and biological components of the earth's systems. CO3: **Understand** and analyse the global scale of environmental problems CO4: **Apply** sustainability as a practice in life, society and industry CO5**: Understand** the pollution control techniques	Cognitive	Understand, Apply

Learning Resources	
1.	Text Books: ➢Fundamental concepts in Environmental studies by DD Mishra, S. Chand Publishing, India ➢ Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by PS Verma and VK Agarwal, S. Chand Publication, India ➢ Fundamentals of Ecology by PD Sharma, Rastogi Publications ➢ Ecology and Environment by PD Sharma, Rastogi Publications ➢ Environmental Chemistry by BK Sharma, GOEL Publishing house ➢ Textbook of Environmental Studies, by E. Bharucha, UGC universities Press ➢ Environmental Studies by R. Rajagopalan, Oxford University Press ➢ Environmental Pollution and Control by JF Peirce, RF Weiner, and PA Vesilind, Elsevier Science & Technology Book ➢ Ecology by Mohan P. Arora, Hmalaya Publishing House ➢ Fundamentals of Ecology by M.C. Dash Reference Books: Fundamentals of Ecology by EP Odum Cengage ➢ Big Questions in Ecology & Evolution by TN Sherratt & DM Wilkinson, Oxford. ➢ Ecology: Experimental Analysis of Distribution & Abudance by CJ Krebs, Pearson Education, London ➢ Concept of Ecology by EJ Kormondy, Pearson Education, London ➢ Conservation Biology: Voices from the Tropics. Bys Sodhi, N.S., Gibson, L. & Raven, P.H. (eds) John Wiley & Sons ➢ Plastic and Environment by RE Hester and RM Harrison, Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK ➢ Environmental Education and Ecotourism by Fernando Ramírez and Josefina Santana, Springer Nature Switzerland AG ➢ Reclamation of Arid lands by Mohammad Jafari, Ali Tavili, Fatemeh Panahi, Ehsan Zandi Esfahan and Majid Ghorbani, Springer International Publishing Switzerland

	➢ Emerging Issues in Ecology and Environmental Science, Case studies from India by T. Jindal, Springer Nature Switzerland ➢ Environmental Water Footprints Concepts and Case Studies from the Food Sector by SS Muthu, Springer Nature Singapore
2.	Journals & Periodicals: ➢Environmental Pollutants and Bioavailability ➢ Clean Air Journal ➢Emerging Contaminants ➢ Environment: Science and Policy for Sustainable Development ➢ Annual Review of Environment and Resources ➢ Renewable Energy ➢ Renewable & Sustainable Energy Reviews ➢ Environmental Health ➢ Environment International ➢ International Journal of Environmental Research and Public Health ➢The Environmental Magazine ➢ Natural History (magazine) ➢ Environment News Service ➢ The Environmentalist ➢ Green Builder Media
3.	Other Electronic Resources: ➢Green.tv—supported by UNEP—broadband TV channel for films about environmental issues ➢ Climate Change TV—funded by companies, governments and organisations, and produced by the magazine Responding to Climate Change—the world's first web channel specific to climate change videos ➢ Terra: The Nature of Our World video podcast produced in conjunction with the Master of Fine Arts program in Science & Natural History Filmmaking at Montana State University, Filmmakers for Conservation, and PBS—weekly video show about science and natural history

	➢ Green Times Ahead—based in India—student run non-profit with a focus on evading the detrimental effects of air and water pollution, constantly involved in communal engagement ➢ IUCN Red data List ➢ Air quality index ➢ Nature Education Knowledge Project.

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	3	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	2	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.	2.6	2.2	1.8	1	0.8	1.8	2.2	2.6	2.8	3	1.6	1.8

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:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1: To **understand** the basic principles of mass transfer operations. 2: To **understand** the equilibria for various systems. 3: To **learn** various types of equipment for gas liquid operations. 4: To **learn** concepts of Gas absorption and Distillation. 5. To learn **design** calculations of absorber and distillation columns used in industries.

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 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	20%	12

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: Understand the knowledge of mass transfer by applying principles of diffusion, mass transfer coefficients and interphase mass transfer. **CO2: Understand** the concept and operation of various types of gas liquid contacts equipment **CO3: Understand** the operation of various types of drying equipment **CO4: Apply** basic concept for design calculations of various mass transfer operations **CO5: Determine** NTU, HTU,HETP and height of packed bed used for Absorption and Humidification operations	Cognitive	Understand, Apply

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	0
CO2	3	1	0
CO3	3	2	0
CO4	3	1	0
CO5	3	1	0
Avg.	3	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	3	1	2	1	1	0	0	0	1	1	0	1
CO2	2	1	1	1	1	0	0	0	1	1	0	1
CO3	2	2	3	1	1	0	0	0	1	1	0	1
CO4	2	1	1	1	1	0	0	0	1	1	0	1
CO5	2	1	1	1	1	0	0	0	1	1	0	1

Avg.	2.2	1.2	1.6	1	1	0	0	0	1	1	0	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:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1: To **learn** concepts of kinetics and mechanism of homogeneous reactions 2: To **design** ideal reactors for single reaction including heat effects 3: To **understand** the importance of multiple reactor systems. 4: To **understand** the temperature and pressure effect on reactor design. 5: To **analyse** non-ideal flow behaviour in reactors.

