Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra
Telephone and Fax.: 02140 - 275142
www.dbatu.ac.in



Curriculum for

Undergraduate Degree Programme

Second Year B. Tech. Petrochemical

In line with National Education Policy 2020

With effect from AY 2024-2025

Department of Petrochemical Engineering

Credit Framework under Four-Years UG Engineering Programme with Multiple Entry and Multiple Exit options:

- The Four-year Bachelor's Multidisciplinary Engineering Degree Programme allows the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning from different institutions.
- The minimum and maximum credit structure for different levels under the Four-year Bachelor's Multidisciplinary Engineering UG Programme with multiple entry and multiple exit options are as given below:

Credit Framework

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	One Year UG Certificate in Engg./ Tech.	40	44	2	1
5.0	Two Years UG Diploma in Engg./ Tech.	80	88	4	2
5.5	Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Engg./ Tech.)	120	132	6	3
	4-Years Bachelor's degree				

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
6.0	(B.E./ B.Tech. or Equivalent) in Engg./ Tech. with Multidisciplinary Minor	160	176	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors with Research and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Major Engg. Discipline with Double Minors (Multidisciplinary and Specialization Minors)	180	194	8	4

- There are multiple exit options at each level. Student will be given a specific Qualification mentioned in the table depending on the level at which he/she decides to have an exit. Ex. If a student decides to exit after completion of two years (level 5.0) of the program, he will be given a Diploma in Engineering with specific exit condition mentioned in the syllabus of the specific branch. He/she can re-join the program with the multiple entry option at the level next where he/she chose to exit previously. (Student can join at level 5.5 if successfully completed level 5.0 previously at the time of exit).
- Minimum credit requirements of each level are mentioned in the credit framework table.
  - There are 4 distinct options available at level 6.0.

- First one is basic level 6.0 option where minimum 160-maximum 176 credits are mandatory which can be completed as per the Semester-wise Credit distribution structure mentioned in the table given below.
  Here, the Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with multidisciplinary minor (min.160-max.176 Credits) i.e. "**B. Tech. in Petrochemical Engineering with Computer Engineering**" (160 - 176 credits) enables students to take up four - six or required additional courses of 14 credits in the discipline other than Petrochemical Engineering distributed over semesters III to VIII. Here in the case of "**B. Tech. in Petrochemical Engineering with Computer Engineering**" (160 - 176 credits) student is supposed to take up courses to complete the credits (assigned 14 credits) from **Computer Engineering minor bucket**.
- Remaining three level 6.0 options are the advanced options where the student is given an opportunity to get extra qualification by earning some extra credits (18-20 extra credits). These three options are given below:
- Level 6.0: The **Bachelor's Engineering Degree with Honors** in chosen Major Engg./ Tech. Discipline i.e. in Petrochemical Engineering with Honours with Multidisciplinary Minor (180 - 194 credits) enables students of Petrochemical Engineering to take up four - six additional courses of 18 to 20 credits in the Petrochemical Engineering discipline distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18 - 20 credits over semesters III to VIII, which are over and above the min.160 - max.176 Credits prescribed for the duration of four years will be taken by Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree with Research** in i.e. in Petrochemical Engineering with Research with Multidisciplinary Minor (180-194 credits) enables students of Petrochemical Engineering to take up a research project of 18 to 20 credits in the Petrochemical Engineering discipline distributed over semesters VII to VIII. **Student must have CGPA equal to or greater than 7.5 at the end of sixth semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary and Specialization Minor, 180-194 credits), i.e. "**B. Tech in Petrochemical Engineering with *other selected discipline in* Engineering (as MDM) with Specialization Minor in Computer Engineering**" (180-194 credits) enables students to take up four - six additional courses of 14 credits in the discipline other than Petrochemical Engineering(for completion of multidisciplinary minor) and 18 to 20 extra credits in the **Computer Engineering discipline** distributed over semesters III to VIII. Here, the ***other selected discipline* in Engineering should be different from Specialization Minor i.e. Computer Engineering**. This enables students to take up four - six or required additional courses of 18 to 20 credits in the **Computer Engineering** discipline distributed over semesters III to VIII, which are over and above the min.160 - max.176 credits. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, prescribed for the duration of four years will be taken by

Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.

Semester-wise Credit distribution structure for Four Year UG Engineering Program - One Major, One Minor

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	06-08	08-10		--	--	--	--	--	14-18
Engineering Science Course		10-08	06-04		--	--	--	--	--	16-12
Programme Core Course (PCC)	Program Courses	--	02	08-10	08-10	10-12	08-10	04-06	04-06	44-56
Programme Elective Course (PEC)		--	--	--	--	04	08	02	06	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	02	02	04	02	02	02	14
Open Elective (OE) Other than a particular program		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		04	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--		04	04
Internship/ OJT		--	---			--	--	12	-	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
Total Credits (Major)		**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**160-176**

Student need to follow the Semester-wise Credit distribution structure for Four Year UG Engineering Program as prescribed in the table given above.

- There are seven vertical categories with specific credits distributed in specific semesters.
- Student can choose a Program Elective Course (PEC) in that specific semester from the given subjects.
- Multidisciplinary course (MDM) and Open Elective (OE) courses can be chosen from the MDM and OE Buckets depending on student's choice. Completion of total credits given in the last column of the table for each vertical is mandatory.
- Students can complete 40% of the courses through online platforms like NPTEL/SWAYAM. The NPTEL SWAYAM course content should be at least 80% similar to the course content in the syllabus.

General Rules and Regulations

1. The normal duration of the course leading to B. Tech. degree will be EIGHT semesters.
2. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
3. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
4. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

Registration:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full- Time Student of a UG/PG Programme:
   A full-time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.

2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfils the following conditions:
   i) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
   ii) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
   iii) Paid all required advance payments of the Institute and hostel for the current semester;
   iv) Not been debarred from registering on any specific ground by the Institute.

Evaluation System:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2023-2024, from I 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 eighth semester of B.Tech. Program.

