Dr. Babasaheb 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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Curriculum for Second Year
Undergraduate Degree Programme
B. Tech. in Chemical Engineering

With effect from AY 2024-2025

Department of Chemical 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 decide 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 rejoin 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 Chemical Engineering with Computer Engineering**" (160-176 credits) enables students to take up five-six or required additional courses of 14 credits in the discipline other than Electronics and Telecommunication Engineering distributed over semesters III to VIII. Here in the case of "**B. Tech in Chemical with Computer Engineering**" (160-176 credits) student is supposed to take up 50% or more courses to complete the 50% or more credits (from assigned 14 credits) from **Computer Engineering minor bucket**. The remaining courses to complete the assigned 14 credits can be covered from other discipline's minor buckets.

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 Honours** in chosen Major Engg./ Tech. Discipline i.e. in Chemical Engineering with Honours with Multidisciplinary Minor (180-194 credits) enables students of Chemical Engineering to take up five-six additional courses of 18 to 20 credits in the Chemical 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 Chemical Engineering with Research with Multidisciplinary Minor (180-194 credits) enables students of Chemical Engineering to take up a research project of 18 to 20 credits in the Chemical 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 Chemical Engineering with *other selected discipline in* Engineering (as MDM) with Specialization Minor in Computer Engineering**" (180-194 credits) enables students to take up five-six additional courses of 14 credits in the discipline other than Chemical 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 five-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 students 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.

B.Tech Chemical Engineering

Rules and Regulations

The normal duration of the course leading to B. Tech degree will be EIGHT semesters.
The normal duration of the course leading to M. Tech. degree will be FOUR semesters.

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 atleast 90 Teaching Days, with atleast 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically fromMid-Julyto Novemberis 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.

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 atleast TWO weeks before the Closing Date of the previous Semester.

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:

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 thatUG/PG programme.

MandatoryPre-Registrationforhigher 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.

PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply. UnderGraduate students may be permitted to register for a few selected PostGraduate 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.

CoursePre-Requisites:

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.

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.

REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.

A student will be permitted to register in the next semester only if he fulfils the following conditions:

Satisfied all the Academic Requirements to continue with the programme of Studies without termination;

Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters; (c)Paid all required advance payments of the Institute and hostel for the current semester;(d)Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2020-21, starting from first year B.Tech.

Percentageof marks	Lettergrade	Gradepoint
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 semesters of B. Tech Program.

CGPA for pass is minimum 5.0	
CGPA up to <5.50	Pass class
CGPA≥ 5.50 & <6.00	Second Class
CGPA≥ 6.00 & <7.50	First Class
CGPA≥ 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.

This will be implemented from the First Year of B. Tech starting from Academic Year 2023-24

Description of Grades:

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

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

Evaluation of Performance:

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

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
'g_i' is the grade-points awarded to the student for the subject based on his performance as per the above table and
-SGPA will be rounded off to the second place of decimal and recorded as such.

Cumulative Grade Point Average (CGPA):An up-to-date assessment of the overall performance of a

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

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

Where

'm'is the total number of subjects from first semester onwards upto 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.

Award of Degree of Honours

Major Degree

The concept of Major and Minors at B.Tech level is introduced to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

Eligibility Criteria for Majors

The Student should have Minimum CGPA of 7.5upto 4th Semester.
Student willing to opt for majors has to register at the beginning of 5th Semester.

The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.

Student may opt for the courses from NPTEL/ SWAYAM platform (if the credits of NPTEL/SWAYAM courses do not match with the existing subject proper scaling will be done).

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

Eligibility Criteria for Minors

The Student should have Minimum CGPA of 7.5 upto 4th Semester.
Student willing to opt for minors has to register at the beginning of 5th Semester.

The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.

Student may opt for the courses from NPTEL/ SWAYAM platform (if the credits of NPTEL/SWAYAM courses do not match with the existing subject proper scaling will be done).

Student complying with these criteria will be awarded with B.Tech Degree in----- Engineering with Minor in ---- Engineering.

(For e.g.: B.Tech in Chemical Engineering with Minor in Petrochemical Engineering)
For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

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

To account for approved leave of absence (e.g.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 maintain75% 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%.

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.

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

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:

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

Credits transferred will be considered for overall credits requirements of the programme.
Credit's transfer can be considered only for the course at same level i.e., UG, PG etc.
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 acceptanceletter 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.

A student has to get minimum passing grades/marks for such courses for which the credits transfers are to be made.
Credits transfers availed by a student shall be properly recorded on academic record(s) of thestudent.

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

Course Structure for Chemical Engineering (Second Year)

Semester III											
Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	**Credit**
BSC	24UD1000BS301	Engineering Mathematics-III	3	-	-	20	20	60	100	**3**
PCC	24UD1507PC302	Fluid Flow Operations	3	-	-	20	20	60	100	**3**
PCC	24UD1507PC303	Process Calculations	3	-	-	20	20	60	100	**3**
PCC	24UD1507PC304	Mechanical Operations	2	-	-	20	20	60	100	**2**
OE	24UD1HAROEM05A	Open Elective - 1(Developing Soft Skills & Personalities)	2	-	-	20	20	60	100	**2**
MDM	24UD1507MD306	Multi-Disciplinary minor I (Mechanical Unit Operations)	2	-	-	20	20	60	100	**2**
Audit Course	24UD1COIVE307	Constitution of India	2	-	-	50	-	-	50	**Audit**
Value Added Course	24UD1000VE308B	Literature on Bharat Ratna Dr. Babasaheb Ambedkar.	1	-	-	50	-	-	50	**1**
HSSM	24UD1507HM309	Engineering Economics and Project Management	2	-	-	20	20	60	100	**2**
AEC	24UD1000AE310A, 24UD1000AE310B, 24UD1000AE310C	Modern Indian Language (Marathi), Modern Indian Language (Hindi), Modern Indian Language (Sanskrit)	2	-	-	20	20	60	100	**2**
ELC	24UD1507CP311	Field Work/CEP	-	-	4	60	-	40	100	**2**
PCC	24UD1507PCL312	Mechanical Operation lab	-	-	2	60	-	40	100	**1**
		Total	22	0	6	380	160	560	1100	**23**
Semester IV										
PCC	24UD1507PC401	Chemical Engineering Thermodynamics-1	3	-	-	20	20	60	100	**3**
PCC	24UD1507PC402	Heat Transfer Operations	3	-	-	20	20	60	100	**3**
PCC	24UD1507PC403	Process Instrumentation	2	-	-	20	20	60	100	**2**
VSEC	24UD1507PCL404	Fluid Flow Operations Lab	-	-	2	60	-	40	100	**1**
OE	24UD1MACOEM05L, 24UD1LAWOEM05C	Open Elective-2 (Basic Principles of Finance and Economy) , (Right to	3	-	-	20	20	60	100	**3**