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: **CO1: Understand** the stoichiometry preferable at more than one temperature **CO2: Evaluate** reactor engineering problems through reasoning rather than memorization of numerous equations **CO3: Understand** rate laws and determine kinetics of several homogenous and heterogeneous reactions **CO4: Understand** the concept of Residence Time Distribution (RTD) in various reactors and obtain the actual design parameters to design Real Reactor **CO5:** Perform, **evaluate** and optimize the design and operation of catalyzed and non-catalyzed chemical reactors	Cognitive	Understanding, Evaluate

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.

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	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
Avg.	3	1.8	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	2	1	1	1	0	0	1	0	0	1
CO2	3	3	3	2	2	0	0	0	1	0	0	1
CO3	3	3	3	2	2	0	0	0	1	0	0	1
CO4	3	3	3	2	1	0	0	0	1	0	0	1
CO5	3	3	3	2	1	0	0	0	1	0	0	1
Avg.	3	2.8	2.8	1.8	1.4	0	0	0	1	0	0	1

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:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1: **Understand** the concept of estimating thermodynamic properties from the network of equations 2: **Understand** the partial molar properties of components in a particular phase, and apply to calculations of heat of mixing, volume, and entropy changes on processing of ideal and real mixtures. 3: **Understand** chemical reaction equilibrium and various parameters affecting it. 4: **Understand** the fundamentals of phase equilibria and estimating VLE data for various systems. 5: **Understand** the LLE for binary systems using LLE diagrams and the concept of SLE.

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: Understand** the concept of chemical potential, fugacity and partial molar properties. **CO2: Understand** the Solid- Liquid and Liquid- Liquid equilibrium and test the thermodynamics consistency **CO3: Calculate** solution properties by using Gibbs Duhem and activity coefficient equations	Cognitive	Understand, Evaluate

CO4 Calculate the equilibrium composition of more than one chemical reaction occurs simultaneously **CO5: Understand** vapor liquid equilibrium and to perform bubble point, Dew point and flash calculation		

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

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	0
CO2	3	2	0
CO3	3	1	0
CO4	3	2	0
CO5	3	2	0
Avg.	3	1.8	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	2	2	2	2	2	0	2	0	0	2
CO2	3	2	2	3	2	1	2	0	2	0	0	2
CO3	3	2	2	3	2	1	2	0	1	0	0	1
CO4	3	3	2	2	2	1	2	0	2	0	0	2
CO5	3	3	2	2	2	2	2	0	1	0	0	2
Avg.	3	2.6	2	2.4	2	1.4	2	0	1.6	0	0	1.8

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:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1: **Understanding** the fundamentals of process control and tools for establishing it for a process. 2: **Developing** the transfer functions for establishing a mathematical model for a system in which process control can be implied. 3: To introduce the fundamentals of process control with **applications** using P, PI, and PID controllers. 4: **Understanding** the frequency response of stability criteria required for a process control in a system. 5. **Understanding** the importance of process control instrumentation and their applications 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: Understand** the basic principles & importance of process control in industrial process plants **CO2: Understand** the use of block diagrams & the mathematical basis for the design of control systems **CO3:** Measure and **calculate/evaluate** system parameters and evaluate the response **CO4: Understand** the importance and application of good instrumentation for the efficient design of process control loops for process engineering plants	Cognitive	Understand, Evaluate, Analyse

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	1	0
CO4	3	2	0
CO5	3	2	0
Avg.	3	1.8	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	2	2	2	2	2	0	2	0	0	2
CO2	3	2	2	3	2	1	2	0	2	0	0	2
CO3	3	2	2	3	2	1	2	0	1	0	0	1
CO4	3	3	2	2	2	1	2	0	2	0	0	2
CO5	3	3	2	2	2	2	2	0	1	0	0	2
Avg.	3	2.6	2	2.4	2	1.4	2	0	1.6	0	0	1.8

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:	24/06/2020
Course Objectives **(As per Blooms' Taxonomy)**	To enable the student: 1. To **introduce** inter-relationship between disaster and development. 2. To **introduce** types of disasters with case studies and create awareness. 3. To **study** the effective use of science for mitigating disasters 4. To **study** case studies of various famous disasters. 5. To **introduce** various disaster management frameworks and strategies adopted at national and international levels.

