

Dr. Bab

Ambedkar Technological University,
Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

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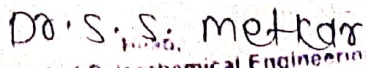
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Curriculum for Second Year
Undergraduate Degree Programme
B. Tech. in Petrochemical Engineering

With effect from AY 2021-2022




REGISTRAR
Dr. Babasaheb Ambedkar Technological University,
LONERE 402 103,
Tal. Mangaon, Dist. Raigad, (Maharashtra)


Department of Petrochemical Engineering
Dr. Babasaheb Ambedkar Technological University
Lonere-Raigad

The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with 'F' grade only.

If any of the students remain absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance. The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPA is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{\sum_{i=1}^n c_i g_i}{\sum_{i=1}^n c_i}$$

Where

'n' is the number of subjects for the semester,

'c_i' is the number of credits allotted to a particular subject, and

'g_i' is the grade-points awarded to the student for the subject based on his performance as per the above table.

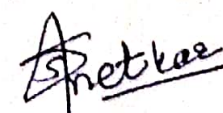
SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since he entered the Institute. CGPA is also calculated at the end of every semester (up to two decimal places). Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{\sum_{i=1}^m c_i g_i}{\sum_{i=1}^m c_i}$$

where

'm' is the total number of subjects from the first semester onwards up to and including the semester S.


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Rules and Regulations

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2019-20, starting from 1 year B.Tech.

Percentage of Marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awarded based on CGPA of all eight semester of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPA upto <5.50	Pass class
CGPA \geq 5.50 & <6.00	Second Class
CGPA \geq 6.00 & <7.50	First Class
CGPA \geq 7.50	Distinction
[Percentage of Marks = CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

1.	Mid-Semester Exam (MSE) Marks	20
2.	Continuous Assessment Marks	20
3.	End Semester Examination (ESE) Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assessment Marks	60
2.	End Semester Examination (ESE) Marks	40

It is mandatory for every student of B.Tech. to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.

EE Grade: The 'EE' grade stands for minimum passing grade.

Semester III										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC 1	BTPCC302	Unit Operations – I	3	1	-	20	20	60	100	4
PCC 2	BTPCC303	Stoichiometry	3	1	-	20	20	60	100	4
PCC 3	BTPCC304	Petrochemical Engineering – I	4	-	-	20	20	60	100	4
LC	BTPCL305	Petrochemical Engineering Lab	-	-	3	60	-	40	100	2
LC	BTPCL306	Unit Operations – I Lab	-	-	3	60	-	40	100	2
Seminar	BTPCS307	Seminar I	-	-	4	60	-	40	100	2
Internship	BTPCI308	Internship – I (Evaluation)	-	-	-	-	-	-	-	Audit
Total			13	3	10	260	80	360	700	22
Semester IV										
PCC 4	BTPCC401	Engineering Thermodynamics	4	1	-	20	20	60	100	5
PCC 5	BTPCC402	Unit Operations – II	3	1	-	20	20	60	100	4
HSSMC	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
PCC 6	BTPCC404	Petrochemical Engineering – II	3	1	-	20	20	60	100	4
PEC 1	BTPCPE405	Professional Elective – I	4	-	-	20	20	60	100	3
LC	BTPCL406	Unit Operations – II Lab	-	-	3	60	-	40	100	2
Seminar	BTPCS407	Seminar II	-	-	4	60	-	40	100	2
Internship		Field Training / Internship 2/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluated in V Sem.
Total			16	2	7	260	100	380	700	23

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course, PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course, HSSMC = Humanities and Social Science including Management Course

Elective - 1

Sr. No.	Course Code	Course Name
01	BTPCPE405 A	Environmentally Sustainable Technology
02	BTPCPE405 B	Fundamentals of Nanotechnology
03	BTPCPE405 C	Numerical Methods for Chemical Engineering
04	BTPCPE405 D	Introduction to Material Science

Course Category	Course Code
PCC 7	BTPC
PCC 8	BT
PCC 9	
OEC 1	
PCC 2	
LC	

Semester III

BTBS301 Engineering Mathematics – III

4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
BSC	BTBS 301	Engineering Mathematics-III	3	1	-	20	20	60	100	4

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Laplace and inverse Laplace transforms and their derivatives for elementary functions
2. properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients
3. definitions and properties of Fourier transforms
4. solutions of partial differential equations governing real-world problems

Course Outcomes:

At the end of the course, the student will be able to:

- comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions
- apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients
- conceptualize the definitions and properties of Fourier transforms, to solve boundary value problems using Fourier transforms
- find the solutions of partial differential equations governing real-world problems
- conceptualize limit, continuity, derivative and integration of complex functions, complex integrals useful in real-world problems

Detailed syllabus:

Unit I

Laplace Transform : Definition – conditions for existence : Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n , scale change property, transforms of functions divided by t , transforms of integral of functions, transforms of derivatives : Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit II

Inverse Laplace Transform : Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit III

Fourier Transform : Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit IV

Partial Differential Equations and Their Applications : Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation (i.e. $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$), and one dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit V

