Dr. Babasaheb Ambedkar Technological University, Lonere

(Established by Government of Maharashtra, vide Dr. Babasaheb Ambedkar Technological University Act. No XXIX of 2014)

Vidyavihar, At Post: Lonere, Dist. Raigad, Maharashtra, India, PIN 402103

Telephone and Fax. 02140 - 275142

www.dbatu.ac.in

NEP 2020 BASED CURRICULUM

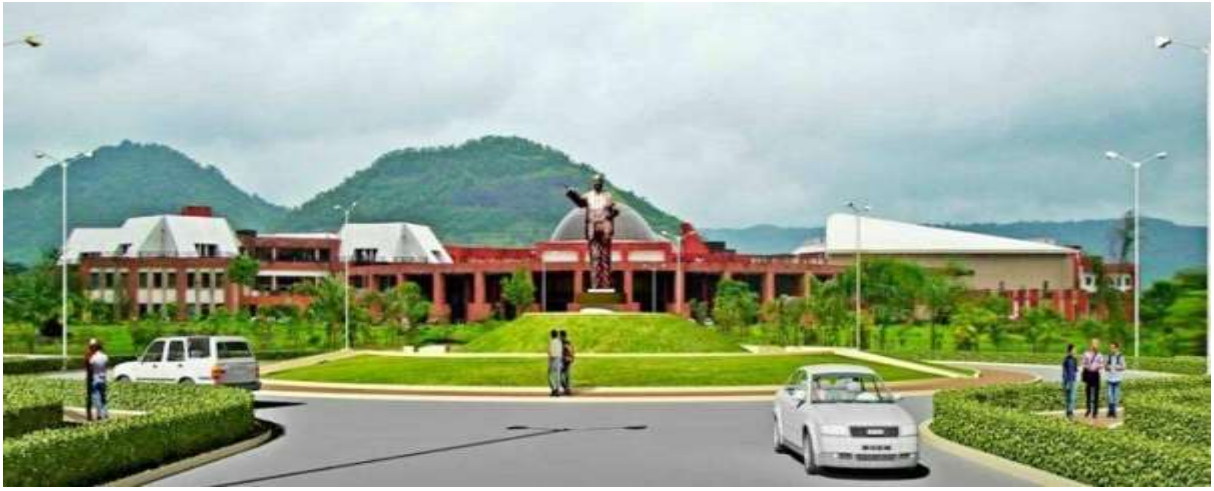
for

AFFILIATED COLLEGES

Second Year B. Tech. in

Mechatronics Engineering

ACADEMIC YEAR 2025-2026



	Vision	Mission
University	The University is committed to become a leading 'Center of Excellence' in the field of Engineering, Technology and Science as a seat of learning with a national character and international outlook.	The University is committed to provide quality technical education, research and development services to meet the needs of industry, business, service sector and society, at large.
Department of Mechanical Engineering	The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.	Imparting quality education, looking after holistic development of students and conducting need-based research and extension.

Graduate Attributes:

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs):

PEO1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO2	Graduates should excel in best post-graduate engineering institutes, reaching advanced degrees in engineering and related discipline.
PEO3	Within several years from graduation, alumni should have established a successful career in an engineering-related multi-disciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
PEO4	Graduates are expected to continue personal development through professional study and self-learning.
PEO5	Graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes:

At the end of the program the student will be able to:

PO1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO2	Analyze problems of production engineering including manufacturing and industrial systems to formulate design requirements.
PO3	Design, implement and evaluate production systems and processes considering public health, safety, cultural, societal and environmental issues.
PO4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO5	Apply current techniques, skills, knowledge and computer-based-methods and tools to develop production systems.
PO6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO11	Apply management principles to manage projects in multidisciplinary environment.
PO12	Pursue life-long learning as a means to enhance knowledge and skills.

Credit Framework under Four-Years Under Graduate 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 Under-Graduate Programme with multiple entry and multiple exit options are as given below:

Credit Framework

Level	Qualification Title	Credit Requirement		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
6.0	4-Years Bachelor's degree (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. The students will be given a specific Qualification mentioned in the table depending on the level at which he/she decides to have an exit, e.g., if a student decides to exit after completion of two years (level 5.0) of the program, he/she 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. The 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 (160 - 176 Credits) i.e. **B. Tech. in Mechanical Engineering with Multidisciplinary Minor** (160 - 176 credits) enables students to take up five-six or required additional courses of 14 credits in the discipline other than Mechanical Engineering distributed over semesters III to VIII. Here in the case of **B. Tech. in Mechanical Engineering with Multidisciplinary Minor** (160 - 176 credits) student is supposed to take up 50% or more Core Courses (mandatory courses, electives, vocational courses, Internship/ Field Projects/ Apprenticeship/Community Engagement Projects, Seminars, and Group Discussions) **from Mechanical Engineering discipline** to complete the 50% or more credits. In addition, the student will have to earn minimum 14 credits from the **multidisciplinary minor bucket**.
- Remaining three level 6.0 options are the advanced options where the student is given an opportunity to get extra qualification by earning some extra credits (18 - 20 extra credits). **These three options are given below:**
    1. Level 6.0: The **Bachelor's Engineering Degree with Honours** in chosen Major Engg./ Tech. Discipline i.e. in Mechanical Engineering with Honours with Multidisciplinary Minor (180 - 194 credits) enables students of Mechanical Engineering to take up five to six additional courses of 18 to 20 credits in the Mechanical Engineering discipline distributed over semesters III to VIII. The mechanism of distribution of these 18 - 20 credits over semesters III to VIII, which are over and above the 160 - 176 Credits prescribed for the duration of four years will be as prescribed by the University from time to time. The **student must have CGPA equal to or greater than 7.5 at the end of second semester to be eligible for this option**.
    2. Level 6.0: The **Bachelor's Engineering Degree with Research** in i.e., in Mechanical Engineering with Research with Multidisciplinary Minor (180 - 194 credits) enables students of Mechanical Engineering to take up a research project

of 18 to 20 credits in the Mechanical Engineering discipline distributed over the semesters VII to VIII. The **student must have CGPA equal to or greater than 7.5 at the end of sixth semester to be eligible for this option**.

3. Level 6.0: The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary Minor and Specialization Minor, 180 - 194 credits), i.e. **B. Tech. in Mechanical Engineering with Multi-disciplinary Minor and 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 Mechanical Engineering (for the 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 mechanism of distribution of these 18 - 20 credits over the semesters III to VIII, prescribed for the duration of four years will be as prescribed by the University from time to time. The **student must have CGPA equal to or greater than 7.5 at the end of second semester to be eligible 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**

It is necessary to follow the Semester-wise Credit distribution structure for Four-year UG Engineering Program as prescribed above.

- There are seven vertical categories with specific credits distributed in specific semesters.
- Student can choose a Program Elective Course (PEC) in that specific semester from the given subjects.

- Multidisciplinary course (MDM) and Open Elective (OE) courses can be chosen from the MDM and OE Buckets depending on student's choice. Completion of total credits given in the last column of the table for each vertical is mandatory.
- The students can complete 40% of the courses through online platforms like NPTEL/SWAYAM. The NPTEL/SWAYAM course content should be at least 80% similar to the course content in the syllabus.

General Rules and Regulations:

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

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

3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. For the First year B. Tech. and M. Tech. Classes, the schedule will be decided as per the admission schedule declared by Government of Maharashtra.

4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.

5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra-curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

Registration:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:
   A full-time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along

with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.

3. PhD students can register for any of PG/ PhD courses and the corresponding rules of evaluation will apply.
4. Under-Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the Departmental Under-Graduate Committee (DUGC) / Departmental Post-Graduate Committee (DPGC) is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

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

Evaluation System:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2023-24, from the first year B. Tech.

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

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

CGPA	Class
5.00 to 5.49	Pass class
5.50 to 5.99	Second Class
6.00 to 7.49	First Class
7.5 and above	Distinction
[Percentage of Marks = (CGPA - 0.5)*10.0]	

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

Mid Semester Exam (MSE) Marks	20
Continuous Assessment Marks	20
End Semester Examination (ESE) Marks	60

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

Continuous Assessment Marks	60
End Semester Examination (ESE) Marks	40

- It is mandatory for every student of B. Tech. to score a minimum of 40 marks out of 100, M. Tech. to score a minimum of 45 marks out of 100 with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.
- This will be implemented from the first year of B. Tech. starting from Academic Year 2023-24.

5. Description of Grades:

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

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

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

FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance.

6. Evaluation of Performance

a. **Semester Grade Point Average (SGPA)**

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

$$SGPA = \frac{\left[\sum_{i=1}^{n} c_i g_i\right]}{\left[\sum_{i=1}^{n} c_i\right]}$$

where,

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

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

'g_i' is the grade-points awarded to the student for the subject based on his/her performance as per the table **given in point No. 1.**

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

b. **Cumulative Grade Point Average (CGPA):**

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

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

where,

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

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

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

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

7. Attendance Requirements:

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

b. To account for approved leave of absence (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 maintain 75% attendance, he/she will be detained for appearing the successive examination. The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as

such the case may be. In any case, the student will not be permitted for appearing the examination if the attendance is less than 65%.

c. 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.

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

8. Transfer of Credits:

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

a) 20 % of the total credit will be considered for respective calculations.
b) Credits transferred will be considered for overall credits requirements of the programme.
c) Credits transfer can be considered only for the course at same level i.e. UG, PG etc.
d) A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. S/he shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to the Dean, Academics for approval.
e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.
f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.
g) In exceptional cases, the students may opt for higher credits than the prescribed.