Award of Class:

The candidates who successfully complete all course/curriculum requirements of B.Tech Programme shall be awarded class as specified below:

a) Those who score CGPA of 8.25 and above shall be awarded First Class with Distinction.
b) Those who score CGPA of 6.75 and above but below 8.25 shall be awarded First Class.
c) Those who score CGPA below 6.75 shall be awarded Second Class.
d)

Following will be the equivalent percentage of CGPA on Ten Point Scale:
The formula used to convert CGPA to percentage is

Percentage of Marks = (CGPA – 0.75) * 10.

Cumulative Grade Point Average (CGPA)	Equivalent Percentage of Marks
5.75	50
6.25	55
6.75	60
7.25	65
7.75	70
8.25	75

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

Mid Semester Exam (MSE) Marks	20
Continuous Assessment Marks	20
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, M. Tech to score a minimum of 45 marks out of 100 with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.
- This will be implemented from the first year of B. Tech starting from Academic Year 2023-24.

5. Description of Grades

EX Grade: An ‘EX’ grade stands for outstanding achievement.

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

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. (SGPI 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 s/he entered the Institute. CGPA is also calculated at the end of every semester (upto 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,

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

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

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

7. Attendance Requirements:

a. All students must attend every lecture, tutorial and practical classes.

b. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted. If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination. The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be. In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

a. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

b. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

8. Transfer of Credits:

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a. 20 % of the total credit will be considered for respective calculations.

b. Credits transferred will be considered for overall credits requirements of the programme.

c. Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d. A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e. A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f. Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g. In exceptional cases, the students may opt for higher credits than the prescribed.

SEMESTER III											
Sr. No.	**Course Category**	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
				L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
1	BSC	24UD1000BS301	Engineering Mathematics-III	3	1	-	20	20	60	100	4
2	PCC	24UD1527PC302	Fluid Flow Operations	3	-	-	20	20	60	100	3
3	PCC	24UD1527PC303	Chemical Process Calculations	3	-	-	20	20	60	100	3
4	PCC	24UD1527PC304	Mechanical Operations	2	-	-	20	20	60	100	2
5	OE	24UD1000OE305 C	Open Elective -1 (Introduction to Psychology)	2	-	-	20	20	60	100	2
6	MDM	24UD1527MD306	MDM Bucket** (World of Petroleum)	2	-	-	20	20	60	100	2
7	VEC Audit	24UD1000VE307	Constitution of India	2	-	-	50	-	-	AU	AU
8	VEC	24UD1000VE308 B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	-	50	-	-	50	1
9	PCC	24UD1527PC309	Introduction to Petroleum Geology and Petroleum Refinery	2	-	-	20	20	60	100	2
10	VEC Audit	24UD1527PC310	Morden Indian Language	2	-	-	60	-	40	100	AU
11	CEP	24UD1527CP311	Field Project/ Community/Engineering Project	-	-	4	60	-	40	100	2
12	PCC	24UD1527PC312L	Unit Operations Lab I	-	-	2	60	-	40	100	1
			Total	**22**	**1**	**6**	**420**	**140**	**540**	**1050**	**22**
SEMESTER IV											
1	PCC	24UD1527PC401	Chemical Engineering Thermodynamics – I	3	-	-	20	20	60	100	3
2	PCC	24UD1527PC402	Heat Transfer Operations	3	-	-	20	20	60	100	3
3	PCC	24UD1527PC403	Petroleum Engineering – I	3	-	-	20	20	60	100	3
4	PCC	24UD1527PC404	Plant Utilities and Plant Safety	3	-	-	20	20	60	100	3
5	OE	24UD1527PC405 A	Open Elective - II (Introduction to MATLAB)	3	-	-	20	20	60	100	3
6	MDM	24UD1527PC406	MDM Bucket** (Petroleum Refinery Operations and Processes)	2	-	-	20	20	60	100	2
7	VEC	24UD1000VE3407	Universal Human Values-II	2	-	-	20	20	60	100	2
8	VEC	24UD1000VE3408 A	Life of Chhatrapati Shivaji Maharaj	1	-	-	50	-	-	50	1
9	PCC	24UD1527PC409L	Unit Operation II Laboratory	-	-	2	60	-	40	100	1
10	VSEC	24UD1527PC410L	Petroleum Engineering - I Laboratory	-	-	2	60	-	40	100	1
11	PCC	24UD1527PC411L	Seminar	-	-	2	60	-	40	100	1
			Total	**20**	**-**	**6**	**370**	**140**	**540**	**1050**	**23**

SEMESTER – III

Engineering Mathematics – III **04 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
BSC	24UD1000BS301	Engineering Mathematics-III	3	1	-	20	20	60	100	04

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:

CO1: Comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions

CO2: Apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients

CO3: Conceptualize the definitions and properties of Fourier transforms, to solve boundary value problems using Fourier transforms

CO4: Find the solutions of partial differential equations governing real-world problems

CO5: Conceptualize limit, continuity, derivative and integration of complex functions, complex
integrals useful in real-world problems

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

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 tn, 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 ∂u∂t=c2∂2u∂x2), and one-dimensional wave equation (i.e., $\partial 2y\partial t2=c2\partial 2y\partial x2$).

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. RajnishVerma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, 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 by I. N. Sneddon, Tata McGraw-Hill, New York.

Fluid Flow Operations **03 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC302	Fluid Flow Operations	3	-	-	20	20	60	100	03

Course Objectives:

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

1. Knowledge of dimensionless groups by dimensional analysis.
2. Manometers and decanters using the principles of fluid statics.
3. Pipe size / flow rate / power requirements under laminar / turbulent conditions
4. Motion of fluid, fluid – solid operations in packed and fluidized beds
5. Machinery for fluid transportation.

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 pipe size / flow rate / power requirements under laminar / turbulent conditions
CO4: Understand and solve 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

Unit II

Prandtl mixing length theory and eddy diffusivity, losses in pipes and fittings. Darcy-Weisbach equation for frictional head loss, friction factor, Moody diagram. Velocity profile and boundary layer calculations for turbulent flow.

Unit III

Flow through packed and fluidized beds. Introduction to non-Newtonian flow and two phase flow.

Unit IV

Pumps and compressors for handling different fluids, valves, pipe fittings and their standards, power requirement for flow. Piping layout and economical pipe diameter. Vacuum producing devices.

Unit V

Flow measuring devices: Orifice meter, Venturi meter, Rotameter, Pitot tube, Anemometer etc. Flow through constrictions such as notches, weirs, nozzles. Mixing and agitation, calculation of power numbers and mixing indices. Liquid-liquid and liquid solid mixing.