Functions of Complex Variables : Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

BTCHC302 Unit Operation - I

(Includes Mechanical and Fluid Flow Operations)

4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTPCC302	Unit Operation -I	3	1	-	20	20	60	100	4

Course Outcomes: At the end of the course, the student will be able to:

CO1	Derive dimensionless groups by dimensional analysis.
CO2	Solve problems related to manometers and decanters using the principles of fluid statics.
CO3	Determine the pipe size / flow rate / power requirements under laminar / turbulent conditions
CO4	Solve problems involving motion of fluid, fluid – solid operations in packed and fluidized beds
CO5	Select machinery for fluid transportation.
CO6	Determine the flow rate of fluid passing through closed channels.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-
CO5	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO6	✓	✓	✓	✓	✓	-	-	-	-	-	-	-

Detailed syllabus:

Unit I

Continuity equation for compressible and incompressible fluids. Bernoulli equation, Euler equation. Equation of motion. Types of flow, steady and unsteady, laminar and turbulent flows, relationship between shear stress and pressure gradient, Hagen Poiseuille equation. Prandtl mixing length theory and eddy diffusivity.

Unit II

Darcy-Weisbach equation for frictional head loss. friction factor. Moody diagram. Velocity profile and boundary layer calculations for turbulent flow. Flow through packed and fluidized beds. Pumps and compressors for handling different fluids, valves, pipe fittings and their standards, power requirement for flow, losses in pipes and fittings. Piping layout and economical pipe diameter.

Unit III

Flow measuring devices: orificemeter, venturimeter, rotameter, pitot tube, anemometer etc. Flow through constrictions such as notches, weirs, nozzles etc. mixing and agitation, calculation of power numbers and mixing indices. Liquid -liquid and liquid solid mixing. Vacuum producing devices.

Unit IV

Particle Characterization, Size Reduction, Sedimentation, Centrifugal Separation, Flocculation, Pneumatic and Hydraulic Conveying - Theory and Industrial Applications.

Unit V

Filtration: The Theory of Filtration, Filtration Practices, Filtration Equipments, Filtration in a Centrifuge and Filtration Calculations. Gas Cleaning Equipments, Size Enlargement.

Texts / References:

1. J. M. Coulson and J. F. Richardson, Chemical Engineering, Vol. 2, 4th ed. Pergamon Press
2. McCabe, J. C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 4th ed. McGraw Hill, 1985
3. S. K. Gupta, Momentum Transfer Operations, Tata McGraw Hill, 1979.
4. A. S. Foust, L. A. Wenzel, C. W. Clump, L. B. Andersen, "Principles of Unit Operations", 2nd ed. Wiley, New York, 1980.

BTPCC303 Stoichiometry

4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTPCC303	Stoichiometry	3	1	-	20	20	60	100	4

Course Outcomes: At the end of the course, student will be able to:

CO1	Understand the material and energy balances of chemical processes.
CO2	Perform material and energy balances on chemical processes/equipment
CO3	Draw the flow diagram and solve the problems involving recycle, purge and bypass
CO4	Understand the ideal and real behavior of gases, vapors and liquids.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-

Detailed syllabus:

Unit I

Introduction to Chemical Engineering: Historical evolution of Chemical Engineering and Chemical Process Industries, Chemistry to Chemical Engineering, Revision of Units and Dimensions, Mathematical techniques, Introduction to use of calculators, Mole concept, composition relationships and stoichiometry

Unit II

Material Balances: Basic Material Balance Principles, Material balance problems without and with chemical reactions, Recycle, Bypass and Purge.

Unit III

Gases, Vapours and Liquids: Ideal Gas Law, Real Gas relationships, Vapour pressure, Vapor-Liquid Equilibrium calculations, Partial saturation & Humidity, Humidity chart, Material balances involving condensation and vaporization.

Unit IV

Energy Balances: Heat Capacity, Calculation of enthalpy changes, Energy balances without chemical reactions, Enthalpy changes of phase changes, Heat of solution and mixing. Energy balances accounting for chemical reactions - Standard heat of reaction, formation and combustion, Hess Law, Effect of temperature, Adiabatic flame temperature.

Unit V

Un-steady state mass balances, with and without reactions.

Texts / References:

1. D.M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 6th Edition, Prentice Hall of India, 1997.
2. B. I. Bhat and S. M. Vora, "Stoichiometry" Tata McGraw-Hill, New Delhi
3. V. Venkataramani, N. Anantharaman and K.M. MeeraSheriffa Begum, "Process Calculations" 2nd edition, Prentice Hall of India, 2015.