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: **CO1: Understand** disasters and its relationships with the development. **CO2: Understand** the prevention and control of Public Health consequences of Disasters **CO3: Understand** the institutional processes about the awareness of Disaster Risk Management in India **CO4: Develop** the skills for Medical and Psycho-Social Response to disasters.	Cognitive	Understand

CO5: Understand the relationship between vulnerability, disasters, disaster prevention and risk reduction		

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	3	2	1
CO2	2	1	1
CO3	2	1	1
CO4	2	2	0
CO5	2	2	1
Avg.	2.2	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	1	0	0	1	2	1	1	0	0	0	2
CO2	3	1	0	1	3	2	2	2	2	1	1	2
CO3	3	1	0	1	3	2	2	2	2	1	1	2
CO4	3	1	0	1	3	2	2	2	2	1	1	2
CO5	1	3	2	3	2	2	1	1	2	1	2	2
Avg.	2.6	1.4	0.4	1.2	2.4	2	1.6	1.6	1.6	0.8	1	2

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

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 **understand** the basic concepts of various mass transfer operations 2: To **select** a suitable equipment for a given mass transfer operations 3: To **learn** designing of mass transfer equipment used in industries. 4: To **learn** equilibrium conditions for various systems 5: To gain **knowledge** about cooling towers and their importance in industries.

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. 4. Font: Times new roman, Sentence case, font size – 12, Justify.		
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: **Understand** the practical importance of mass transfer in industries. CO2: Able to **identify** applications of different separation techniques in chemical industries. CO3: **Learn** designing of mass transfer equipment used in industries. CO4: **Learn** equilibrium conditions for various systems. CO5: Gain **knowledge** about cooling towers and their importance in industries.	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>MCQs</td><td>10 marks</td></tr>
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</table>

Mapping of PSOs & COs

	PSO1	PSO2	PSO2
CO1	3	2	2
CO2	3	3	2
CO3	3	3	3
CO4	3	2	2
CO5	3	1	1
Avg.	3	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	2	2	2	1	1	2	3	2	2	3
CO2	3	2	3	2	2	3	0	2	3	2	2	3
CO3	2	2	3	3	3	3	2	3	3	2	2	3
CO4	1	2	3	3	3	2	2	2	3	2	3	3
CO5	2	2	2	2	3	1	1	1	2	2	2	2
Avg.	2.2	2.2	2.6	2.4	2.6	2	1.2	2	2.8	2	2.2	2.8

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. **Learn** the kinetics of fluid fluid reactions and reactor design. 2. **Learn** the kinetics of fluid solid reactions and reactor design 3. **Understand** physical properties of solid catalyst. 4. **Learn** the kinetics and mechanism of catalytic reaction. 5. **Apply** to the kinetics concept in designing 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: **Develop** the kinetics of fluid-fluid reactions and use the appropriate kinetics in designing of non-catalytic reactors. CO2: **Develop** rate expressions for gas-solid and liquid solid reactions and use the kinetics in designing of non-catalytic reactors. CO3: **Understand** the physical properties of catalyst and its importance. CO4: **Analyse** the catalytic reactors and its applications in industry. CO5: **Apply** the concept of kinetic model to design the catalytic reactor.	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	3	1	2
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1

CO5	3	2	1
Avg.	3	1.8	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	3	2	1	1	0	0	0	1	0	0	1
CO2	3	3	2	2	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	2	1	0	0	0	1	0	0	1
CO5	3	3	3	2	1	0	0	0	1	0	0	1
Avg.	3	3	2.2	1.8	1	0	0	0	1	0	0	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. **Learn** the basic design steps for piping system and fluid transportation devices 2. **Learn** the process design of various types of heat exchangers, condensers and reboilers 3. **Learn** the process design of Distillation Column using various methods 4. **Learn** the process design of absorption column 5. **Learn** the process design of extractors

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** process equipment and modify the design of existing equipment to new process conditions or new required capacity CO2: **Build** a bridge between theoretical and practical concepts used for designing the equipment in any process industries. CO3: **Create** understanding of equipment design. CO4: **Review** the importance of design concepts in the process industry. CO5: **Review** the importance of property estimation.	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:**

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Mapping of PSOs & COs

	PSO1	PSO2	PSO2
CO1	2	2	1
CO2	3	3	2
CO3	1	0	1
CO4	3	1	0
CO5	3	3	2
Avg.	2.4	1.8	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	1	0	2	1	1	2	3	3	2	3
CO2	3	3	2	1	3	3	2	1	3	3	3	3
CO3	1	1	0	2	0	1	3	0	0	3	0	2
CO4	3	3	2	2	2	1	0	0	1	3	3	2
CO5	3	3	2	2	3	2	2	1	3	3	3	3
Avg.	2.6	2.4	1.4	1.4	2	1.6	1.6	0.8	2	3	2.2	2.6