		information and Good Governance)								
MDM	24UD1507MD406	Multi-Disciplinary minor II	2	-	-	20	20	60	100	**2**
VEC	24UD1UHVVE407	UHV -2	3	-	-	20	20	60	100	**3**
Value Added Course	24UD1000VE408A	Literature on Chatrapati Shivaji Maharaj	1	-	-	-	-	-	-	**1**
HSSM	24UD1507HM409	Innovations and Entrepreneurship	2	-	-	20	20	60	100	**2**
VSEC	24UD1507PCL410	Heat Transfer operations Lab	-	-	2	60	-	40	100	**1**
		Field Training / Internship /Industrial Training (minimum of 2 weeks which can be completed partially in third semester and fourth semester or in at one time).								
		Total	19	0	4	260	140	500	900	**21**

SEMESTER – III

Engineering Mathematics III **3 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
BSC	24UD1000BS301	Engineering Mathematics-III	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:

Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.

Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.

Vector differentiation and integration required in Electro-magnetic and Wave theory.

Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, students will be able to:

CO1: Solve higher order linear differential equation using appropriate techniques for modelling and analyzing electrical circuits.

CO2: Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.

CO3: Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.

CO4: Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.

CO5: Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 1: 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 2: 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 3: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 4: 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 (), and one dimensional wave equation.

Unit 5: Functions of Complex Variables

Analytic Functions, Cauchy-Riemann Equations in Cartesian and polar forms, Harmonic Futions Functions in Cartesian form, Cauchy's Integral theorem, Cauchy's integral formula, Residues, Cauchy's residue theorem (All theorems without proofs).

Text Books

Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.

Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.

Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.

A Text Book of Engineering Mathematics by PeterO Neil, Thomson Asia Pte Ltd., Singapore.

Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.

Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, NewYork.

Fluid Flow Operations 3 Credits

Category	Code	SubjectName	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1507PC302	Fluid Flow 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. 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: Conceptual understanding and application
4. Motion of fluid, fluid – solid operations in packed and fluidized beds: Conceptual understanding and application
5. Machinery for fluid transportation: design, operation and troubleshooting.

Course Outcomes:

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

1. Derive dimensionless groups by dimensional analysis;
2. Solve problems related to manometers and decanters using the principles of fluid statics;
3. Deter mine pipe size / flow rate / power requirements under laminar / turbulent conditions;
4. Understand and solve problems related to motion of fluid, fluid-solid operations in packed and fluidized beds;
5. Select Machinery for fluid transportation and determine flow rate of fluid passing through.

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:

Basics of Fluid Mechanics and Fluid Flow Operations: Introduction; Difference between solids and fluids; Definition of a fluid; Fluids classification; Fluid Properties and their dependence; Newton's law of viscosity and Newtonian and non-Newtonian Fluids; Stress and strain; introduction to Stress tensor; Measurement of pressure and basics of manometers; decanters; Dimensional Analysis, Reynold's number and significance: laminar, turbulent and transitional flow, Reynolds's experiment.

Unit II:

Nature of Fluid flow and related equations: Internal and external flows, types of flow (rotational/ irrotational, uniform/non-uniform, steady/unsteady etc.); fluid dynamics; Flow of incompressible fluids in and out of pipes; hydraulic radius, equivalent diameter, entrance length; introduction to fluid friction; roughness parameter and friction factor; friction factor chart; equations for fluid flow: continuity equation, Bernoulli's equation; laminar and turbulent flow.

Unit III:

Fluid Transport (application of equations of fluid flow): Fittings for pipes and their standards; valves; accessories; pumps and compressors for transporting different fluids, power requirement for flow; piping layout and economic pipe diameter; vacuum producing devices.

Unit IV:

Flow with air and solids present: Flow through packed and fluidized beds. Introduction to two phase flow.

Unit V:

Flow measuring devices and mixing of fluids: Orifice meter; Venturimeter; rotameter; Pitot tube; anemometer;non-destructive flow measurement; flow through constrictions such as notches, weirs, nozzles (introduction only); mixing and agitation, agitators, calculation of power numbers and mixing indices,liquid-liquid and liquid solid mixing (introduction only).

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. Unit Operations – 1, K. A. Gavhane, NiraliPrakashan

Process Calculations 3 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1507PC303	Process Calculation	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 :

Material and energy balances of chemical processes.

Material and energy balances on chemical processes/equipment

Chemical Engineering problems involving recycle, purge and bypass

Ideal and real behavior of gases, vapors and liquids.

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

Understand the material and energy balances of chemical processes.

Perform material and energy balances on chemical processes/equipment

Draw the flow diagram and solve the problems involving recycle, purge and bypass

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:

D.M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 6th Edition, Prentice Hall of India, 1997.

B. I. Bhat and S. M. Vora, “Stoichiometry” Tata McGraw-Hill, New Delhi

V. Venkataramani, N. Anantharaman and K.M. Meera Sheriffa Begum, “Process Calculations” 2nd edition, Prentice Hall of India, 2015.

Mechanical Operations — 2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1507PC304	Mechanical Operations	2	-	-	20	20	60	100	2

Course Objectives:

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

Mechanical operations and their role in chemical engineering

Nature of solids, their characterization, handling, and the processes involving solids.