BTPCC304 Petrochemical Engineering -I

4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTPCC 304	Petrochemical Engineering -I	4	-	-	20	20	60	100	4

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand composition of crude oil
CO2	Evaluate quality of crude oil and analyze product pattern
CO3	Understand different operations in Refinery
CO4	Evaluate and analyze quality of Petroleum Products
CO5	Understand needs of Indian Petroleum Industry

Mapping of course outcomes with program outcomes

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

Detailed syllabus:

Unit I

Petroleum Geology and its scope. Origin of Petroleum (emphasis on both techniques and geochemistry). Composition of petroleum, Heteroatoms and metallic trace impurities, Oil and gas traps. Application of remote sensing in petroleum resource development, Basin and exploration strategies. Instruments used – principles and working: magnetometers, seismogram, radiation counters and gravimeters

Unit II

Drilling methods (vertical, deviated and horizontal), drilling fluids, platform casing and cementation, geological formation testing, functions of geologist on drilling well, assessment of potential.

Unit III

Brief review of Petroleum, its formation and composition of crude oil, Characterization of crude oil, pretreatment of crude, removal of moisture, salts etc., general refinery set – up and function of various units, refinery flow diagram, equipment and tank yard layout.

Unit IV

Types of refineries such as simple, intermediate and complex, preflashing distillation principles, atmospheric distillation, column types, vacuum distillation, pressure distillation

Unit V

Major petroleum products and their specifications like LPG, Gasoline, Industrial solvents, naphtha, Kerosene, aviation turbine fuel (ATF), high speed diesel (HSD), LDO, furnace fuel, lubricants, base oil, tar and bitumen. Blending of various petroleum fractions to meet required specification, Gas to liquid processes. Methane, natural gas, CNG, rebuilding of hydrocarbons

Texts /References:

1. G. D. Hobson, Modern Petroleum Technology, Volume I
2. Lovetrsen, Geology of Petroleum
3. B. G. Deshpande, World of Petroleum
4. Hobson G.D., 'Modern Petroleum Technology, Volume – II' John Wiley & Sons 1986
5. Speight J.H., 'The Chemistry and Technology of Petroleum Hydrocarbons' Mercel Dekker, Inc, 1982

BTPCL 305 Petrochemical Engineering Lab

2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	BTPCL 305	Petrochemical Engineering Lab	-	-	3	60	-	40	100	2

Course Outcomes: At the end of the course, students will be able to:

CO1	Perform different Tests and Understand their Significance
CO2	Evaluate quality of products
CO3	Understand scientific principles involved in a test
CO4	Understand and predict performance of Product in Real life
CO5	Analyze and identify adulteration of products
CO6	Setup different industrial parameters of Refinery

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	✓	-	-	-	✓	-	-	-	-	-	-
CO2	-	✓	-	-	-	✓	-	-	-	-	-	-
CO3	✓	✓	✓	-	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO5	-	✓	-	-	-	-	-	-	-	-	-	-
CO6	-	✓	-	-	-	-	-	-	-	-	-	-

List of Experiments:

- To determine the Density, Specific gravity and API gravity of given petroleum and petroleum fraction.
- To determine cloud point and of pour point given petroleum and petroleum fraction.
- To determine the flash point and fire point of given petroleum fraction.
- To determine the Reid Vapor Pressure of given petroleum product
- To determine the aniline point of given petroleum fraction
- To determine the carbon residue of given petroleum fraction by Ramsbottom Method.
- To determine the carbon residue of given petroleum fraction by Conradson Method.
- Detection of copper strip corrosion by petroleum product using copper strip tarnish test.
- To determine the smoke point of given petroleum product.
- To determine the viscosity of given petroleum product by different viscometers
- To determine the penetration index of given grease sample.
- To Determine the vaporization characteristics of given petroleum product (Gasoline) by ASTM -D 086 distillation.
- To Determine the vaporization characteristics of given petroleum product (Diesel) by ASTM -D086 distillation.

BTPCL 306 Unit Operations - I Lab

2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	BTPCL 306	Unit Operations - I Lab	-	-	3	60	-	40	100	2

(Perform minimum 9 and maximum 11 of the experiments from the two sets, viz. Fluid Flow and mechanical Operations with at least 4 experiments from each set. This list is indicative. Colleges and departments can choose additional experiments as per availability subject to adherence with the syllabus.)

Course Outcomes: At the end of the course, the student will be able to:

CO1	Determine viscosity using Fenske or other viscometer and terminal velocity
CO2	Distinguish laminar and turbulent flows.
CO3	Select manometric fluid for experiment.
CO4	Determine the characteristics of packed & fluidized beds and centrifugal pumps
CO5	Identify ball, gate, globe, check valves, elbow, bend and T-joint

Mapping of course outcomes with program outcomes

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

List of Experiments (Fluid Flow Operations):

1. Determination of flow regimes -Reynolds' apparatus
2. Verification of Bernoulli's equation
3. Determination of Fanning friction factor for smooth and rough pipes
4. Determination of equivalent length of pipe fittings
5. Determination of viscosity with capillary tube viscometer.
6. Determination of friction factor for flow through packed bed.
7. Determination of discharge coefficient for venturi meter
8. Centrifugal pump characteristics
9. Study of Rota meter

List of Experiments (Mechanical Operations):

1. Determination of screen effectiveness
2. Dry screen analysis
3. Wet screen analysis
4. Study of sedimentation
5. Study of air elutriation
6. Study of cyclone separator
7. Study of froth flotation

BTPCS307 Seminar I

2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Seminar	BTPCS307	Seminar - I	-	-	4	60	-	40	100	2

Course Outcomes: At the end of the course, the student will be able to:

CO1	Acquire knowledge on topics outside the scope of curriculum.
CO2	Communicate with group of people on different topic
CO3	Collect and consolidate required information on a topic
CO4	Prepare a seminar report and present

Each student is expected to collect information on recent advances in Chemical Engineering by regularly referring to national and international journals and reference books. At the end of the semester he/she is required prepare a report as per the guide lines prescribed by the Department. Each student will be assigned a guide for this seminar course. Every student shall give a power point presentation on his Seminar topic before a panel of examiners.