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 **understand** the terminology, properties and classification of petroleum 2. To **remember** the origin and composition 3. To **understand** various refining aspects 4. To **understand**, the modern fractionation processes 5. To **apply** the knowledge of petroleum products

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: 1. CO1: To **understand** the terminology, properties and classification of petroleum 2. CO2: To **undertsand** the origin and composition of petroleum 3. CO3: To **understand** various refining aspects 4. CO4: To **understand** the modern fractionation processes 5. CO5: To **apply** the knowledge of different petroleum products	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	PSO2
CO1	3	1	2
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
Avg.	3	1.8	1.2

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2	0	2	0	0	2
CO2	3	2	2	3	2	1	2	0	2	0	0	2
CO3	3	2	2	3	2	1	2	0	1	0	0	1
CO4	3	3	2	2	2	1	2	0	2	0	0	2
CO5	3	3	2	2	2	2	2	0	1	0	0	2
Avg.	3	2.6	2	2.4	2	1.4	2	0	1.6	0	0	1.8

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

COURSE CODE BTCH605 B	COURSE NAME POLYMER 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)**	To make learner **understand** the basics and types of polymer. To **understand** the processes associated with manufacturing of polymers and its recycling. To **analyse** the behaviour of polymer product To **understand** the principles of polymer Technology To **understand** the basic concept of monomer, polymer and repeating units and their properties. To understand the basic concept of monomer, polymer and repeating units and their properties.

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: **Understand** the basic concepts of monomer, polymer, degree of polymerization, and repeating units and their properties CO2: **Understand** in details about the chemistry, polymerization process and rheology of polymers. CO3: **Analyse** polymers by different characterization techniques CO4: **Apply** plastic waste management knowledge CO5: **Select** polymers for different applications and correct approach recycling to make 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	3	1
CO2	2	1	0
CO3	2	2	1
CO4	3	3	2
CO5	3	3	2
Avg.	2.6	2.4	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	2	2	1	0	2	2	0	0	2	1	0	1
CO2	2	3	3	2	1	3	1	0	0	0	1	1
CO3	3	2	0	3	3	0	1	0	0	2	1	1
CO4	3	3	3	2	3	3	3	3	3	2	3	3
CO5	2	3	3	2	3	3	2	0	1	2	3	3
Avg.	2.4	2.6	2	1.8	2.4	2.2	1.4	0.6	1.2	1.4	1.6	1.8

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)**	To **understand** the concept of green technology. To **understand** the fundamentals of green and clean production. To **learn** various routes for waste to wealth generation. To **apply** the concept of green building. To make the learner **aware** of various developments in Green Industrial processes

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: **Understand** the principles of green chemistry and engineering. CO2: **Apply** design synthetic routes and modification in existing industrial processes of different disciplines.	Cognitive	Understand, Apply, Explain

CO3: **Understand** the concept and principles of cleaner production. CO4: **Apply** different unit operations in the industrial production process to minimize pollution. CO5: **Explain** the concept of green building and organic farming.		

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	3	2	1
CO2	3	1	2
CO3	2	1	2
CO4	3	2	1
CO5	2	1	1
Avg.	2.6	1.4	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	1	0	2	2	0	0	3	1	0	1
CO2	2	3	3	2	1	3	1	0	0	0	1	1
CO3	3	2	0	3	3	0	1	0	0	2	1	1
CO4	3	3	3	2	3	3	3	3	3	2	3	3
CO5	2	3	3	2	3	3	2	0	1	2	3	3
Avg.	2.4	2.6	2	1.8	2.4	2.2	1.4	0.6	1.4	1.4	1.6	1.8

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)**	To develop a student's skills in understanding the Intra-functional linkage of respective Units concepts and activities. To **understand** the importance of critical data and its analysis, used in each Unit. It provides them overview and understand the theories and principles of modern management. To **enhance** their skills to achieve the desired goal in a more efficient and effective way with use facts/data. To **encourage** and make an appreciation of these principles in relation to their own experiences and selected case studies

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: To **develop** a student's skills in understanding the Intra-functional linkage of respective Units concepts and activities. CO2: To **understand** the importance of critical data and its analysis, used in each Unit. CO3: It provides them overview and **understand** the theories and principles of modern management. CO4: To **enhance** their skills to achieve the desired goal in a more efficient and effective way with use facts/data. CO5: To **apply** these principles in relation to their own experiences and selected case studies	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
CO1	0	0	2
CO2	0	0	3
CO3	0	0	1
CO4	0	0	2
CO5	0	0	2
Avg.	0	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	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
Avg.	1.2	1	0.6	0.8	0.6	1.4	0.2	2	2	1.2	2.2	2.4

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)**	To **understand** the basic principles advanced separation techniques. To **study** various membrane separation processes. To **understand** advantages and disadvantages of advanced separation techniques over conventional techniques. To **study** limitations of advanced separation techniques.