Performance of size reduction equipment and calculate the power requirements.

Solid-fluid separation equipment.

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

Understand mechanical operations and their role in chemical engineering

Understand nature of solids, their characterization, handling, and the processes involving solids.

Analyze the performance of size reduction equipment and calculate the power requirements.

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:

Introduction: Unit operations and their role in chemical industries; Types of mechanical operations. Properties and handling of particulate solids: Characterization of solid particles, Properties of masses of particles, mixing of solids, Size reduction, ultrafine grinders.

Unit II:

Screening: Screening equipment, Screen capacity.

Unit III:

Cake filters: Centrifugal filters, Filter media, Principles of cake filtration, Washing filter cakes, Clarifying filters: Liquid clarification, Gas cleaning, Principles of clarification.

Unit IV:

Cross flow filtration: Types of membranes, Permeate flux for ultrafiltration, Concentration Polarization, Application of Ultrafiltration, Dia-filtration, Microfiltration

Unit V:

Sedimentation: Gravity sedimentation processes, Centrifugal sedimentation processes.

Text / Reference:

McCabe W. L., Jullian Smith C. and Peter Harriott - Unit operations of Chemical Engineering, 7th Edition, McGraw-Hill international edition, 2005.

Coulson J.M., Richardson J.F, Chemical Engineering, Vol. II, 4th Edition, Elsevier India, 2006.

Open Elective-I **2 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
OE	24UD1HAROE305A	Open Elective - 1(Developing Soft Skills & Personalities)	2	-	-	20	20	60	100	2

Course Objectives:

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

To introduce students to a structured approach for developing personal and professional soft skills.

To enhance self-awareness and self-management through planning, goal setting, and habit formation.

To cultivate effective communication skills, including listening, speaking, and non-verbal cues.

To develop conflict resolution techniques and stress management strategies for personal growth.

To prepare students for professional environments through improved presentation skills, interpersonal relations, and digital communication etiquette.

Course Outcomes:

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

1: Understand the significance of self-awareness, goal setting, and self-management in personal development.

2: Identify and implement productive habits while effectively managing stress and interpersonal conflicts.

3: Apply active listening and telephone communication skills in both academic and professional settings.

4: Demonstrate proficiency in digital communication, including e-mail etiquette and handling technological influences on communication.

5: Interpret and apply non-verbal communication techniques in interviews, group discussions, and public speaking scenarios.

6: Exhibit improved human relations by practicing trust-building, integrity, and professional presentation skills.

Detailed syllabus

Unit I:

Introduction: A New Approach to Learning Lecture, Planning and Goal-Setting, Human Perceptions: Understanding People, Types of Soft Skills: Self-Management Skills, Aiming for Excellence: Developing Potential and Self-Actualization, Need Achievement and Spiritual Intelligence, Conflict Resolution Skills: Seeking Win-Win Solution, Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types of Conflicts: Becoming a Conflict Resolution Expert, Types of Stress: Self-Awareness about Stress, Regulating Stress: Making the best out of Stress.

Unit II:

Habits: Guiding Principles, Habits: Identifying Good and Bad Habits, Habits: Habit Cycle, Breaking Bad Habits, Using The Zeigarnik Effect For Productivity and Personal Growth Forming Habits of Success. Communication: Significance of Listening Communication: Active Listening, Communication: Barriers to Active Listening Telephone Communication: Basic Telephone Skills, Telephone Communication: Advanced Telephone Skills, Telephone Communication: Essential Telephone Skills.

Unit III:

Technology and Communication: Technological Personality, Technology and Communication: Mobile Personality. Topic: Technology and Communication: E-Mail Principles, Technology and Communication: How Not To Send E-Mails! Technology and Communication: Netiquette Technology and Communication: E-Mail Etiquette, Communication Skills: Effective Communication, Barriers to Communication: Arising out of Sender/Receiver's Personality, Barriers to Communication: Interpersonal Transactions, Barriers to Communication: Miscommunication, Non-Verbal Communication: Pre-Thinking Assessment-1, Non-Verbal Communication: Pre-Thinking Assessment-2.

Unit IV:

Communication Skills: Effective Communication: Barriers to Communication: Arising out of Sender/Receiver's, Barriers to Communication: Interpersonal Transactions, Barriers to Communication: Miscommunication, Non-Verbal Communication: Pre-Thinking Assessment-1, Non-Verbal Communication: Pre-Thinking Assessment-2.

Unit V:

Nonverbal Communication: Introduction and Importance, Non-Verbal Communication: Issues and Types, Non-Verbal Communication: Basics and Universals, Non-Verbal Communication: Interpreting Non-Verbal Cues, Body Language: For Interviews, Body Language: For Group Discussions, Presentation Skills: Overcoming Fear, Presentation Skills: Becoming A Professional, Presentation Skills: The Role of Body Language, Presentation Skills: Using Visuals, Reading Skills: Effective Reading, Human Relations: Developing Trust and Integrity.

MDM-I 2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
MDM-I	24UD1507MD306	Mechanical Unit Operations	2	-	-	20	20	60	100	2

Course Objectives:

To introduce students to the fundamental principles of mechanical operations used in chemical and process industries.
To understand the characteristics and behavior of particulate materials, including their size, shape, and distribution.
To familiarize students with the equipment and techniques used for size reduction, screening, and storage of bulk solids.
To explain the principles and applications of various solid-fluid separation methods such as filtration, sedimentation, and centrifugation.
To impart knowledge on advanced separation processes including membrane separations and flotation techniques.

Course Outcomes:

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

1: Identify different types of particulate solids, explain their characteristics, and analyze size reduction processes.

2: Understand and design storage and conveying systems for bulk solids and evaluate flow behavior around bluff bodies.

3: Analyze and model flow through packed and fluidized beds and understand the working principles of various filtration techniques.

4: Describe and evaluate membrane separation techniques and sedimentation processes used for solid-liquid separation.

5: Explain the operation and applications of centrifugal separation and flotation methods in mechanical separation processes.