BTPCI 308 Internship - 1 (Evaluation)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Internship	BTPCI308	Internship - 1 (Evaluation)	-	-	-	-	-	-	-	Audit

BTPCI 308 Internship - I (Industrial Training)

Course Outcomes: At the end of the course, the student will be able to:

CO1	Acquire knowledge on topics outside the scope of curriculum
CO2	Communicate with group of people on different topics.
CO3	Collect and consolidate required information on a topic.
CO4	Prepare the report and present

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓
CO2	✓	✓	-	-	✓	✓	-	-	✓	✓	✓	✓
CO3	-	✓	-	-	✓	-	✓	-	-	-	✓	✓
CO4	-	-	-	-	-	-	-	-	✓	-	✓	✓

Each student is expected to spend Four weeks in any one factory/project/workshop at the end of semester II (during summer vacation). Here he/she shall observe layout, working and use of various machinery, plants, design, instruments, process etc. under the general supervision of the foreman/artisan/engineer of the factory etc.

The student shall submit the report in a systematic technical format about the major field of the factory, particularly about the section/department where he/she has received the training giving details of equipment, machinery, materials, process etc. with their detailed specifications, use etc. The report shall be checked and evaluated by the concerned teacher and appropriate grade shall be awarded.

Semester IV

5 Credits

BTPCC401 Engineering Thermodynamics

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTPCC401	Engineering Thermodynamics	4	1	-	20	20	60	100	5

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply the first and second laws of thermodynamics to chemical processes.
CO2	Compute the properties of ideal and real mixtures.
CO3	Analyze the behavior of flow and non-flow processes using mass and energy balances
CO4	Estimate heat and work requirements for industrial processes.
CO5	Determine the efficiency of processes involving heat into work, refrigeration and liquefaction

Mapping of course outcomes with program outcomes

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

Detailed syllabus:

Unit I

Introduction : The Scope of thermodynamics; Dimensions and units; Measures of Amount or size; Force; Temperature; Pressure; Work; Energy; Heat.

The First Law of Thermodynamics: Joule's Experiments; Internal Energy; The First Law of Thermodynamics; Energy balance for closed systems; Thermodynamic state and state functions; Equilibrium; The phase rule; The reversible process; Constant V and constant P processes; Enthalpy; Heat capacity; Mass and energy balances for open systems.

Volumetric Properties of Pure Fluids : PVT Behavior of pure substances; the Virial Equation; The Ideal Gas; Application of the Virial Equation; Cubic Equations of State; Generalized Correlation's for gases; Generalized correlation's for Liquids.

Heat Effects: Sensible Heat Effects, Heat Effects Accompanying Phase Changes of Pure Substances,

Unit II

The Second Law of Thermodynamics : Statement of the Second law : The Heat Engine; Thermodynamic Temperature Scales; Entropy; Entropy changes of an ideal gas; Mathematical statement of the Second Law; Entropy balance for open systems; Calculation of ideal work; Lost work; The Third Law of Thermodynamics; Entropy from the Microscopic view point.

Thermodynamic Properties of Fluids: Property Relations for Homogeneous phase; Residual Properties; Residual properties by equations of state; Two phase systems. Thermodynamic diagrams; Tables of Thermodynamic properties; Generalized property correlations for gases.

Unit III

Applications of Thermodynamics to Flow Processes: Duct flow of compressible fluids; Turbines (expanders); Compression processes.

Refrigeration And Liquefaction : The Carnot Refrigerator: the vapour-compression cycle; The Choice of refrigerant; Absorption Refrigeration; The heat pump; Liquefaction Processes.

Vapour/Liquid Equilibrium Introduction: The nature of equilibrium, the Phase Rule, Duhem's Theorem, VLE: Qualitative behaviour. Simple models for vapour/liquid equilibrium, VLE by modified Raoult's Law, VLE from K- value correlations.

Unit IV

Solution Thermodynamics: Theory: Fundamental property relation. The chemical potential and phase equilibria, Partial properties, Ideal gas mixtures. Fugacity and fugacity coefficient. Fugacity and fugacity coefficient: Species in the solution, generalized correlations for the fugacity coefficient, the ideal solution, Excess properties.

Solution Thermodynamics: Applications: Liquid-phase properties from VLE data. Models for the excess Gibbs energy, Property changes of mixing, Heat Effects of mixing processes.