Texts / References:

1. W. L. McCabe and J. C. Smith, P. Harriot, Unit Operations of Chemical Engineering 4th ed. McGraw Hill 1985.
2. S. K. Gupta, Moment Transfer Operations, Tata McGraw Hill, 1979.
3. J. M. Coulson and J. F. Richardson, Chemical Engineering Vol. I. Pergamon Press, 1970.
4. S. Foust, L. A. Wenzel, C. W. Clump, L. B. Andersen. Principles of Unit Operations, 2nd ed. John Wiley, New York, 1980.

Chemical Process Calculation
03 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC303	Chemical Process Calculation	3	-	-	20	20	60	100	03

Course Objectives:

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

1. Material and energy balances of chemical processes.
2. Material and energy balances on chemical processes/equipment
3. Chemical Engineering problems involving recycle, purge and bypass
4. Ideal and real behaviour of gases, vapours and liquids.

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 behaviour of gases, vapours 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, Vapour- 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. Meera Sheriffa Begum, “Process Calculations” 2nd edition, Prentice Hall of India, 2015

Mechanical Operations **02 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC304	Mechanical Operations	2	-	-	20	20	60	100	02

Course Objectives:

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

1. Mechanical operations and their role in chemical engineering
2. Nature of solids, their characterization, handling, and the processes involving solids.
3. Performance of size reduction equipment and calculate the power requirements.
4. Solid-fluid separation equipment.

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

CO1: Understand mechanical operations and their role in chemical engineering
CO2: Understand nature of solids, their characterization, handling, and the processes involving solids.
CO3: Analyse the performance of size reduction equipment and calculate the power requirements.
CO4: Design solid-fluid separation equipment.

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
Particulate Solids - Particle Characterization, Particulate Solids in Bulk, Blending of Solid Particle, Classification of Solid Particles
Screening: Screening equipment, Screen capacity.

Unit II
Size Reduction of Solids - Mechanism of Size Reduction. Energy for Size Reduction, Methods of Operating Crushers, Nature of Material to be Crushed, Types of Crushing Equipment's

Sedimentation - Gravitational Sedimentation, Centrifugal Separation, Flocculation.

Flow through Packed Columns - Flow of a Single Fluid through a Granular Bed, Dispersion in Packed Columns.

Unit III

Filtration - The Theory of Filtration. Filtration Practices, Filtration Equipment, Filtration in a Centrifuge and Filtration Calculations.

Fluidization - Characteristics of Fluidized Systems, Liquid-Solid and Gas-Solid Systems, Applications of the Fluidized Solids Technique.

Unit IV

Gas Cleaning - Gas Cleaning Equipment's such as Gravity Separators, Centrifugal Separators, Electrostatic Precipitators etc.

Pneumatic and Hydraulic Conveying - Theory and Industrial Applications.

Unit V

Flow of particulate matter - Flow of solids through silos and hoppers. Storage and transport of powders.

Size Enlargement - Principles of agglomeration palletizing (cone and disk) , press and tabulating machines and extrusion and granulating machines.

Texts / References:

1. J. M. Coulson and J. F. Richardson, Chemical Engineering, Vol. 2, 4th ed. Pergamon Press
2. W. L. 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.

Open Elective I (Introduction to Psychology) 02 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
OE	**24UD1000OE305C**	**Open Elective -1 (Introduction to Psychology)**	**2**	**-**	**-**	**20**	**20**	**60**	**100**	**02**

NPTEL Links

Introduction to Psychology – IIT Kanpur (Jan-Mar 2026)

https://www.nptel.ac.in/courses/109104105

Brief Introduction to Psychology, IIT Kanpur (Jul-Aug 2026)

https://nptel.ac.in/courses/109104093

Course Objectives

The course aims to: Introduce students to the historical development, major areas, methods, and changing boundaries of psychology, develop an understanding of perception and learning processes

and their relevance to human behavior, explain the role of memory and emotions in human cognition and behavior, understand the genetic and environmental influences on behavior and the concept of personality.

Course Outcomes (COs)

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

CO1: Explain the major milestones, areas, methods and evolving boundaries of psychology.

CO2: Describe and interpret the basic principles of perception and learning

CO3: Explain and analyse the role of memory and emotion in human cognition, learning and behaviour.

CO4: Analyse the genetic and environmental influences on behaviour

CO5: Demonstrate and interpret basic psychological observations/experiments related to perception

Mapping of course outcomes with program outcomes

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1
CO1	1	2	–	1	–	2	–	1	1	2	–
CO2	1	3	2	2	1	2	–	1	2	2	–
CO3	1	3	2	2	1	2	–	2	2	3	1
CO4	1	3	2	2	–	3	1	3	3	3	2
CO5	1	3	3	3	2	3	1	2	3	3	2

Detailed Syllabus:

Unit I

Major milestones in psychology; Major areas of psychology; Major methods used in psychology;

Redefining boundaries of the discipline

Unit II

Perception and Learning

Unit III

Memory and Emotion

Unit IV

Genetic and Environmental bases of behaviour, Personality

Unit V

Lab session: Perception

Books and references

1. Feldman, R.S. (2004). Understanding Psychology. Tata McGraw-Hill, New Delhi

MDM1- World of Petroleum **02 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
MDM	24UD1527MD306	World of Petroleum	2	-	-	20	20	60	100	02

Detailed syllabus:

Unit I : Occurrence and origin of oil and gas.

Unit II: Methods used in exploration and prospecting of petroleum

Unit III: Drilling methods for oil and gas

Unit IV: Production of oil and gas

Unit V: Statistical information on Indian and world petroleum industry

Text Books:

1. G. D. Hobson, Modern Petroleum Technology, Volume I

2. B. G. Deshpande, World of Petroleum

3. B.K. Bhaskararao : Modern Petroleum Refining , Khanna Publishers Delhi First edition 2015

Constitution of India **(Audit Course)**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
VEC	24UD1000VE307	Constitution of India	2	-	-	50	-	-	Audit	Audit

Course Objective:

1. To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the legal conceptsand its implications for engineers.
4. To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework.
5. To make students learn about role of engineering in business organizations and e-governance.