Detailed Syllabus:-

UNIT-I

Introduction of Particulate Sizes and Shapes , Screening, Size Reduction.

UNIT-II

Storage and Conveying of Bulk Solids, Size Enlargement, Flow past Bluff Bodies.

UNIT-III

Flow Through Packed and Fluidized Beds, Filtration.

UNIT-IV

Cross Flow Filtration and Membrane Separations, Gravity Sedimentation Processes.

UNIT-V

Centrifugal Separations, Floatation.

Constitution of India **Audit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Audit Course	**24UD1COIVE307**	**Constitution of India**	**2**	**-**	**-**	**50**	**-**	**-**	**50**	**Audit**

Universal declaration of Human Rights and Provisions of India, Constitution and Law, National Human Rights Commission and State Human Rights Commission.

Course Objectives:

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.

To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.

To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.

To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework.

To make students learn about role of engineering in business organizations and e-governance.

Course Outcomes:

At the end of the course the students will

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

CO2: Differentiate and relate the functioning of Indian parliamentary system at the center 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.

Module 1--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.

Module 2-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, LokAyukta, The Lokpal and Lokayuktas 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.

Module 3- 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.

Module 4-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.

Module 5 -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.

TEXT/REFERENCE BOOKS:

Suggested Readings:

Brij Kishore Sharma: Introduction to the Indian Constitution, PHI, New Delhi, latest edition.

Granville Austin: The Indian Constitution: Cornerstone of a Nation. 1966, Oxford Clarendon Press.

Subhash C. Kashyap: Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT, 2018.

PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.

V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)

Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi-88

P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi

Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.

BL Wadehra: Patents, Trademarks, Designs and Geological Indications.Universal Law Publishing - Lexis Nexis.

Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)

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 36).https://www.icsi.edu/media/web modules/publications/Company%20Law.pdf

Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writer read data/files/eGovernanace_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf.

Companies Act, 2013 Key highlights and analysis by PWC. https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights-and-analysis.pdf

Value Added Course **1 Credit**

Category	Code	Subjec Name	L	T	P	CA	MSE	ESE	Total	Credit
Value Added Course	**24UD1000VE308B**	**Literature on Bharat Ratna Dr.Babasaheb Ambedkar**	**1**	**-**	**-**	**50**	**-**	**-**	**50**	**1**

Course Objectives:

Completing this course the students will:

Analyze Dr. Ambedkar's role in shaping India's constitution and social justice movements.

Recognize the relevance of his principles in contemporary engineering and societal contexts.

Develop critical thinking and problem-solving skills through case studies and discussions

Course Outcomes:

Completing this course the students will be able to:

Explain Dr. Ambedkar's key contributions to the Constitution of India, establishment of human values and social reform.

Identify and analyze his leadership qualities and strategic thinking.

Evaluate the impact of his legacy on Maharashtra's culture, politics, and economy.

Detailed Syllabus:

Unit 1

Introduction: Introduction to the socio-political context of Ambedkar's era ,British Colonialism, Indian National Movement, Caste Hierarchy,Untouchability, Social Reform Movements,Role in the Indian freedom struggle.

Unit 2

The Contribution of Dr. Babasaheb Ambedkar: Contributions to the Constitution of India, Vision for social justice and empowerment.

Unit 3

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/ Reference:

Keer, Dhananjay.*Dr.Babasaheb Ambedkar Life and Mission*. Popular Prakashan. 1954.

Ambedkar, B. R. *Annihilation of Caste*. Fingerprint Publishing. 2023.

Ambedkar, B. R. *Buddha or Karl Marx*. Infinite Words. 2024.

Ambedkar, B. R. *The Problem of Rupee: It's Origin and it's Solution*. Sudhir Prakashan. 2021

Engineering Economics& Project Management **2 Credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
HSSM	24UD1507HM309	Engineering Economics and Project Mangement	2	-	-	20	20	60	100	2

Course Objectives:

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

Fixed and Working Capital investment, total product cost.
Application of time value of money, interest and investment costs.
Taxes and insurance, depreciation and depreciation methods
Profitability of projects.
Optimum process design, CPM/PERT Techniques.

Course Outcomes: On completion of course, students will be able to
Analyze alternative process and equipment for manufacturing product.

Design plant layout and engineering flow diagrams.

Perform economic analysis related to process design.

Evaluate project profitability.

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

Capital cost estimation in chemical industries, different methods of calculation of fixed costs, capital investment and working capital.

Unit II

Time value of money, types of interest, investment costs, annuities, perpetuity and capitalized costs, discounted cash flow analysis.

Unit III

Taxes and insurance, depreciation, amortization and obsolescence in chemical industries, types of depreciation methods, breakeven point analysis.

Unit IV

Discussion projects, Causes for time and cost overruns, project evaluation and assessment of project profitablity, organization of project engineering.

Unit V

Optimum process design with examples, project development and commercialization, plant location and layout, selection of plant capacity.Project engineering management, project scheduling and its importance, use of CPM/PERT techniques.

Texts/References:

M.S.Peters and K.D. Timmerhaus, "Plant design economics for chemical Engoneers", 5th Ed., Mc Graw-Hill, New York-2003.

U.V.Uhland A.W.Hawkins, "Technical Economics for Chemical Engineers'', AIChE-1971.

J.Moderand Philips," Project Engineering with CPM and PERT", ReinHold.

Choudhary,"Project Management''.

Jelen, "Cost and Optimization Engineering".

Modern Indian Language (Marathi) **2 credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
HSSM	24UD1000 AE310A	Modern Indian Language (Marathi)	2	-	-	20	20	60	100	2

Course Objectives:

मराठी भाषेचा ऐतीहासिक 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 कौशल्य विकसित करणे.

भाषांतर तत्वे, प्रक्रिया आणि सांस्कृतिक संदर्भ यांचा विचार करून माराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर करण्याचे कौशल्य प्राप्त करणे.