Unit V

Chemical Reaction Equilibria: The reaction coordinate. Application of equilibrium criteria to chemical reactions, The standard Gibbs energy change and equilibrium constant. Effect of temperature on the equilibrium constants. Relation of equilibrium constants to composition, Equilibrium conversions for single reactions, Phase rule and Duhem's theorem for reacting systems, Multi reaction equilibria.

Texts/References:

1. J. M. Smith, H.C. Van Ness, and M.M. Abbott, Chemical Engineering Thermodynamics, 6thed, Tata McGraw Hill edition, 2003.
2. Y. V. C. Rao, "Chemical Engineering Thermodynamics", University Press 1997
3. S. I. Sandler. "Chemical Engineering Thermodynamics". Wiley, New York, 1999.

BTPCC 402 Unit Operations -II

4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTPCC402	Unit Operations -II	3	1	-	20	20	60	100	4

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the modes of heat transfer.
CO2	Determine heat transfer coefficients for forced and natural convection.
CO3	Understand heat transfer involving phase change.
CO4	Analyze the heat exchanger performance for co-current and counter-current flows.
CO5	Design double pipe and shell & tube heat exchangers

Mapping of course outcomes with program outcomes

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

Detailed syllabus:

Unit I

Conduction: Conduction through a single homogeneous solid, thermal conductivity of solids, liquids and gases. Conduction through several bodies in series. Contact resistances. Unsteady state heat conduction, lumped heat capacity system, transient heat flow in a semi-infinite solid.

Heat transfer by Convection: Forced convection. Laminar heat transfer on a flat plate Laminar and turbulent flow heat transfer inside and outside tubes. Film and overall heat transfer coefficients. Resistance concept, Coefficients for scale deposits, L.M.T.D. in heat exchangers with co and counter current flow. Heat exchanger design. Effectiveness – N T U method in finned tube heat exchangers.

Unit II

Natural convection: Heat transfer from plates and cylinders in verticals and horizontal configuration, natural convection to spheres. Heat transfer with phase change, i. e. heat transfer in Boiling and condensation, Single and multiple effect evaporators.

Heat Transfer by Radiation: Black and gray body radiations, view factor, luminous and non-luminous gases. Combined heat transfer, i.e. conduction, convection and radiation together. Concept of critical insulation thickness.

Unit III

Combined natural and forced convection: Fluid flow and heat transfer across cylinders and spheres. Combined natural and forced convection heat transfer in horizontal circular conduits. Heat transfer in extended surfaces such as fins, conduction convection heat transfer, forced convection heat transfer in circular conduits with longitudinal fins. Heat transfer in non Newtonian fluids.

Unit IV

Introductory Concepts of Heat exchanger design: Design of single and multi pass shell and tube type exchangers using LMTD and effectiveness – NTU methods. Spiral coil and plate type heat exchangers. Single and multi phase condenser. Design of Reboilers, vapourisers, Kettle type and Thermosiphon reboilers. forced circulation vaporizers. Heat transfer in agitated vessels both, jacketed and with coil, Determination of overall heat transfer coefficient, transient heating or cooling. Heat transfer in packed and fluidized beds.

Unit V

Heating of crude oil through exchangers. Pipestill heaters, their types and constructional features, estimation of heat duty, combustion calculation and heat transfer area in different parts in pipe still heater. Calculation of pressure drop and stack height.

Texts / References:

1. J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol. 1 ELBS, Pergamon press, 1970
2. J. M. Coulson and J. F. Richardson. "Chemical Engineering" Vol. 2 ELBS, Pergamon press, 1970
3. W. L. McCabe J. C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 4th ed. McGraw Hill 1985.
4. D. Q. Kern, "Process Heat Transfer", McGraw Hill, 1950.

BTHM403 Basic human rights

3 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
HSSMC	BTHM403	Basic human rights	3	-	-	20	20	60	100	3

Course Objectives:

- 1) To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
- 2) To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
- 3) To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
- 4) To develop sympathy in their minds for those who are denied rights.
- 5) To make the students aware of their rights as well as duties to the nation.

Course Outcomes:

- Students will be able to understand the history of human rights.
- Students will learn to respect others caste, religion, region and culture.
- Students will be aware of their rights as Indian citizen.
- Students will be able to understand the importance of groups and communities in the society.
- Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

Detailed syllabus:

Unit I

The Basic Concepts: - Individual, group, civil society, state, equality, justice, Human Values, Human rights and Human Duties; - Origin, Contribution of American bill of rights, French revolution, Declaration of independence, Rights of citizen, Rights of working and exploited people

Unit II

Fundamental rights and economic programme. Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

Unit III

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy. NGOs and human rights in India: - Land, Water, Forest issues.

Unit IV

Human rights in Indian constitution and law:-

- i) The constitution of India: Preamble
- ii) Fundamental rights.
- iii) Directive principles of state policy.
- iv) Fundamental duties.
- v) Some other provisions.

Unit V

Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission.