Course Outcome:

At the end of the course, learners should be able to

CO1: Identify and explore the basic features and modalities about Indian constitution.

CO2: Differentiate and relate the functioning of Indian parliamentary system at the entre and state level.
CO3: Differentiate different aspects of Indian Legal System and its related bodies.
CO4: Discover and apply different laws and regulations related to engineering practices.
CO5: Correlate role of engineers with different organizations and governance models.

Detailed Syllabus:

Unit I

Introduction and Basic Information about Indian Constitution:

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the

Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Unit II

Union Executive and State Executive:

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Unit III

Introduction and Basic Information about Legal System:

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

Unit IV

Intellectual Property Laws and Regulation to Information:

Intellectual Property Laws- Introduction, Legal Aspects of Patents, Filing of Patent Applications,

Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure

Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

Unit V

Business Organizations and E-Governance:

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up.

E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

Pedagogy: Lecture, Problem based learning, Group discussions, Visual media, Films, Documentaries, Debate forums.

Suggested Readings:

1. Brij Kishore Sharma: Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
2. Granville Austin: The Indian Constitution: Cornerstone of a Nation. 1966, Oxford Clarendon Press.
3. Subhash C. Kashyap: Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT, 2018.
4. PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.
5. V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)
6. Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi 88
7. P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
8. Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.
9. BL Wadehra: Patents, Trademarks, Designs and Geological Indications. Universal Law Publishing - LexisNexis.
10. Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)
11. Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
12. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e-Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf
13. Companies Act, 2013 Key highlights and analysis by PWC. https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights-andanalysis.pdf

Referred Case Studies:

1. Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
2. Maneka Gandhi V. Union of India AIR, 1978 SC 597.
3. S.R. Bammai V. Union of India, AIR 1994 SC 1918.

4. Kuldip Nayyar V. Union of India, AIR 2006 SC312.
5. A.D.M. Jabalpur V. ShivkantShakla, AIR 1976 SC1207.
6. Remshwar Prasad V. Union of India, AIR 2006 SC980.
7. Keshav Singh in re, AIR 1965 SC 745.
8. Union of India V. Talsiram, AIR 1985 SC 1416.
9. Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
10. SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
11. Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
12. Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.

Prescribed Legislations:
1. Information Technology Act, 2000 with latest amendments.
2. RTI Act 2005 with latest amendments.
3. Information Technology Rules, 2000
4. Cyber Regulation Appellate Tribunal Rules, 2000

Suggested aid for Students and Pedagogic purpose
1. RSTV debates on corporate law, IPR and patent issues
2. NPTEL lectures on IPR and patent rights

Life of Bharat Ratna Dr. Babasaheb Ambedkar
01 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
VEC	24UD1000VE3408B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	-	50	-	-	50	1

Course Objectives:

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

1. Analyze Dr. Ambedkar's role in shaping India's constitution and social justice movements
2. Recognize the relevance of his principles in contemporary engineering and societal contexts
3. Develop critical thinking and problem-solving skills through case studies and discussions

Course Outcomes:

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

CO1: Explain Dr. Ambedkar's key contributions to the Constitution of India, establishment of human values and social reform
CO2: Identify and analyze his leadership qualities and strategic thinking
CO3: Evaluate the impact of his legacy on Maharashtra's culture, politics, and economy

Detailed syllabus:

Unit I

Introduction: Introduction to the Socio-political Context of Dr. Babasaheb Ambedkar's Era, British Colonialism, Indian National Movement, Caste Hierarchy, Untouchability, Social Reform Movements, Role in the Indian freedom struggle.

Unit II

The Contribution of Dr. Babasaheb Ambedkar: Contributions to the Constitution of India, Vision for Social Justice and Empowerment

Unit III

Legacy and Relevance Today: Dr. Ambedkar and Marxism: An Exploration of his Thoughts on Marxism, Common Ground with Marxism, Focus on Class Struggle. Caste vs Caste, Primacy of Caste in Indian Society, Economic Ideas and Policies.

Text Books/reference:

1. Keer, Dhananjay. *Dr.Babasaheb Ambedkar Life and Mission*. Popular Prakashan. 1954.
2. Ambedkar, B. R. *Annihilation of Caste*. Fingerprint Publishing. 2023.
3. Ambedkar, B. R. *Buddha or Karl Marx*. Infinite Words. 2024.
4. Ambedkar, B. R. *The Problem of Rupee: It's Origin and it's Solution*. Sudhir Prakashan. 2021.

Introduction to Petroleum Geology and Petroleum Refinery 02 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC309	Introduction to Petroleum Geology and Petroleum Refinery	2	-	-	20	20	60	100	02

Course Objectives:

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

1. Indian Petroleum Refinery
2. Composition of crude oil
3. Quality of crude oil and petroleum products
4. Different operations in Refinery

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 analyse product pattern

CO3: Understand different operations in Refinery
CO4: Evaluate and analyse 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, plat form casting 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 require 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

Modern Indian Language **02 Credit**

उपयोजित मराठी/ व्यावहारिक मराठी अभ्यासक्रम

Course Code	Course Title	Teaching Scheme			Examination Scheme					
2311372AE204	उपयोजित मराठी/ व्यावहारिक मराठी	L	T	P	Continuous Assessment(1)	Continuous Assessment(2)	Mid Term Test	End Semester Exam	Total	Credits
		2	0	0	10	10	20	60	100	2

Course Objectives:

- मराठी भाषेचा ऐतिहासिक प्रवास, तिच्या निर्मितीतील संस्कृत, प्राकृत आणि अपभ्रंश भाषांचा प्रभाव समजून घेणे.
- मराठी लेखनाचे नियम, व्याकरण व शुद्धलेखन यांची अचूकता आत्मसात करणे.
- सर्जनशील आणि औपचारिक लेखन कौशल्ये विकसित करणे.
- भाषांतर तत्त्वे, प्रक्रिया आणि सांस्कृतिक संदर्भ यांचा विचार करून मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर करण्याचे कौशल्य प्राप्त करणे.

Course Outcomes:

- विद्यार्थी मराठी भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
- शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
- विविध प्रकारच्या लेखन शैली आत्मसात करून सृजनशील, विश्लेषणात्मक आणि औपचारिक लेखन करू शकतील.
- अचूक, स्पष्ट आणि भाषिक-सांस्कृतिक दृष्टिकोनातून योग्य भाषांतर करू शकतील.
- व्यावसायिक आणि साहित्यिक भाषांतरात प्रावीण्य मिळवू शकतील.