Course Outcomes:

विद्यार्थी मराठी भाषेच्या ऐतीहासिक 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 प्राविण्य 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

वाक्यप्राचार (विधानार्थी वाक्य, प्रश्नार्थी वाक्य, आज्ञार्थी आवकीय इ.)

विरामचिन्हे आणि त्यांचे उपयोग

शुद्धलेखन

समानार्थी शब्द (पर्यायवाची शब्द), विरुद्ध शब्द

घटक – ४. लेखन कौशल्य

लेखन कौशल्याचा परिचय – लेखन कौशल्याचे महत्व आणि आवश्यकता

पत्रलेखण

निबंध लेखन

वृत्तलेखन (वृतपत्रिय लेखन)

इतिवृत लेखन

सारांश लेखन

घटक – ५. भाषांतर (मराठीतून इंग्रजी आणि इंग्रजीतून मराठी)

भाषांतराचा मूलभूत परिचय – भाषांतराची व्याख्या आणि स्वरूप, महत्व आणि उपयोग, भाषांतराचे प्रकार इ.

पारिभाषिक शब्दावली

मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर.

संदर्भ साहित्य

प्राशासनिक लेखन. भाषा संचालनालय, महाराष्ट्र शासन, मुंबई १९६६

सुगम मराठी व्याकरण व लेखन – मो. रा. वाळंबे

"अनुवाद सिद्धांत आणि प्रयोग" – डॉ. भालचंद्र नेमाडे (लोकवाङ्मय गृह प्रकाशन)
मराठी भाषा आणि साहित्याचा इतिहास – वि. का. राजवाडे प्रकाशक : राजवाडे संशोधन मंडळ, धुळे
भाषांतर : सिद्धांत आणि प्रयोग – डॉ. अशोक केळकर प्रकाशक : लोकवाङ्मय गृह, मुंबई .

Field work/CEP **2 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
ELC	24UD1507CP311	Field work/ CEP	-	-	4	60	-	40	100	2

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

1. Acquire knowledge on topics outside the scope of curriculum on summer training.

2. Communicate with group of people on different topics of summer training.

3. Collect and consolidate required information on a topic of summer training.

4. Prepare a seminar report on summer training

Each student is expected to spend two weeks in any one factory/project/workshop/Community Project at the end of III semester (during winter vacation). For community project he/she has to consider any problem statement and find solutions to that problem which should be helful to community. For Factory visit/project/workshop, he/she shall observe layout, working anduse of various machinery, plants, design, instruments, process etc. under the generalsupervision of the foreman/artisan/engineer of the factory etc. Student shall submit report in asystematic technical format about the major field of the factory, particularly about thesection/department where he/she has received the training giving details of equipment,machinery, materials, process etc. with their detailed specifications, use etc. The report shallbe checked and evaluated by the concerned teacher and appropriate grade shall be awarded.

Mechanical Operations Lab **1 Credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1507PCL312	Mechanical Operations Lab	-	-	2	60		40	100	1

Course Objectives:

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

1. Screen effectiveness
2. Dry and wet screen analysis
3. Cyclone separator and froth flotation

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

1. Understand screen effectiveness
2. Understand dry screen analysis
3. Understand wet screen analysis
4. 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						-	-	-	-	-	-	-

List of Experiments (Mechanical Operations):

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

8. Study of Plate and frame press
9. Study of Ball mill
10. Study of thickener

SEMESTER – IV

Chemical Engineering Thermodynamics -I 3 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1507PC401	Chemical Engineering Thermodynamics -I	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:

First and second laws of thermodynamics to chemical processes and the properties of ideal and real mixtures.
Behaviour of flow and non-flow processes using mass and energy balances
Heat and work requirements for industrial processes.
Efficiency of processes involving heat into work, refrigeration and liquefaction
Heat effects involved in industrial chemical processes

Course Outcomes:

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

Apply the first and second laws of thermodynamics to chemical processes.
Compute the properties of ideal and real mixtures.
Analyze the behavior of flow and non-flow processes using mass and energy balances
Estimate heat and work requirements for industrial processes.
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 1:

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 Behaviour of pure substances; the Virial Equation; The Ideal Gas; Application of the Virial Equation; Cubic Equations of State; Generalised Correlation's for gases; Generalised correlation's for Liquids**.**

Unit III:

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 IV:

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 V:

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; Generalised property correlations for gases. **APPLICATIONS OF THERMODYNAMICS TO FLOW PROCESSES:** Duct flow of compressible fluids; Turbines (expanders); Compression processes.

Text/Reference books:

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 **3 credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	24UD1507PC402	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:

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

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

Understand the modes of heat transfer.
Determine heat transfer coefficients for forced and natural convection.

Understand heat transfer involving phase change.

Analyze the heat exchanger performance for co-current and counter-current flows.

Design double pipe and shell & tube heat exchangers.

Detailed syllabus

Unit I:

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, Concept of critical insulation thickness.

Unit II:

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. **Natural convection**: Heat transfer from plates and cylinders in verticals and horizontal configuration, natural convection to spheres. **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.

Unit III:

Heat transfer with phase change,heat transfer in condensing vapour, types of condensation. Nusselt Theory,Heat transfer to Boiling liquid, Pool boiling. Evaporation , Single and multiple effect evaporators,Types of evaporators, Performance of evaporator, Calculations of single and multiple effect evaporator.

Unit IV:

Heat Transfer by Radiation: Black and gray body radiations, emissivity, laws of radiation, view factor, luminous and non-luminous gases. Radiation between surfaces, Combined heat transfer, i.e. conduction, convection and radiation together. .

Unit V:

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. 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.

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.

Process Instrumentation — 2 credit

	Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Cred
Course	PCC	24UD1507PC403	Process Instrumentation	2	-	-	20	20	60	100	2

Objectives:

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

Measure techniques for Pressure and Temperature.

Measurement techniques for Flow and Level.

Recording, indicating and signalling instruments.

repeatability, precision and accuracy of instruments.