Reference books:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives(Law in India), Oxford India

BTPCC 404 Petrochemical Engineering -II

4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTPCC 404	Petrochemical Engineering -II	3	1	-	20	20	60	100	4

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand working types and calculate heat duty for pipe still heaters
CO2	Understand the equilibrium of multicomponent systems
CO3	Design distillation column for multicomponent system
CO4	Understand different types of distillation column, and to do inter-conversion of data

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed syllabus:

Unit I

Flash distillation, Dew point and Bubble point calculations, temperature and concentration profile in a distillation column.

Unit II

Multicomponent distillation, Calculation of number of stages in distillation, Key component concept, Comparison between multicomponent distillation and petroleum distillation

Unit III

Distillation curves and their interconversion at atmospheric, sub atmospheric and super atmospheric pressure, Collection and data for distillation column design and operation etc.

Unit IV

Atmospheric distillation, principles and mode of excess heat removal, Flash zone calculation and estimation of side draw tray temperatures, Design aspects, Post treatment of straight run products.

Unit V

Vacuum distillation column internals and operational aspects for lubes, asphalt, cracking feedstock, Pressure distillation and gas fractionation units, Difference between various types distillation regaining products of pressure distillation.

Texts / References:

1. B.K.Bhaskar Rao , Modern Petroleum Refining Processes . Oxford & IBH (2006)
2. W.L. Nelson, Petroleum Refinery Engineering, McGraw –Hill, 1964
3. M. Vanwinkle , Distillation , McGraw –Hill ,1961

BTPCE405 Professional Elective – I

3 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PEC	BTCHE405	Professional Elective - II	3	-	-	20	20	60	100	3

A. Environmentally Sustainable Technology

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand Basics of Green Chemistry
CO2	Understand and Evaluate Problems of Waste Production
CO3	Measure and Compare performance of different processes
CO4	Understand new Technologies
CO5	Design Green Process

Mapping of course outcomes with program outcomes

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

Detailed syllabus:

Unit I

Principles and concepts of Green Chemistry: Introduction, Sustainable Development and Green Chemistry, Atom Economy, Atom Economic Reactions, Rearrangement Reactions, Addition Reactions, Atom Un-economic Reactions, Substitution Reactions, Elimination Reactions, Wittig Reactions, Reducing Toxicity, Measuring Toxicity.

Unit II

Waste Production, Problems and Prevention: Introduction, Some Problems Caused by Waste, Sources of Waste from the Chemical Industry, The Cost of Waste, Waste Minimization Techniques, The Team Approach to Waste Minimization, Process Design for Waste Minimization, Minimizing Waste from Existing Processes, On-site Waste Treatment, Physical Treatment, Chemical Treatment, Bio treatment Plants, Design for Degradation, Degradation and Surfactants, DDT, Polymers, Some Rules for Degradation, Polymer Recycling, Separation and Sorting, Incineration, Mechanical Recycling, Chemical Recycling to Monomers.

Unit III

Measuring and controlling environmental performance: The Importance of Measurement, Lactic Acid Production, Safer Gasoline, Introduction to Life Cycle Assessment, Green Process Metrics, Environmental Management Systems, The European Eco-management and Audit Scheme, Eco-labels, Legislation, Integrated Pollution Prevention and Control.

Catalysis and green chemistry: Introduction to Catalysis, Comparison of Catalyst Types, Heterogeneous Catalysts, Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous Catalysis, Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Phase Transfer Catalysis, Hazard Reduction, C-C Bond Formation, Oxidation Using Hydrogen Peroxide, Biocatalysis, Photo catalysis.

Unit IV

Organic solvents, Environmentally benign solutions: Organic Solvents and Volatile Organic Compounds, Solvent-free Systems, Supercritical Fluids, Supercritical Carbon Dioxide, Supercritical Water, Water as a Reaction Solvent, Water-based Coatings, Ionic Liquids, Ionic Liquids as Catalysts, Ionic Liquids as Solvents, Fluorous Biphasic Solvents.

Renewable resources: Biomass as a Renewable Resource, Energy, Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable Feedstock, Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies, The Syngas Economy, The Bio refinery, Chemicals from renewable feed stocks.

Unit V

Emerging Greener technologies and Alternative energy solutions: Design for Energy Efficiency, Photochemical Reactions, Advantages of and Challenges Faced by Photochemical, Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves, Microwave Heating, Microwave-assisted Reactions, Sonochemistry and Green Chemistry, Electrochemical Synthesis, Examples of Electrochemical Synthesis.

Designing greener processes: Conventional Reactors, Batch Reactors, Continuous Reactors, Inherently Safer Design, Minimization, Simplification, Substitution, Moderation, Limitation, Process Intensification, Some PI Equipment, Examples of Intensified Processes, In-process Monitoring, Near-infrared Spectroscopy.

An integrated approach to a greener chemical industry: Society and Sustainability, Barriers and Drivers, The Role of Legislation, EU White Paper on Chemicals Policy, Green Chemical Supply Strategies.

Texts / References:

1. Mike Lancaster, Green Chemistry, Royal Society of Chemistry, 2010.
2. Paul T. Anastas John C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 2000.
3. Jay Warmke, Annie Warmke, Green Technology, Educational Technologies Group, 2009.