घटक- १. मराठीचा उगम आणि विकास

- मराठीचा उगम आणि विकास
- मराठी भाषेवर संत परंपरेचा प्रभाव- ज्ञानेश्वर, तुकाराम, नामदेव आणि एकनाथ यांच्या रचनांचा अभ्यास.
- मराठीत बखरी लेखन व इतिहासदर्शन.
- आधुनिक मराठी आणि सुधारणा चळवळी- टिळक, फुले, आणि आगरकर यांचे योगदान.

घटक- २. स्वातंत्र्यानंतरची मराठी भाषा

- महाराष्ट्र राज्य निर्मिती व मराठीचा अधिकृत दर्जा.
- डिजिटल युगातील मराठी भाषा : ब्लॉग, सोशल मीडिया आणि ई-साहित्य.
- मराठी भाषा संरक्षणासाठी उपाययोजना.
- शिक्षणव्यवस्थेतील मराठीचा वापर.
- जागतिक स्तरावर मराठी भाषेचा प्रभाव.

घटक-३. मराठी लेखनाचे नियम आणि व्याकरण

- संधि
- वाक्यप्रकार (विधानार्थी वाक्य, प्रश्नार्थी वाक्य, आज्ञार्थी वाक्य इ.)
- विरामचिन्हे आणि त्यांचे उपयोग
- शुद्धलेखन
- समानार्थी शब्द (पर्यायवाची शब्द), विरुद्धार्थी शब्द

घटक-४. लेखन कौशल्य

- लेखन कौशल्याचा परिचय- लेखन कौशल्याचे महत्त्व आणि आवश्यकता
- पत्रलेखन
- निबंध लेखन
- वृत्तलेखन (वृत्तपत्रीय लेखन)
- इतिवृत्त लेखन
- सारांश लेखन

घटक- ५. भाषांतर (मराठीतून इंग्रजी अणि इंग्रजीतून मराठी)

- भाषांतराचा मूलभूत परिचय- भाषांतराची व्याख्या आणि स्वरूप, महत्त्व आणि उपयोग, भाषांतराचे प्रकार इ.
- पारिभाषिक शब्दावली
- मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर.

संदर्भ साहित्य:

1. प्रशासनिक लेखन, भाषा संचालनालय , महाराष्ट्र शासन, मुंबई १९६६
2. सुगम मराठी व्याकरण व लेखन - मो.रा. वाळंबे
3. "अनुवाद सिद्धांत आणि प्रयोग" – डॉ. भालचंद्र नेमाडे (लोकवाङ्मय गृह प्रकाशन)

4. मराठी भाषा आणि साहित्याचा इतिहास – वि.का. राजवाडे प्रकाशक : राजवाडे संशोधन मंडळ, धुळे
5. भाषांतर : सिद्धांत आणि प्रयोग – डॉ. अशोक केळकर प्रकाशक : लोकवाङ्मय गृह, मुंबई

सामान्य हिंदी / व्यावहारिक हिंदी पाठ्यक्रम

Course Code	Course Title	Teaching Scheme			Examination Scheme					
		L	T	P	Continuous Assessment (1)	Continuous Assessment (2)	Mid Term Test	End Semester Exam	Total	Credits
2311372AE204	सामान्य हिंदी / व्यावहारिक हिंदी	2	0	0	10	10	20	60	100	2

पाठ्यक्रम उद्देश्य (Course Objectives):

- हिंदी भाषा के उद्भव, विकास और ऐतिहासिक प्रवृत्तियों को समझाना।
- हिंदी व्याकरण और लेखन कौशल में दक्षता प्रदान करना।
- प्रशासन, शिक्षा और संचार में हिंदी के व्यावहारिक उपयोग को स्पष्ट करना।
- अनुवाद कौशल विकसित करना, जिससे तकनीकी एवं व्यावसायिक संचार सुगम हो।

अपेक्षित परिणाम (Course Outcomes):

- विद्यार्थी हिंदी भाषा के ऐतिहासिक और आधुनिक विकास को समझेंगे।
- हिंदी व्याकरण और लेखन के नियमों में दक्षता प्राप्त करेंगे।
- व्यावसायिक, प्रशासनिक और तकनीकी लेखन में हिंदी का प्रयोग कर सकेंगे।
- अनुवाद के सिद्धांतों को सीखकर अंग्रेजी और हिंदी के बीच प्रभावी अनुवाद कर सकेंगे।

इकाई – १. हिंदी भाषा का उद्भव और स्रोत

- हिंदी भाषा की उत्पत्ति और स्वरूप
- संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास
- हिंदी की प्रमुख बोलियाँ (ब्रज, अवधी, खड़ी बोली, भोजपुरी, राजस्थानी आदि)
- हिंदी पर फारसी, अरबी और अंग्रेज़ी भाषाओं का प्रभाव

इकाई- २. स्वातंत्र्योत्तर काल में हिंदी भाषा

- प्रशासन, शिक्षा और संचार माध्यमों में हिंदी की भूमिका
- राजभाषा के रूप में हिंदी – संवैधानिक स्थिति और व्यावहारिक उपयोग

- हिंदी का वैश्विक विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिति
- प्रशासन और संचार माध्यमों में हिंदी

इकाई- ३. हिंदी भाषा लेखन के नियम और व्याकरण

- वर्णमाला
- शब्द-भेद
- संधि
- वाक्य रचना
- वर्तनी
- उपसर्ग, प्रत्यय और शब्द निर्माण की प्रक्रिया
- विराम चिन्हों का प्रयोग
- पर्यायवाची शब्द
- विलोम शब्द

इकाई- ४. लेखन कौशल

- पत्र लेखन
- प्रतिवेदन (रिपोर्ट) लेखन
- विज्ञप्ति, नोटिस और परिपत्र लेखन
- निबंध लेखन
- सार लेखन

इकाई- ५. अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी)

- अनुवाद : सिद्धांत और परंपरा
- अनुवाद : क्षेत्र, प्रकार
- पारिभाषिक शब्दावली
- अंग्रेजी से हिंदी और हिंदी से अंग्रेजी अनुवाद