Course Outcomes:

Understand the measurement technique for Pressure and Temperature.
Understand the measurement techniques for Flow and Level.
Understand recording, indicating and signaling-instruments.
Analyze repeatability, precision and accuracy of instruments.

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:

Characteristics of Measurement system Elements of instrument, Static and dynamic Characteristics, basic concept of response of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy and response of thermometers.

Unit II:

Pressure measurement -pressure, vacuum and head manometers, measuring elements for gauge pressure and vacuum, measuring pressure in corrosive liquids, measuring of absolute pressure, static accuracy and response of pressure gases.

Unit III:

Temperature Measurement-Industrial thermocouples, thermocouples wires, thermo wells and response of the thermocouples.

Unit IV:

Flow Measurement -head flow meters, open channels meters, area flow meters, flow of dry materials, viscosity measurement.

Unit V:

Level Measurement-direct measurement of liquid level, level measurement in pressure vessels, measurements of interface level, level of dry materials. Instruments for Analysis-recording instruments indicating and signaling instruments, instrumentation diagram.

Text/Reference:

Patranabis D, Principles of Industrial Instrumentation,2ndEdition,TataMcGraw Hill Publishing Company, New Delhi, 1999.

Eckman Donald P., Industrial Instrumentation, Wiley Eastern Ltd.,2004.

William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, 1st Edition,Tata McGraw-Hill Education Private Limited, 2009.

Fluid Flow Operations Lab **1 Credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
VSEC	24UD1507PCL404	Fluid Flow Operations Lab	-	-	2	60	-	40	100	1

Course Objectives:

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

Viscosity determination using Fenske or other viscometer

Laminar and turbulent flows.

Selection of manometric fluid for experiment.

Characteristics of packed & fluidized beds and centrifugal pumps

Ball, gate, globe, check valves, elbow, bend and T-joint

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

Determine viscosity using Fenske or other viscometer and terminal velocity

Distinguish laminar and turbulent flows.

Select manometric fluid for experiment.

Determine the characteristics of packed & fluidized beds and centrifugal pumps

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):

Determination of flow regimes -Reynolds' apparatus

Verification of Bernoulli's equation

Determination of Fanning friction factor for smooth and rough pipes

Determination of equivalent length of pipe fittings

Determination of viscosity with capillary tube viscometer

Determination of friction factor for flow through packed bed

Determination of discharge coefficient for venturimeter

Centrifugal pump characteristics

Study of Rotameter.

Open Elective-2 **3 credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credi
PCC	24UD1MACOEM05L	Open Elective-2 Basic Principle of Finance and Economy	3	-	-	20	20	60	100	3

Course Objectives:

Students will be able to:

1. Students will be able to know and apply accounting and finance theory.
2. Students will be able to understand the mechanics of preparation of financial statements, their analysis and interpretation.
3. Students will be able to explain basic economic terms, concepts, and theories
4. Students will be able to identify key macroeconomic indicators

Detailed syllabus:

Unit I

Introduction: Explaining the Economy. The Supply and Demand Model Using the Supply and Demand Model

The Competitive Equilibrium Model: Deriving Demand Deriving Supply, Market Equilibrium and Efficiency

Unit II

Deviations from Competition: Monopoly and Market Power between Monopoly and Competition Antitrust Policy and Regulation

Unit III

Macro facts and measures: Getting Started with Macroeconomic Ideas, Measuring Production, Income and Spending of Nations

Unit IV

Accounting Transaction: Journal entries Debit credit rules, Compound journal entry Journal and ledger Rules of posting entries Trial balance

Unit V

Capital and Revenue: Income and expenditure Expired costs and income Final accounts, Manufacturing accounts Trading accounts, Profit and Loss account Suspense account, Balance sheet, Concept of Depreciation.

Course

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Cred
PCC	**24UD1LAWOEM05C**	**Open Elective-2** **Right to Information and Good Governance**	**3**	**-**	**-**	**20**	**20**	**60**	**100**	3

Objectives:

To provide a comprehensive learning on the Right to Information

To deal with multiple facets of Right to Information from a constitutional perspective to be a Statutory right

To acquaint students of RTI's evolution as an executory right through administrative and judicial process.

Course Outcomes:

At the end of the course the students will

CO1: Gain a comprehensive understanding of the RTI Act, including its provisions, implementation measures, and exemptions.

CO2: Comprehend the relationship between RTI and good governance, recognizing how RTI fosters transparency, accountability, and participation in democratic processes.

CO3: Understand the role of public authorities under the RTI Act, their obligations to provide information, and the significance of Citizen Charters and grievance handling mechanisms.

CO4: Learn the importance of accountability in public service delivery and the role of RTI in ensuring quality in service delivery.

CO5: Recognize RTI as a powerful tool for empowering citizens to hold the government accountable and participate in democratic governance

Detailed syllabus:

Week 1: History and Background to RTI
Week 2:
- Legislating RTI
- Official Secrets Act and RTI
- Role of NGOs and activist in RTI
- Mis-use of RTI
- Important SC and HC judgments in RTI

Week 3: Constitution and RTI
Week 4: Salient Features of RTI-1
Week 5: Salient features of RTI-2
Week 6: Powers and Functions of Information Commission
Week 7: Public Authority
Week 8: Exempted Information
Week 9: RTI & Its interface
- Public Records Act
- Whistleblowers Protection Act
- Judiciary and RTI

Week 10:
- Ecological perspective on RTI
- Lessons from RTI: Sakaala: Public Service Guarantee Act

Week 11: RTI: A comparative perspective
- Comparative Constitutional and Comparative FOI regime
- RTI in Srilanka

Week 12: How to Draft RTI Application and Appeals: Do it yourself

MDM-2 **2 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credi

PCC	**24UD1507 MD406**	**MDM-2 (FFO)**	**2**	**-**	**-**	**20**	**20**	**60**	**100**	**2**

Course Objectives:

To introduce students to the fundamental physical properties of fluids and their behavior under static and dynamic conditions.
To develop understanding of various types of fluid flow, including laminar and turbulent, compressible and incompressible, and one-, two-, and three-dimensional flows.
To explain the principles and equations governing the conservation of mass, momentum, and energy in fluid systems.
To provide knowledge on the flow of viscous fluids, boundary layer theory, and various flow losses in pipelines.
To explore specialized topics such as compressible flow, open channel flow, cavitation, and dimensional analysis.
To understand the characteristics and applications of multiphase flow and methods used for flow measurement in engineering systems.