B. Fundamentals of Nanotechnology

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the properties of nano-materials and their applications
CO2	Apply chemical engineering principles to nano-particles production and scale-up
CO3	Solve the quantum confinement equations
CO4	Characterize nano-materials.
CO5	State the applications of nanotechnology in electronics and chemical industries.

Mapping of course outcomes with program outcomes

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

Detailed syllabus:

Unit I

Introduction to Nanotechnology: Introduction to nanotechnology and materials. Nanomaterials, Introduction to nano sizes and properties comparison with the bulk materials, different shapes and sizes and morphology.

Fabrication of Nanomaterials: Top Down Approach, Grinding, Planetary milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Micro emulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Sonochemical Approach, Microwave and Atomization, Gas phase Production Methods : Chemical Vapour Depositions.

Unit II

Kinetics at Nanoscale: Nucleation and growth of particles, Issues of Aggregation of Particles, Oswald Ripening, Stearic hindrance. Layers of surface Charges, Zeta Potential and pH.

Unit III

Carbon Nanomaterials: Synthesis of carbon buckyballs. List of stable carbon allotropes extended fullerenes, metallofullerenes solid C60, bucky onions nanotubes, nanocones Difference between Chemical Engineering processes and nanosynthesis processes. Characteristics of quantum dots, Synthesis of quantum dots, Semiconductor quantum dots, Introduction - Nanoclay Synthesis method, Applications of nanoclay.

Unit IV

Nanomaterials characterization: Instrumentation Fractionation principles of Particle size measurements, Particle size and its distribution. XRD, Zeta potential Microscopy's SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy

Unit V

Applications in Chemical Engineering: Self-assembly and molecular manufacturing : Surfactant based system Colloidal system applications, ZnO, TiO₂, Silver Nanoparticles Functional materials Applications, Production Techniques of Nanotubes, Carbon arc, bulk synthesis, commercial processes of synthesis of nanomaterials, Nanoclay, Commercial case study of nano synthesis - applications in chemical engineering, Nano inorganic materials - CaCO₃ synthesis, Hybrid wastewater treatment systems, Electronic Nanodevices, sensor applications, Nanobiology: biological methods of synthesis. Applications in drug delivery, Nanocontainers and Responsive Release of active agents, Layer by Layer assembly for nanospheres, Safety and health Issues of nanomaterials, Environmental Impacts, Case Study for Environmental and Societal Impacts.

Texts /References:

1. Kulkarni Sulabha K., Nanotechnology: Principles and Practices, Capital Publishing Company, 2007.
2. Gabor L. Hornyak., H.F. Tibbals, Joydeep Dutta, John J. Moore, Introduction to Nanoscience and Nanotechnology, CRC Press.
3. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005.
4. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
5. Davies, J.H. 'The Physics of Low Dimensional Semiconductors: An Introduction', Cambridge University Press, 1998.

C. Numerical Methods for Chemical Engineering

Course Outcomes: At the end of the course, the student will be able to:

CO1	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
CO2	Apply numerical methods to obtain approximate solutions to mathematical problems
CO3	Derive numerical methods for various mathematical operations like interpolation, differentiation etc.
CO4	Analyze and evaluate the accuracy of common numerical methods.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	-	-	✓	-	✓	-	-	-	-	-	-
CO2	✓	-	-	✓	-	✓	-	-	-	-	-	-
CO3	✓	-	-	✓	-	✓	-	-	-	-	-	-
CO4	✓	-	-	✓	-	✓	-	-	-	-	-	-

Detailed syllabus:

Unit I

Solutions of Linear Algebraic Equations - Gauss elimination and LU decomposition, Gauss-Jordan Elimination, Gauss-Seidel and relaxation methods.

Eigen values and Eigen Vectors of Matrices - Faddeev-Leverrier method, Power method, Householder's and Given's method

Unit II

Nonlinear Algebraic Equations - Fixed point method, Multivariable successive substitutions, Single variable Newton-Raphson Technique, Multivariable Newton-Raphson Technique

Unit III

Function Evaluation - Least-squares curve fit, Newton's Interpolation formulae, Newton's divided difference interpolation polynomial, Lagrangian interpolation, Pade approximations, Cubic spline approximations

Unit IV

Ordinary Differential Equations (Initial value problems) – RungeKutta Methods, Semi-implicit RungeKutta Techniques, Step size control and estimates of error

Ordinary Differential Equations (Boundary value problems) - Finite difference technique, Orthogonal collocation technique, Orthogonal collocation on finite elements

Unit V

Partial Differential Equations – Introduction to finite difference technique

Texts / References:

S.K. Gupta, "Numerical Methods for Engineers", Wiley Eastern, 1995.

M.E. Davis, "Numerical Methods & Modeling for Chemical Engineers", Wiley, 1984.