Dr. Babasaheb Ambedkar Technological University Lonere
Department of Mechanical Engineering
Course Structure and Syllabus (as per NEP 2020)
Second Year B. Tech. in Mechatronics Engineering
(for Affiliated Colleges)

Semester III (w.e.f. A.Y. 2025-26)

Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BSC	25AF1000BS301	Engineering Mathematics- III	2	1	-	20	20	60	100	3
PCC	25AF1612PC302	Material Science and Metallurgy	3	-	-	20	20	60	100	3
PCC	25AF1624PC303	Analog and Digital Electronics	2	1	-	20	20	60	100	3
PCC	25AF1612PC304	Machine Drawing and CAD	2	-	-	20	20	60	100	2
OE*	25AF1612OE305A	Renewable Energy Sources	3	-	-	20	20	60	100	3
	25AF1624OE305B	Internet of Things								
	25AF1624OE305C	Fluid Mechanics								
MDM		MDM**	3	-	-	20	20	60	100	3
VEC	25AF1CIVE3407	Constitution of India (Audit)	2	-	-	50	-	-	50	AUDIT
IKS	25AF1DBAIK308	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	-	50	-	-	50	1
VSEC	25AF1612L309	Material Science and Metallurgy Lab	-	-	2	60	-	40	100	1
VSEC	25AF1612L310	Machine Drawing and CAD Lab	-	-	4	60	-	40	100	1
VSEC	25AF1624L311	Analog and Digital Electronics Lab	-	-	2	60	-	40	100	2
		Total	**18**	**2**	**6**	**400**	**120**	**480**	**1000**	**22**

MDM to be offered to other departments: Basic Thermodynamics

OE*: The students can opt for the Open Elective from the Open Elective bucket declared for the particular semester.
MDM**: The students will have to choose the MDM course being offered by other disciplines available/offered at the college)

Semester IV (w.e.f. A.Y. 2025-26)

Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
PCC	25AF1624PC401	Theory of Machines	3	-	-	20	20	60	100	3
PCC	25AF1624PC402	Drives and Control	2	1	-	20	20	60	100	3
PCC	25AF1612PC403	Strength of Materials	2	1	-	20	20	60	100	3
OE*	25AF1624OE404A	Process Instrumentation	2	-	-	20	20	60	100	2
	25AF1612OE404B	Numerical Methods in Engineering								
	25AF1612OE404C	Introduction to Artificial Intelligence								
	25AF1612OE404D	Python Programming								
MDM		MDM**	2	-	-	20	20	60	100	2
VEC	25AF1UHVVE406	Universal Human Values-II	3	-	-	20	20	60	100	3
IKS	25AF1CSMIK407	Life of Chhatrapati Shivaji Maharaj	1	-	-	50	-	-	50	1
AEC	25AF1000AE408A 25AF1000AE408B 25AF1000AE408C	Modern Indian Language Marathi Hindi Sanskrit	2	-	-	50	-	-	50	2
VSEC	25AF1624L409	Theory of Machines Lab	-	-	2	60	-	40	100	1
VSEC	25AF1624L410	Drives and Control Lab	-	-	2	60	-	40	100	1
VSEC	25AF1612L411	Strength of Materials Lab	-	-	2	60	-	40	100	1
		Total	**17**	**2**	**6**	**400**	**120**	**480**	**1000**	**22**

MDM to be offered to other departments: Strength of Materials/ Material Science and Metallurgy

OE*: The students can opt for the Open Elective from the Open Elective bucket declared for the particular semester.
MDM**: The students will have to choose the MDM course being offered by other disciplines available/offered at the college)

Exit Option-II: Qualifier for UG Diploma
Broad areas of Training: (1) CNC Programming-II (2) AutoCAD Drafting of Mechanical Components etc.

- To be completed during vacation after Second Year in the industry/institute.
- This should contain the well-defined project activity which is equivalent to 10 Credits.
- It should be carried out for the duration of 08 Weeks.
- The project/training should be evaluated by a panel of examiners.

Course Code: 25AF1000BS301
Course Title: Engineering Mathematics - III

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	Comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions
CO2	Apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients
CO3	Conceptualize the definitions and properties of Fourier transforms, to solve boundary value problems using Fourier transforms
CO4	Find the solutions of partial differential equations governing real-world problems
CO5	Conceptualize limit, continuity, derivative and integration of complex functions, complex integrals useful in real-world problems

Mapping of course outcomes with program outcomes:

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

Course Contents

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 t_n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 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; heat 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 flow equation i.e. $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$and one dimensional wave equation i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$

Unit 5: Functions of Complex Variables
Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Texts:

1. B. S. Grewal; Higher Engineering Mathematics, Khanna Publishers, New Delhi.
2. H. K. Das and Er. Rajnish Verma; Higher Engineering Mathematics; S. Chand & Co. Pvt. Ltd., New Delhi.
3. B. V. Ramana; Higher Engineering Mathematics; Tata McGraw-Hill Publications, New Delhi.