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: **Understand** importance of advanced separation techniques in industries. CO2: Able to **identify** applications of different separation techniques in chemical industries. CO3: To **apply** the advanced separation technique in problem solving where conventional techniques are not fruitful and require replacement. CO4: **Learn** advantages and disadvantages of advanced separation techniques. CO5: To **select** criteria for advanced separation techniques and conventional separation techniques.	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	2	0
CO2	3	1	0
CO3	3	1	0
CO4	2	0	0
CO5	2	1	1
Avg.	2.4	1	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	1	0	0	0	1	2	3	0	0	0	0	0
CO2	3	1	1	0	2	3	2	0	0	0	0	1
CO3	3	2	1	0	3	3	1	2	0	0	1	0
CO4	2	1	0	1	1	2	1	1	0	0	0	1
CO5	3	3	2	1	2	0	3	2	0	0	1	1
Avg.	2.4	1.4	0.8	0.4	1.8	2	2	1	0	0	0.4	0.6

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)**	Student will be able to interpret the usage of water as utility across various applications in an industry. Knowledge of utilization of air and various form of air utilization in industry. Understanding of application and means of generation of steam in industry. Understanding of refrigeration systems and its utilization in an industry. Knowledge of implementing a venting system and vacuum system in an industry

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: Student will be able to **interpret** the usage of water as utility across various applications in an industry. CO2: **Knowledge** of utilization of air and various form of air utilization in industry. CO3: **Understanding** of application and means of generation of steam in industry. CO4: **Understanding** of refrigeration systems and its utilization in an industry. CO5: **Knowledge** of implementing a venting system and vacuum system in an industry	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	1	2
CO2	2	2	1
CO3	2	1	1
CO4	2	2	1
CO5	2	1	1
Avg.	2	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	2	2	1	1	2	2	3	2	2	3	2	1
CO2	2	1	2	2	1	2	2	2	2	3	2	1
CO3	2	1	2	2	1	2	2	2	2	3	2	1
CO4	3	2	2	3	2	2	3	1	2	2	2	1
CO5	2	1	2	2	1	2	2	2	2	3	2	1
Avg.	2.2	1.4	1.8	2	1.4	2	2.4	1.8	2	2.8	2	1

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)**	To gain the basic knowledge of Corrosion To understand the thermodynamic and kinetics of corrosion To distinguish the different forms of corrosion To gain the knowledge of different corrosion control mechanism To understand the major industrial hazards due to corrosion

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: Students will **understand** the basics and fundamentals of Corrosion CO2: Students will **understand** the corrosion mechanism of different material in various environment CO3: Students can **analyse** the different forms of Corrosion CO4: Students will **remember** different corrosion control mechanism CO5: Students can **apply** the knowledge of corrosion control mechanism for different industrial application	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	2	2	1
CO2	1	1	1
CO3	2	2	1
CO4	3	3	1
CO5	3	1	1
Avg.	2.2	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	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 BTOE08	COURSE NAME ENERGY 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)**	Study all types of fuels and its impact on Environment. Understand the types of energy, energy storage and energy conversion systems. To enable students to have a fuel usage patterns in various industries. To understand the global energy crisis and finding ways for judicious fuel usage. To comprehend the theories of Nuclear energy, solar energy and energy from Biomass.

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: **Understand** the concepts of energy usage and global energy scenario. CO2: **Learn** the characterization of any fuel and analyze technology applications CO3: To **explore** the best use of non-renewable energy with minimal intrusion to the environment and of renewable energy to sustain the advancement of civilization.	Cognitive	Understand, Analyse, Remember, Apply

CO4: **Apply** energy conversion device principles and evaluate their operation and performance. CO5: **Identify** the working principle of different resources of energy. Student will be able to interpret the usage of water as utility across various applications in an industry.		

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
CO1	2	1	2
CO2	2	2	1
CO3	2	1	1
CO4	2	2	1
CO5	2	1	1
Avg.	2	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	2	2	1	1	2	2	3	2	2	3	2	1
CO2	2	1	2	2	1	2	2	2	2	3	2	1
CO3	2	1	2	2	1	2	2	2	2	3	2	1
CO4	3	2	2	3	2	2	3	1	2	2	2	1
CO5	2	1	2	2	1	2	2	2	2	3	2	1
Avg.	2.2	1.4	1.8	2	1.4	2	2.4	1.8	2	2.8	2	1

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

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 understand the Indian Constitution. 2. To remember the framework of Indian Constitution. 3. To understand of the role of the government of the union. 4. To be aware of the role of the state government. 5. To understand administration organization

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: CO:1 **Analyse** importance of Indian constitution. CO:2 **Know** powers of state and union government. CO3: **Understand** administration of Indian Constitution	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	3	2	1
CO2	2	1	1
CO3	2	1	1
Avg.	2.3	1.3	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	0	0	1	2	1	1	0	0	0	2
CO2	3	1	0	1	3	2	2	2	2	1	1	2
CO3	3	1	0	1	3	2	2	2	2	1	1	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. **Understand** and learn the concepts for applying modelling-based simulation and Techniques. 2. **Perform** the simulation of the chemical processes, different parts of the processes and unit operations 3. Get familiar with the preferred software packages and optimization techniques to **solve** linear programming and nonlinear programming problems. 4. Use **principles** of Engineering to develop equality and inequality constraints. 5. **Learn** various optimization techniques and optimize the problems linked with chemical engineering.