Course Outcomes:

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

1: Define and explain basic fluid properties (density, viscosity, surface tension, etc.) and apply fluid statics principles to determine forces in static fluids.

2: Distinguish between various flow types and analyze steady and unsteady, compressible and incompressible flows using continuity and momentum equations.

3: Apply Navier-Stokes equations and boundary layer theory to evaluate velocity profiles and pressure losses in laminar and turbulent flows.

4: Analyze open channel flows, hydraulic jumps, and predict forces acting on bodies due to fluid motion, including drag, lift, and cavitation effects.

5: Understand compressible flow phenomena and calculate flow parameters using isentropic, Fanno, and Rayleigh flow models.

6: Interpret flow measurement techniques and describe the behavior of multiphase flows in practical chemical or mechanical systems.

Detailed syllabus:

UNIT-I

Characteristics of a fluid: Fluid: Units and dimensions; Density, specific gravity and specific volume;Viscosity; Surface tension; Compressibility; Characteristics of a perfect gas. Fluid statics: Pressure: Forces acting on the vessel of liquid: Why does an object float?; Relatively stationary state.

UNIT-II

Fundamentals of flow: Streamline and stream tube; Steady flow and unsteady flow; Three-dimensional, two-dimensional and one-dimensional flow; Laminar flow and turbulent flow; Reynolds number; Incompressible and compressible fluids; Rotation and spinning of a liquid; Circulation, One-dimensional flow: mechanism for conservation of flow properties; Continuity equation; Conservation of energy; Conservation of momentum; Conservation of angular momentum.

UNIT-III

Flow of viscous fluid: Continuity equation; Navier-Stokes equation; Boundary layer; Velocity distribution of laminar flow; Velocity distribution of turbulent flow; Theory of lubrication, Losses in pipes: Loss by pipe friction; Frictional loss on pipes other than circular pipes; Various losses in pipe lines; Flow in the inlet region; Pumping to higher levels.

UNIT-IV

Flow in a water channel: Flow in an open channel with constant section and flow velocity; Best section shape of an open channel; Specific energy; Constant discharge; Constant specific energy; Constant water depth; Hydraulic jump, Drag and lift and cavitation: Flows around a body; Forces acting on a body; The drag of a body; The lift of a body; Cavitation, Dimensional analysis and law of similarity: Dimensional analysis; Rayleigh's method, Buckingham's Pi theorem; Application examples of dimensional analysis; Law of similarity.

UNIT-V

Compressible fluid flow: Introduction, Thermodynamic characteristics, Speed of sound or sonic velocity, Mac number, Basic Equations of One dimensional, compressible flow, Isentropic compressible Flow, Shock Waves, Expansion waves, Fanno and Rayleigh Flow, Measurement of flow: Measurement of flow velocity; Measurement of flow discharge, Multiphase flow phenomena and its application: Introduction of multiphase flow patterns; Flow patterns map; Hydrodynamics in multiphase flow, Application of multiphase flow.

Universal Human Values II **3 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit

VEC	**24UD1UHVVE407**	**UHV-2**	**3**	**-**	**-**	**20**	**20**	**60**	**100**	**3**

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.

Course Outcomes:

CO1: The students start exploring themselves: get comfortable with each other and with the teacher; they start appreciating the need and relevance for the course.

CO2: The students are able to see that all physical facility they are required for a limited time in alimited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.

CO3: The students are able to note that the natural acceptance (intention) is always for living in harmony, only competence is lacking!. The students are able to see that respect is right evaluation, and only right evaluation leads to fulfillment in relationship. Many present problems in the society are an outcome of differentiation(lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms and so on so forth.

CO4: The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them.

CO5: The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.

Module 1 Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Understanding Value Education

Lecture 2: Self-exploration as the Process for Value Education

Tutorial 1 Practice Session PS1 Sharing about Oneself

Lecture 3: Continuous Happiness and Prosperity the Basic Human Aspirations

Lecture 4: Right Understanding, Relationship and Physical Facility

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

Module 2 Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the Self and the Body

Lecture 8: Distinguishing between the Needs of the Self and the Body

Tutorial 4: Practice Session PS4 Exploring the difference of Needs of Self and Body

Lecture 9: The Body as an Instrument of the Self

Lecture 10: Understanding Harmony in the Self

Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the Self

Lecture 11: Harmony of the Self with the Body

Lecture 12: Programme to ensure self-regulation and Health

Tutorial 6: Practice Session PS6 Exploring Harmony of Self with the Body

Module 3 Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family the Basic Unit of Human Interaction

Lecture 14: Values in Human-to-Human Relationship

Lecture 15: 'Trust' the Foundational Value in Relationship

Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust

Lecture 16: 'Respect' as the Right Evaluation

Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 17: Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order

Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

Module 4 Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

Module 5 Implications of the Holistic Understanding a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal human order.

Text Book and Teachers Manual

a. 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

b. 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. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, 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 - PanditSunderlal
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)

Value Added Course **1 Credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Value Added Course	24UD1000 VE408A	Life on Chatrapati Shivaji Maharaj	1	-	-	-	-	-	-	1

Detailed Syllabus:

Unit 1

Shivaji Maharaj as a Great Conqueror, Master Strategist and innovator in Military Tactics Guerrilla Warfare (Ganimi Kava), Fortress Strategy, Avoidance of Direct Confrontation, Diplomacy and Alliances, Naval Power.

Unit 2

Shivaji Maharaj's Management and leadership strategies, Architecture and metallurgy of Raigad Fort Use of Light Cavalry, Intelligence Network, Asymmetric Warfare, Logistics and Supply Chains, Fortifications and Military Architecture.