संदर्भ ग्रंथ:

- "हिंदी भाषा का उद्भव और विकास" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
- "हिंदी भाषा का इतिहास" – डॉ. रामविलास शर्मा (राजकमल प्रकाशन)
- "भारत में राजभाषा हिंदी" – डॉ. विश्वनाथ प्रसाद (भारतीय राजभाषा परिषद)

- "हिंदी व्याकरण और रचना" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
- "हिंदी लेखन कौशल" – डॉ. रमेश गुप्ता (साहित्य भवन)
- "अनुवाद विज्ञान और सिद्धांत" – डॉ. ओमप्रकाश (राजकमल प्रकाशन)

संस्कृत अभ्यासक्रम

Course Code	Course Title	Teaching Scheme			Examination Scheme					
		L	T	P	Continuous Assessment (1)	Continuous Assessment (2)	Mid Term Test	End Semester Exam	Total	Credits
2311372AE204	संस्कृत अभ्यास क्रम	2	0	0	10	10	20	60	100	2

Course Objectives:

- संस्कृत भाषेचा ऐतिहासिक प्रवास
- संस्कृत लेखनाचे नियम, व्याकरण आत्मसात करणे.
- दैनंदिन संवादासाठी लागणारे काही शब्द यांचा अभ्यास करणे.

Course Outcomes:

- विद्यार्थी संस्कृत भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
- शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
- विविध प्रकारच्या लेखन शैली आत्मसात करून लेखन करू शकतील.
- अचूक, स्पष्ट आणि भाषिक-सांस्कृतिक दृष्टिकोनातून योग्य भाषांतर करू शकतील.

1. Introduction to Sanskrit

- Importance and history of Sanskrit
- Sanskrit alphabets (Varnamala)
- Swaras (Vowels)
- Vyanjanas (Consonants)
- Pronunciation and script (Devanagari)

2. Basic Grammar

- Nouns, pronouns, Grammatical numbers, Grammatical genders, Grammatical person
- Verbs, Tenses, Sandhi (Combination of letters)
- Karaka (Case system) – Nominative, Accusative, Instrumental, etc.

- Vibhakti (Declensions of nouns and pronouns)
- Linga (Gender: Masculine, Feminine, Neuter)
- Vakya Rachana (Sentence construction)

3. Simple Vocabulary and Sentence Formation

- Basic words and their meanings (nature, family, animals, objects, etc.)
- Greetings and basic conversational phrases
- Formation of simple sentences

4. Selected Sanskrit Shlokas and Subhashitas

- Recitation and meaning of simple verses from Bhagavad Gita, Hitopadesha, or Panchatantra
- Common proverbs (Subhashitas)

5. Reading and Writing Practice

- Reading simple Sanskrit texts
- Writing small paragraphs in Sanskrit

Community Engineering Project / Field Project 02Credit

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
CEP	24UD1527CP311	Community Engg. Project/ Field Project	-	-	4	60	-	40	100	02

Every student will be required to prepare and submit a project report/dissertation based on community related work carried out under the supervision of Project Guide. Student must report the Guide at least once in a week on a specified day and report the progress of his work to the Project Guide. The project report will be evaluated by a panel examiner.

Industrial Exposure Evaluation (Assessment PP or NP grades)

Students who have undergone industrial exposure during the summer vacation after 2nd semester 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 (PP or NP) shall be awarded.

Unit Operations - I Laboratory **01 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC312L	Unit Operations - I Lab	-	-	2	60	-	40	100	1

(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 Objectives:

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

1. Viscosity determination using Fenske or other viscometer
2. Laminar and turbulent flows.
3. Selection of manometric fluid for experiment.
4. Characteristics of packed & fluidized beds and centrifugal pumps
5. Ball, gate, globe, check valves, elbow, bend and T-joint
6. Screen effectiveness
7. Dry and wet screen analysis
8. Cyclone separator and froth flotation

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
CO6: Understand screen effectiveness
CO7: Understand dry screen analysis
CO8: Understand wet screen analysis
CO9: Understand cyclone separator and froth flotation

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	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO7	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO8	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO9	✓	✓	✓	✓	✓	-	-	-	-	-	-	-

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

Semester IV

Chemical Engineering Thermodynamics I **03 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC401	Chemical Engineering Thermodynamics - I	3	-	-	20	20	60	100	03

Course Objectives:

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

1. First and second laws of thermodynamics to chemical processes and the properties of ideal and real mixtures.
2. Behaviour of flow and non-flow processes using mass and energy balances
3. Heat and work requirements for industrial processes.
4. Efficiency of processes involving heat into work, refrigeration and liquefaction
5. Heat effects involved in industrial chemical processes
6. Thermodynamic properties of gaseous mixtures / solutions
7. Bubble-P & T, Dew-P & T for binary and multi-component systems
8. Vapour-liquid equilibrium (VLE) composition for ideal and non-ideal systems
9. Equilibrium constant and composition of product mixture at given temperature and pressure.

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 behaviour 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.

Unit II

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, The Standard Heat of Reaction, The Standard Heat of Formation, The Standard Heat of Combustion, Effect of Temperature on the standard Heat of Reaction.

Unit III

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.

Unit IV

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 V

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.

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.

Heat Transfer Operations **03 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC402	Heat Transfer Operations	3	-	-	20	20	60	100	3

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

1. Different modes of heat transfer.
2. Heat transfer coefficients for forced and natural convection.
3. Heat transfer involving phase change.
4. Heat exchanger performance for co-current and counter-current flows.
5. Double pipe and shell & tube heat exchangers.

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: Analyse 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.