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 **apply** process models based on conservation principles and process data. CO3: To **use** optimization as a tool in process design and operation. CO4: To get proficient in the applications of optimization for **optimizing** important industrial processes CO5: To **work** on professional simulation software such as ASPEN PLUS, GAMS, HYSIS, CHEMCAD and MATLAB which will make them ready for industry.	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	

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	1	0
CO2	3	2	1
CO3	2	3	1
CO4	3	3	1
CO5	2	3	2
Avg.	2.2	2.4	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	1	0	1	2	0	1	2	0	1
CO2	3	2	0	1	0	0	1	0	2	3	1	2
CO3	2	3	3	1	3	2	0	1	2	3	3	2
CO4	3	2	3	2	3	1	0	0	3	3	2	2
CO5	3	3	3	2	3	1	1	1	3	2	3	3
Avg.	2.4	2.2	1.8	1.4	1.8	1	0.8	0.4	2.2	2	1.8	2

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

COURSE CODE BTCH702	COURSE NAME PLANT DESIGN & ECONOMICS	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 **understand** the fundamentals of process plant design. 2: To **learn** the design of process auxiliaries. 3: To **learn** the development of plant layout. 4: To s**tudy** the different factors affecting project cost estimation. 5. To **understand** project planning and scheduling.

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: Cost Estimation & Depreciation **Cost Estimation:** Factors involved in project cost estimation, Total fixed & working capital, Types & methods of estimation of total capital	22.2%	10

investment, Estimation of total product cost, Cost index factors involved **Depreciation:** Types & methods of determination of depreciation, Evaluation of depreciation		
Unit 5: Profitability and Project Planning Alternative investment & replacement methods for profitability evaluation, Break-Even Point, Economic consideration in process and equipment design, Rate of return, Payback period, Inventory control Project Planning & Scheduling: Introduction, PERT & CPM, Bar chart	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: **Understanding** of the plant design and will be able to select the process. CO2: **Design** different auxiliaries and utility sections of process plant. CO3: **Design** the overall plant layout. CO4: **Estimate** the cost of a project. CO5: **Calculate** breakeven point and will be able to do scheduling of a project plan.	Cognitive	Understand Create Create Analyse Analyse

Learning Resources	
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	1	1	0
CO2	3	3	1
CO3	2	2	1
CO4	2	3	2
CO5	2	0	1
Avg.	2	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	1	1	0	1	0	1	2	0	1	2	0	1
CO2	3	2	3	1	3	2	1	0	3	3	3	2
CO3	3	2	1	0	2	1	1	0	3	3	2	3
CO4	3	3	1	2	3	3	1	2	3	3	3	3
CO5	2	2	1	3	1	0	0	2	2	3	3	2
Avg.	2.4	2	1.2	1.4	1.8	1.4	1	0.8	2.4	2.8	2.2	2.2

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

COURSE CODE BTCH708	COURSE NAME PROCESS EQUIPMENT DESIGN - 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 **understand** the codes/standards for designing a process equipment in mechanical aspects and to learn about properties associated with material selection for construction of pressure vessels. 2: To gain **knowledge** about hazards occurring and safety measures adopted in process industries. 3: To **learn** the design aspects of supports and other peripherals required for pressure vessels 4: To **learn** the methods for designing a pressure vessel. 5. To gain **knowledge** about sustainability of a process in terms of design aspects.

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: To **understand** the codes/standards for designing a process equipment in mechanical aspects. CO2: To **understand** about properties associated with material selection for construction of pressure vessels. CO3: To **design** aspects of supports and other peripherals required for pressure vessels. CO4: To **design** of a pressure vessel. CO5: To **understand** sustainability of a process in terms of design aspects.	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	2	1	1
CO2	2	1	1
CO3	3	3	0
CO4	3	3	0
CO5	1	1	0
Avg.	2.2	1.8	0.4

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	2	1	1	2	1	2	2	0	0	2
CO2	1	2	2	2	1	2	3	2	2	0	0	2
CO3	3	3	3	2	2	2	2	1	2	1	1	1
CO4	3	3	3	2	2	1	2	1	2	1	1	2
CO5	2	2	2	1	1	2	3	1	1	2	2	2
Avg.	2.2	2.4	2.4	1.6	1.4	1.8	2.2	1.4	1.8	0.8	0.8	1.8