Unit 3

Shivaji Maharaj's views about Women's rights, their dignity andreligious views. His views on Democracy &Nationalism.

Entrepreneurship courses (Innovation and Entrepreneurship) 2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
HSSM	**24UD1507 HM409**	**Innovation and Entrepreneurship**	**2**	**-**	**-**	**20**	**20**	**60**	**100**	**2**

Course Outcomes:

Students will be able to:

Develop entrepreneurial mind-set and attributes;

Apply process of problem-opportunity identification and feasibility assessment through developing a macro perspective of the real market, industries, domains and customers.

Analyse Customer and Market segmentation, estimate Market size.

Initiate Solution design, Prototype for Proof of Concept. Understand MVP development and validation techniques to determine Product-Market fit.

Craft initial Business and Revenue models, financial planning and pricing strategy for profitability and financial feasibility of a venture.

Understand and apply story telling skills in presenting a persuasive and defensible Venture Pitch.

Detailed syllabus

Unit I:

Entrepreneurship Fundamentals & Context:

Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. Gamified role play based exploration aligned to one's short term career aspiration and ambition. An understanding of how to build

entrepreneurial mindset, skillsets, attributes and networks while on campus. Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity.

Unit II:

Problem & Customer Identification:

Understanding and analysing the macro Problem and Industry perspective, technological, socio-economic and urbanization trends and their implication on new opportunities. Identifying passion, identifying and defining problem using Design thinking principles. Analysing problem and validating with the potential customer. Iterating problem-customer fit. Understanding customer segmentation, creating and validating customer personas. Competition and Industry trends mapping and assessing initial opportunity. Core Teaching Tool: Several types of activities including: Class, game, Gen AI, 'Get out of the Building' and Venture Activity.

Unit III:

Solution design & Prototyping:

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition. Developing Problem-solution fit in an iterative manner. Understanding prototyping and MVP. Developing a feasibility prototype with differentiating value, features and benefits. Initial testing for proof-ofconcept and iterate on the prototype. Core Teaching Tool: Venture Activity, nocode Innovation tools, Class activity.

Unit IV:

Opportunity Assessment and Sizing:

Assess relative market position via competition analysis, sizing the market and assess scope and potential scale of the opportunity. Core Teaching Tool: Class and Venture Activity.

Unit V:

Business & Financial Model, Go-to-Market Plan:

Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build - Measure – Lean approach Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial

Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analysing financial performance. Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options. Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

References:

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Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.

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Simon Sinek (2011) Start With Why, Penguin Books limited

Brown Tim (2019) Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business

Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited

Collins Jim, Porras Jerry, (2004) Built to Last: Successful Habits of Visionary Companies

Burlington Bo, (2016) Small Giants: Companies That Choose to Be Great Instead of Big

Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd

डॉ. बाबासाहेब आंबेकडर तंत्राशस्त्र विद्यापीठ, लोणेरे

इंग्रजी विभाग

सामान्य हिन्दी / व्यावहारिक हिन्दी पाठ्यक्रम

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

पाठ्यक्रम उद्देश (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, प्राशासनिक और तकनीकी लेखन में हिंदी का प्रयोग कर सकेंगे।

अनुवाद के सिद्धांतों को सीखकर अंग्रेजी और हिंदी के बीच प्रभावी अनुवाद क्र सकेंगे।

इकाई – १. हिंदी भाषा का उद्भव और स्त्रोत

हिंदी भाषा की उत्पत्ति और स्वरूप

संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास

हिंदी की प्रमुख बोलियाँ (ब्रज, अवधी, खडी बोली, भोजपुरी, राजस्थानी आदि)

हिंदी पर फारसी, अरबी और अंग्रेजी भाषाओं का प्रभाव

इकाई – २. स्वातंग्रोतर 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 वै विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिती

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 चिंन्हो का प्रयोग

पर्यायवाची शब्द

विलोम शब्द

इकाई – ४. लेखन कौशल

पत्र लेखन

प्रतिवेदन (रिपोर्ट) लेखन

विज्ञाप्ति, 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 वर्मा (राजकामल 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 (राजकामल प्रकाशन)

Course code	Course Title	Teaching Scheme			Examination Scheme					
		L	T	P	Continuous Assessment (1)	Continuous Assessment (2)	Mid Term Test	End Semester Test	Total	Credits
2311372AE204	संस्कृत अभ्यासक्रम	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 प्रमानबद्ध 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.

Heat Transfer Operation Lab **1 credit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
VSEC	**24UD1507PCL410**	**Heat Transfer Operations Lab**	**-**	**-**	**2**	**60**	**-**	**40**	**100**	**1**

Course Objectives:

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

Electrical analogy in relation to heat conduction.

Emissivity of a given body.

Heat flow for resistances in series

Heat losses from cylindrical furnace

Temperature profiles in rod-double pipe heat exchanger, helical coil, heat pipe demonstration experiment.

Boiling Phenomena in liquids.

Differentiate between film-wise and drop-wise condensation.

To analyze and calculate heat transfer through composite walls.

Calculate heat transfer rates through forced convection.

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

Understand the Electrical analogy in relation to heat conduction

Determine Emissivity of a given body.

Determine heat flow for resistances in series

Determine heat losses from cylindrical furnace

Determine temperature profiles in rod-double pipe heat exchanger, helical coil, heat pipe demonstration experiment.

Understand boiling Phenomena in liquids

Analyze the effects of dropwise and filmwise condensation on heat transfer performance.

To analyze and calculate heat transfer through composite walls.

To analyze and calculate heat transfer rates through forced convection.

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 (Heat Transfer):

To determine thermal conductivity of given metal rod

Study of Double Pipe Heat Exchanger

Study of Shell and Tube Heat Exchanger

Study of Study of emissivity of circular discs with and without black coating.

Study of Stefan-Boltzmann's constant

To determine the surface heat transfer coefficient for a vertical tube losing heat by natural convection.

To study Film-wise and drop-wise condensation.

To study heat transfer through composite wall.

To study heat transfer through forced convection.