Petrochemical Engineering –I **03 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC403	Petrochemical Engineering –I	3	-	-	20	20	60	100	03

Course Objectives:

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

1. Indian Petroleum Refinery
2. Composition of crude oil
3. Quality of crude oil and petroleum products
4. Different operations in Refinery

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 analyse product pattern
CO3: Understand different operations in Refinery
CO4: Evaluate and analyse 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, plat form casting 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 require 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

Process Plant Utilities and Safety **03 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC404	Process Plant Utilities and Safety	3	-	-	20	20	60	100	03

Course Objectives:

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

1. Different plant utilities
2. Different boilers used in chemical industries and its operation
3. Principle of refrigeration and different refrigerants
4. Hazard and safety associated with chemicals and processes
5. Safety associated in chemical industry
6. Handling of gases, liquid and solids

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

CO1: List utilities in a plant
CO2: Understand properties of steam and operation of boiler for steam generation
CO3: Classify and describe the types of water, water treatment methods, storage and distribution techniques
CO4: Understand refrigeration methods used in industry
CO5: Understand hazard and safety associated in chemicals and processes

CO6: Understand safety in chemical industry
CO7: Understand safety in handling gases, liquids and solids

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	✓	-	✓	✓	-	✓	✓	-	-	-	-	-
CO7	✓		✓	✓		✓	✓					

Detailed syllabus:

Unit I
Identification of common plant utilities: water, compressed air, steam, vacuum, refrigeration, venting, flaring and pollution abating. Water and its quality, storage and distribution for cooling and firefighting. Water treatment methods.

Unit II
Steam generation by boilers: Types of boilers and their operation, Steam generation by utilizing process waste heat using thermic fluids, Distribution of steam in a plant.

Principles of refrigeration: Creation of low temperature using various refrigerants. Creation of low pressure/vacuum by pumps and ejectors.

Unit III
Chemicals and their Hazards: Introduction, Acetonitrile, acetyl chloride, butyl amine, acrylamide, acrylonitrile, allyl alcohol, benzene, bromine, isopropyl alcohol, acetaldehyde, ethylene oxide, butane, n-hexane, anhydrous ammonia, acetone, toluene, p-xylene, acetic acid, monochloro benzene, oleum, carbon monoxide.

Safety in Chemical Processes: Introduction, Chemical Process classification, Process design and safety parameters. Safety parameters in the process design of phenol from cumene, safety in polyvinyl chloride plant.

Unit IV
Hazards in Chemical Process Plants: Introduction, Hazards, Hazard code and explosive limit, electrical safety in chemical process plants, static electricity hazards, pressure vessel hazards, LEL and UEL of various compounds, explosive hazard, flammable liquid hazards, protection to storage tanks, fire zone location, fireball, fireball hazard.

Safety in Handling Gases, Liquids and Solids: Introduction, safety in handling of gases, chlorine hazards, chlorine leakage management, safety in handling of fluorine, important safety considerations in ammonia storage, flammable solids storage, flammable liquid storage, handling of LNG, requirements to be fulfilled for storing hydrocarbons or chemicals, fail safe concept,

transportation of hazardous chemicals, Hazardous in plastics processing.

Unit V

Combating Chemical Fires: Classification of fires, control of high vaour pressure fire, firefighting foams, foam for fire protection, Foam characteristics, gaseous agent extinguishing system, automatic sprinkler system, chemical extinguishing powders, natural gas fire control. Portable fire extinguishers: Soda-acid extinguishers, carbon dioxide extinguisher, dry chemical fire extinguisher, general safety precautions for maintenance of fire extinguishers.

Safety Checklist: safety studies for chemical plants, safety checklist during startup, safety checklist during shutdown mode, safety checklist for installation, safety needs during construction. Protective devices.

Texts / References:

1. D. A. Wangham, Theory and practice of Heat engines, ELBS Cambridge University press, 1970.
2. J. L. Threlkeld, Thermal Environmental Engineering, Prentice Hall 1970
3. S.D. Dawande, Chemical Hazards and safety, Dennet and Co publishers, 2007

Open Elective II (Introduction to Mat Lab) 03 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
OE	24UDISCIOE405A	Open Elective II (Introduction to Mat Lab)	3	-	-	20	20	60	100	03

NPTEL link:

MATLAB Programming for Numerical Computation – IIT Madras (Jan-Apr 2026)

https://www.nptel.ac.in/courses/103106118

Course Objectives:

To introduce students to the MATLAB environment, basic commands, and programming concepts, develop programming skills using conditional statements, loops and control structures, develop proficiency in user-defined functions, built-in functions and matrix operations, enable students to perform mathematical computations, plotting and debugging of MATLAB programs, Apply MATLAB to solve engineering numerical problems

Course Outcomes (COs):

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

CO1: Explain and use the MATLAB environment to develop simple MATLAB programs.

CO2: Develop MATLAB programs using conditional statements, loops and control structures for solving computational problems.

CO3: Implement user-defined, built-in functions, arrays and matrices

CO4: Perform and interpret mathematical computations, 2-D/3-D plots and graphical representations, and debug MATLAB scripts.

CO5: Apply MATLAB and numerical methods to solve engineering problems

Mapping of course outcomes with program outcomes

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

Detailed syllabus:

Unit I

Introduction MATLAB: Introduction MATLAB, MATLAB window, Command window, workshop window, workspace, basic command assigning variables, operations with variables, data files and data types, characters and string.

Unit II

Control Loops: Control statement programming, conditional statement programming, loop and conditional statements, if, else, switch, for, while, continue, break, programming with control statements

Unit III

Functions: Function definition, User defined function, Built in function, Function calling, Return value, Type of functions, Global Variable. Array definition, Types of Array, Matrix Arithmetic operations, Array Arithmetic operations, operators and special characters, Relational, mathematical and logical operators, matrix operations, transpose Determinant and inverse and matrix function.

Unit IV

MATLAB Operations and Plot: Arithmetic operations, operators and special characters, solving arithmetic equations, matrix operations. Trigonometric functions, complex numbers, fractions real numbers, M file, plots 2D, 3D, GUI design

Unit V

Debugging M Files: Debugging process, preparation for debugging, setting break points, running with break points, correcting and ending debugging, correcting Mfile. Application of MATLAB: Numerical solution of nonlinear equations, numerical solution of simultaneous linear algebraic equations.

Books and references:

Amos Gilat, MATLAB: An Introduction with Applications, Wiley.

Rudra Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford University Press.