D. Introduction to Material Science

Course Outcomes: At the end of the course, the student will be able to:

CO1	Correlate processing, microstructure and properties of materials.
CO2	Understand behavior of materials under various conditions.
CO3	Characterize modes of failure of engineering materials and design new materials with better properties and cost effective processes.
CO4	Identify suitable materials for engineering applications.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	✓	-	-	✓	-	✓	-	✓	-	-	-
CO2	-	✓	-	-	✓	-	✓	-	✓	-	-	-
CO3	-	✓	-	-	✓	-	✓	-	✓	-	-	-
CO4	-	✓	-	-	✓	-	✓	-	✓	-	-	-

Detailed syllabus:

Unit I

Materials Science and Engineering Materials, Classification of Materials and Properties: Mechanical, Dielectric, Magnetic and Thermal.

Unit II

Metallurgical Aspects of Materials: Structure of Metals and Alloys, Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals, Significance of micro structural features.

Unit III

Heat Treatment: effect of cooling and heating rates and ageing materials for mechanical load bearing applications; Corrosion Resistant Materials: Some important Metals, Alloys, Ceramics and Polymers.

Unit IV

Materials for Electrical Applications: Conductors, Dielectrics, insulators; Materials for Civil Engineering Applications.

Unit V

Materials for Biomedical applications: Steels, Ti and its alloys, Ni-Ti alloys, bioceramics, porous ceramics, Bioactive glasses, calcium phosphates, collagen, thin films, grafts and coatings, biological functional materials Latex products.

Texts/ References:

1. M.F. Ashby: Engineering Materials, 4th Edition, Elsevier, 2005.
2. M.F. Ashby: Materials Selection in Mechanical Design, B H, 2005.
3. ASM Publication Vol. 20. Materials Selection and Design. ASM, 1997
4. Pat L. Mangonon: The Principles of Materials Selection and Design, PHI, 1999.

BTPCL406 Unit Operations - II Lab

2 Credit

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	BTPCL406	Unit Operations II Lab	-	-	3	60	-	40	100	2

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the Electrical analogy in relation to heat conduction
CO2	Determine Emissivity of a given body.
CO3	Determine heat flow for resistances in series
CO4	Determine heat losses from cylindrical furnace
CO5	Determine temperature profiles in rod-double pipe heat exchanger, helical coil, heat pipe demonstration experiment
CO6	Understand boiling Phenomena in liquids

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	-	✓	-	-	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO6	✓	✓	✓	✓	-	-	-	-	-	-	-	-

List of Experiments

1. To determine thermal conductivity of given metal rod
2. Study of Double Pipe Heat Exchanger
3. Study of Shell and Tube Heat Exchanger
4. Study of Study of emissivity of circular discs with and without black coating.
5. Study of Stefan-Boltzman's constant
6. To determine the surface heat transfer coefficient for a vertical tube losing heat by natural convection.

BTPCS407 Seminar II

2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credits
Seminar	BTPCS407	Seminar - II	-	-	4	60	-	40	100	2

Course Outcomes: At the end of the course, the student will be able to:

CO1	Acquire knowledge on topics outside the scope of curriculum	3
CO2	Communicate with group of people on different topics.	
CO3	Collect and consolidate required information on a topic.	
CO4	Prepare a seminar report and present	

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓
CO2	✓	✓	-	-	✓	✓	-	-	✓	✓	✓	✓
CO3	-	✓	-	-	✓	-	✓	-	-	-	✓	✓
CO4	-	-	-	-	-	-	-	-	✓	-	✓	✓

Each student is expected to collect information on recent advances in Chemical Engineering by regularly referring to national and international journals and reference books. At the end of the semester he/she is required prepare a report as per the guide lines prescribed by the Department. Each student will be assigned a guide for this seminar course.

Every student shall give a power point presentation on his Seminar topic before a panel of examiners.

BTCH1508 Internship - 2

Audit

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Internship	BTPCI508	Internship - 2							-	Audit

Field Training / Internship 2 / Industrial Training (minimum of 4 weeks, which can be completed partially in third semester and fourth semester or at one time). Credits to be evaluated in V Sem.

Internship- II (Industrial Training)

Course Outcomes: At the end of the course, the student will be able to:

CO1	Acquire knowledge on topics outside the scope of curriculum
CO2	Communicate with group of people on different topics.
CO3	Collect and consolidate required information on a topic.
CO4	Prepare a seminar report and present

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓
CO2	✓	✓	-	-	✓	✓	-	-	✓	✓	✓	✓
CO3	-	✓	-	-	✓	-	✓	-	-	-	✓	✓
CO4	-	-	-	-	-	-	-	-	✓	-	✓	✓

Each student is expected to spend Four weeks in any one factory/project/workshop at the end of semester IV (during summer vacation). Here he/she shall observe layout, working and use of various machinery, plants, design, instruments, process etc. under the general supervision of the foreman/artisan/engineer of the factory etc. Student shall submit report in a systematic technical format about the major field of the factory, particularly about the section/department where he/she has received the training giving details of equipment, machinery, materials, process etc. with their detailed specifications, use etc. The report shall be checked and evaluated by the concerned teacher and appropriate grade shall be awarded.