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

COURSE CODE BTCH704	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 **understand** the norms related to alarm management system related to SCADA and DCS system. 2: To **understand** Hazard and operability studies. 3: To **understand** general aspects of fire, explosions & safety norms. 4: To **learn** the process plant safety. 5. To **learn** case studies of major disasters.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Alarm Management System Alarm Management Best Practices, The History and Nature of Alarm Problem, Common DCS and SCADA Alarm Display, Capabilities and Their Misuse, Alarm Data Types, Interlock and other safeguard systems, The Future of Alarm Management	22.2%	10
Unit 2: Hazard and Operability Studies Hazard analysis. Failure modes and effect analysis, fault tree analysis, event tree analysis. Acceptable risk and safety properties, protective equipment for personal and plant for various hazards, safety procedure, emergency response. Insurance, workers safety and public liability, other liabilities. Occupational safety rules and regulations, Layer of protection analysis – LOPA	26.6%	12
Unit 3: Fire and Safety General aspects of fires and explosions, Flammability analysis, design to prevent fires and explosions, Fire and explosion indices, Phenomena of vapour cloud explosion, flash fires and BLEVE, Risk assessment methods. Safety audit and Emergency planning	22.2%	10
Unit 4: Process Plant Safety Role of safety in engineering, chemical hazards and worker safety, hazardous properties of chemicals. Safety aspects in site selection, plant	15.5%	07

layout, installation, operation and maintenance of selected process equipment, relief system and flares and design of pressure vessels, storage, handling, and transportation of hazardous chemicals etc.		
Unit 5: Relief System & Case Studies Design of relief system (flare design and knockout drum design), Case studies regarding environment, health and safety. Case studies: Major disasters	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: CO1: To **learn** about alarm management system implemented in industries. CO2: To do proper Hazard and operability studies. CO3: To do proper fire & safety audits. CO4: To **learn** to design relief valve and knockout drums. CO5: To prepare case studies of major disasters	Cognitive	Understand Apply Apply Apply Understand

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	3	1	0
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	1	1
Avg.	3	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	1	1	1	1	1	2	0	0	1	1	0	1
CO2	1	1	1	2	1	0	0	0	1	1	0	1
CO3	1	2	2	2	1	0	0	0	1	1	0	1
CO4	2	1	3	1	1	0	0	0	1	1	0	1
CO5	1	1	1	1	1	0	0	0	1	1	0	1
Avg.	1.2	1.2	1.6	1.4	1	0.4	0	0	1	1	0	1

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

COURSE CODE BTCH705	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: Develop an **understanding** of the conservation laws that govern mass, momentum, and heat transfer. 2: **Learn** to derive and solve the ordinary and partial differential equations that result from the application of the conservation laws to specific systems. 3: Develop the **ability** to formulate and solve mathematical models for physical situations. 4: To enable the students to **understand** and different mathematical models applied to actual situations. 5. To enable the students to **understand** Mechanism of fluids in motion under different 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: Students would gain the **knowledge** of fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes. CO2: The students would be able to **understand** the mechanism of fluids in motion under different conditions CO3: Recognize and **apply** analogies among momentum, heat and mass transfer. CO4: **Apply** information obtained from solutions of the balance equations to obtain Engineering quantities of interest. CO5: To **understand** Mechanism of fluids in motion under different conditions	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	2	2	1
CO2	2	3	0
CO3	2	3	0
CO4	2	3	0
CO5	2	2	0
Avg.	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	1	2	1	2	2	2	1	1	1	0	1
CO2	1	2	3	3	2	1	1	1	2	0	0	2
CO3	3	2	3	3	3	2	1	1	2	0	0	2
CO4	3	2	3	3	2	1	2	1	1	0	0	2
CO5	2	3	1	2	1	1	1	1	1	1	0	2
Avg.	2	1	2	1	2	2	2	1	1	1	0	1

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

COURSE CODE BTCH706A	COURSE NAME PETROLEUM REFINING PROCESSES	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: **Learn** about processes associated with cracking of petroleum. 2: **Understand** the need of catalysts in various processes while going for cracking of petroleum. 3: **Learn** about the important process parameters for refining processes.