Stephen J. Chapman, MATLAB Programming for Engineers, McGraw-Hill

MDM - Petroleum Refinery Operations and Processes **02 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
MDM	24UD1527MD406	Petroleum Refinery Operations and Processes	2	-	-	20	20	60	100	02

Detailed syllabus:

Unit I: General refinery setup and functions of various units

Unit II: Refinery flow diagram, equipment and tankyard layout

Unit III: Types of refineries such as simple, intermediate and complex refinery

Unit IV: Separation and conversion processes in refinery

Unit V: Energy conservation in petroleum refinery

Text Books:

1. G. D. Hobson, Modern Petroleum Technology, Volume I

2. J. P. Wauquier, Crude Oil: Petroleum Products, Process flow sheets Vol.I, Editions Technip

Universal Human Values – II **02 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
VEC	24UDIUHVVE407	Universal Human Values – II	2	-	-	20	20	60	100	02

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Detailed Syllabus:

Unit I

Introduction to Value Education

Understanding Value Education,Self-exploration as the Process for Value Education,Continuous Happiness and Prosperity – the Basic Human Aspirations,Right Understanding, Relationship and Physical Facility,Happiness and Prosperity – Current Scenario,Method to Fulfill the Basic Human Aspirations.

Unit II

Harmony in the Human Being

Understanding Human being as the Co-existence of the Self and the Body,Distinguishing between the Needs of the Self and the Body,The Body as an Instrument of the Self,Understanding Harmony in the Self,Harmony of the Self with the Body,Programme to Ensure self-regulation and Health.

Unit III

Harmony in the Family and Society

Harmony in the Family – the Basic Unit of Human Interaction,Values in Human-to-Human Relationship,'Trust' – the Foundational Value in Relationship,'Respect' – as the Right Evaluation,Understanding Harmony in the Society, Vision for the Universal Human Order

Unit IV

Harmony in the Nature (Existence)

Understanding Harmony in the Nature,Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Unit V

Implications of the Holistic Understanding – a Look at Professional Ethics

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order,Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies,Strategies for Transition towards Value-based Life and Profession

READINGS:

Text Book and Teachers Manual

The Textbook

A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

The Teacher's Manual

Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Life of Chhatrapati Shivaji Maharaj — 01 Credit

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
VEC	24UD1000VE3408A	Life of Chhatrapati Shivaji Maharaj	1	-	-	50	-	-	50	01

Course Objectives: Completing this course the students will:

- **CO1** Analyze Chhatrapati Shivaji Maharaj's leadership qualities, strategic thinking, and management skills.
- **CO2** Develop critical thinking and problem-solving skills through case studies and discussions.
- **CO3** Recognize the relevance of the Chhatrapati's principles and values in modern times.

Course Outcomes: Completing this course the students will be able to:

- **CO1** Explain Chhatrapati Shivaji Maharaj's military strategies, conquests, and establishment of the Maratha Empire.
- **CO2** Evaluate the Chhatrapati's leadership qualities, such as courage, vision, human values and adaptability.
- **CO3** Apply the Chhatrapati's principles, such as decentralization and social welfare, to modern engineering challenges.

SYLLABUS

Unit 1 **Title: Shivaji Maharaj as a Great Conqueror** **5 Hrs.**

- Master Strategist and innovator in Military Tactics
- Guerrilla Warfare (Ganimi Kava)
- Fortress Strategy
- Avoidance of Direct Confrontation
- Diplomacy and Alliances
- Naval Power

Unit 2 **Title: Shivaji Maharaj's Management and leadership strategies** **5 Hrs.**

- Architecture and metallurgy of Raigad Fort
- Use of Light Cavalry
- Intelligence Network
- Asymmetric Warfare
- Logistics and Supply Chains
- Fortifications and Military Architecture

Unit 3 **Title: Shivaji Maharaj's views on Democracy and Nationalism** **5 Hrs.**

- Shivaji Maharaj's views about Women's rights, their dignity and religious views
- His views on Democracy & Nationalism

Text Books / Reference:

1 Desai, Ranjit. *Shriman Yogi.* Mehta Publishing House. 2018.

2 Kurundkar, Narhar. *Chatrapati Shivaji Maharaj Jeevan Rahasya.* Deshamukh and Company. 2024.

3 Sarkar, Jadunath. Shivaji and His Times by Jadunath Sarkar, Classic Book on the Life and History of the Maratha Emperor. Nandy Books. 2024.

4 Keluskar, Krushnaji Arjun. *Chhatrapati Shivaji Maharaj*. Sudhir Prakashan. 2020.

5 Bedekar, Ninad. *Kalatil Vyavsthapan Tatve*. 2015.

Unit Operations - II Laboratory **01 Credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1527PC409L	Unit Operations II Lab	-	-	2	60	-	40	100	01

Course Objectives:

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

1. Electrical analogy in relation to heat conduction
2. Emissivity of a given body.
3. Heat flow for resistances in series
4. Heat losses from cylindrical furnace
5. Temperature profiles in rod-double pipe heat exchanger, helical coil, heat pipe demonstration experiment
6. Boiling Phenomena in liquids

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 pip 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.

Petrochemical Engineering Laboratory **01 Credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
VSEC	24UD1527PC410L	Petrochemical Engineering - I Lab	-	-	2	60	-	40	100	01

Course Objectives:

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

1. Different tests for petroleum and their significance
2. Quality of products
3. Performance of products in Real life
4. Identification of adulteration of products
5. Different industrial parameters of Refinery

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: Analyse 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:

1. To determine the Density, Specific gravity and API gravity of given petroleum and petroleum fraction.
2. To determine cloud point and of pour point given petroleum and petroleum fraction.
3. To determine the flash point and fire point of given petroleum fraction.
4. To determine the Reid Vapour Pressure of given petroleum product
5. To determine the aniline point of given petroleum fraction
6. To determine the carbon residue of given petroleum fraction by Ramsbottom Method.
7. To determine the carbon residue of given petroleum fraction by Conradson Method.
8. Detection of copper strip corrosion by petroleum product using copper strip tarnish test.
9. To determine the smoke point of given petroleum product.
10. To determine the viscosity of given petroleum product by different viscometers

11. To determine the penetration index of given grease sample.
12. To Determine the vaporization characteristics of given petroleum product (Gasoline) by ASTM –D 086 distillation.
13. To Determine the vaporization characteristics of given petroleum product (Diesel) by ASTM –D086 distillation

Seminar **01 Credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	**24UD1527PC411L**	**Seminar**	**-**	**-**	**2**	**60**	**-**	**40**	**100**	**1**

Each student is expected to spend two 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.