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	22.2%	10

feedstocks for hydrotreatment and desuphurization. Gasoline and Diesel Fuel Polishing.		
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: **Understand** the cracking process in refineries. CO2: **Understand** the application and selection of catalyst in catalytic cracking processes. CO3: **Analyse** the process selection for a particular operation as well as parameters for the same.	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	2	1
CO2	1	2	0
CO3	1	2	0
Avg.	1	2	0.33

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	2	0	2	1	1	1	0	1	2
CO2	1	1	2	2	1	2	2	1	2	0	0	1
CO3	1	1	2	1	1	2	1	1	1	0	2	1
Avg.	1	1	1.66	1.66	0.66	2	1.33	0.22	1.33	0	1	1.33

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

COURSE CODE BTCH706B	COURSE NAME POLYMER 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: **Learn** the fundamentals of chemical engineering aspects of polymeric materials. 2: **Study** the aspects of processing, testing and applications. 3: Equip students with basic **knowledge** of polymer synthesis that will help them to develop new materials. 4. To study of various types of mould and **understand** their construction and working. 5. **Develop** the capacity to make informed, scientific decisions involving materials selection and processing

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: **Understand** the need of additives and flow properties of polymer during processing CO2: **Apply** knowledge of additives and formulation for producing different products CO3: **Analyse** polymer using various characterization techniques. CO4: **Understand** the various processing techniques of polymers to produce different products CO5: **Analyse** the process specific equipment, various dies, their working and designing aspects.	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	2	3	2
CO3	2	2	1
CO4	3	1	3
CO5	1	3	0
Avg.	2.2	2.2	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	2	1	1	0	0	1	1	1	2	1	0	1
CO2	2	1	2	0	1	1	0	1	2	1	0	1
CO3	2	1	2	3	2	1	0	0	2	1	0	1
CO4	3	3	1	2	3	3	0	1	1	1	0	1
CO5	1	3	3	1	3	0	1	0	2	1	0	1
Avg.	2	1.8	1.8	1.2	1.8	1.2	0.4	0.6	1.8	1	0	1

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

COURSE CODE BTCH706C	COURSE NAME BIOPROCESS 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)**	To familiarize students with little or no formal training in the life sciences. To focus on the engineering aspects of biotechnology. To study about issues include enzyme technology, cell growth and product formation, transport etc. To study about bio-reactors, bio-reactor design, media formulation and sterilization and bio-separations etc. To co relate the engineering with bio processing techniques and to understand the biological factors on reaction

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	**20%**	**9**

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		
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: Students will be able to **understand** the integrated bio process. CO2: Students will **learn** to maintain contamination free environment in bio processes and to develop concepts to scale-up bio processes. CO3: Students will **understand** about bio-reactors, bio-reactor design, media formulation and sterilization and bio-separations etc. CO4: Students will be able to **apply** engineering aspects of biotechnology to the fields required the bio processes. CO5: Students will have brief understanding of overall knowledge of life science.	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
CO1	1	1	0
CO2	3	3	1
CO3	2	2	1
CO4	2	3	2
CO5	2	0	1
Avg.	2	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	3	3	2	2	2	2	2	0	2	0	0	2
CO2	3	2	2	3	2	1	2	0	2	0	0	2
CO3	3	2	2	3	2	1	2	0	1	0	0	1
CO4	3	3	2	2	2	1	2	0	2	0	0	2
CO5	3	3	2	2	2	2	2	0	1	0	0	2
Avg.	3	2.6	2	2.4	2	1.4	2	0	1.6	0	0	1.8

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

COURSE CODE BTCH706E	COURSE NAME PROCESS INTENSIFICATION	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)**	To understand basics of process intensification processes To apply the knowledge of process intensification in Chemical Industries To learn to convert batch to continuous process To save the Energy utilization in industry

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: Able to identify problems of different processes of chemical industry. CO2: Ability to solve the problems related to process engineering using process intensification. CO3: Learn the transformation of semi batch processes into continuous processes	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	3	2	2
CO2	2	3	2
CO3	2	2	1
CO4	3	1	3
CO5	1	3	0
Avg.	2.2	2.2	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	2	1	1	0	0	1	1	1	2	1	0	1
CO2	2	1	2	0	1	1	0	1	2	1	0	1
CO3	2	1	2	3	2	1	0	0	2	1	0	1
Avg.	2	1	1.6	1	1	1	0.4	0.6	2	1	0	1

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

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. 1: To **understand** concepts of Materials Management and Resource Optimization 2. To **understand** basics of quality management principles and tools adopted 3. To **learn** different aspects of Business laws. 4. To **understand** Industrial Relations Conflicts & Resolutions Process 5. To **understand** concepts of Lean Management.

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: To develop the skills in **understanding** the Intra-functional linkage of respective Units concepts and activities. CO2: To **understand** the importance of critical data and its analysis, used in each Unit CO3: To gain an overview and **understanding** of the theories and principles of modern management CO4: To enhance their skills to **achieve** the desired goal in a more efficient and effective way with use facts/data CO5: To **make** an appreciation of these principles in relation to their own experiences and selected case studies	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	0	0	2
CO2	0	0	3
CO3	0	0	1
CO4	0	0	2
CO5	0	0	2
Avg.	0	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	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
Avg.	1.2	1	0.6	0.8	0.6	1.4	0.2	2	2	1.2	2.2	2.4

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

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