References:

1. Erwin Kreyszig; Advanced Engineering Mathematics; John Wiley & Sons, New York.
2. Peter O' Neil; A Text Book of Engineering Mathematics; Thomson Asia Pte Ltd. Singapore.
3. C. R. Wylie & L. C. Barrett; Advanced Engineering Mathematics; Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. I. N. Sneddon; Integral Transforms; Tata McGraw-Hill, New York.

Course Code: 25AF1612PC302
Course Title: Materials Science and Metallurgy

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	Analyze the crystal structures of materials
CO2	Understand the mechanism of plastic deformation and evaluate the mechanical properties of metals
CO3	Evaluate phase diagram of steels
CO4	Suggest appropriate heat treatment process for a given application
CO5	Demonstrate the use of various macroscopic and microscopic techniques

Mapping of course outcomes with program outcomes:

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

Course Contents

Unit 1: Structure of Materials

Crystal Structures: Atomic arrangement: crystalline vs. amorphous materials; unit cell, space lattice, 14 Bravais lattices, lattice parameters, 7 crystal systems; BCC, FCC, and HCP structures: Basic Characteristics: average number of atoms per unit cell, Coordination number, atomic packing factor; Indexing of lattice planes: finding Miller indices of a given plane, drawing a plane with given Miller indices, inter-planar spacing for cubic systems, angle between planes, indexing for hexagonal system; Indexing of lattice directions, importance, procedure, finding Miller indices of a given direction, drawing a direction with given Miller indices, angle between directions; crystallographic directions for hexagonal system: conversion of 3-parameter Miller indices into 4-parameter Miller-Bravais indices.

Crystal Imperfections: Importance, Classification: Point defects: vacancy, interstitials, impurities, Frenkel, Schottkey defects, Line defects: definition, types, edge, screw, mixed dislocations, characteristics of each type, planar defects: external surfaces, grain boundaries: high and low angle, tilt and twist boundaries; twin boundaries, stacking faults: intrinsic, extrinsic; Volume defects: examples.

Unit 2: Plastic Deformation and Mechanical Properties

Mechanism of plastic deformation: Slip: slip direction, slip plane, slip systems for cubic structures, Mechanism of slip: movement of dislocations; Twinning: twin direction and plane; types: deformation and annealing twinning; slip vs twinning; Deformation of single crystal by

slip: Schmid's law, calculation of critical resolved shear stress, sliding and rotation of slip planes; Strain hardening: mechanism, Frank-Read source; Plastic deformation of polycrystalline materials: piling up of dislocations, effect of grain size on stress-strain curve, preferred orientation of slip systems

Mechanical Properties and their Testing: Tension test, Engineering stress-strain curves, True stress-strain curves, true strain, relationship between engineering and true stress – strain, corrected and uncorrected true stress-strain curves, Evaluation of properties: proportional stress, elastic limit, ultimate tensile strength, breaking or fracture stress, yield stress, proof stress, resilience, toughness, stiffness, ductility, Compression test: Introduction, sources of error, types of fracture, Poisson's ratio, Formability: Importance, Erichsen test; hardness testing, different hardness tests: Brinell, Rockwell and Vickers tests; Impact tests: Charpy and Izod.

Non-destructive testing: Introduction, dye penetrant test, magnetic particle inspection, ultrasonic test, and eddy current test.

Unit 3: Equilibrium Diagrams

Introduction: Importance, Definitions of terms, Hume-Rothery rules of solid-solubility, Gibb's phase rule, solidification of a pure metal, types of cooling curves for pure metals and binary solid solutions, plotting of equilibrium diagrams, Lever rule, Iron-iron carbide equilibrium diagram, phases present, different transformations, critical temperatures, non-equilibrium cooling of steels, property variation with microstructures, classification and applications of steels, specification of steels (as per Indian, American and British standards), transformation products of austenite: pearlite, bainite and martensite; TTT diagrams: determination, effect of carbon, critical cooling rate, CCT diagram: determination of CCT curves.

Unit 4: Heat Treatment

Introduction, Heat treatment of steels, Objectives/purposes, Heating: media, soaking; cooling: media, polymer quenchant, mechanism of heat removal, Annealing processes: full annealing: purposes, process details and mechanism; isothermal annealing, spheroidize annealing, sub-critical annealing: types; Normalizing: comparison with annealing, Hardening: purpose, types, Tempering: purposes, process details and types; hardenability: Jominy end quench test, Jominy curves for different materials

Surface hardening processes: Carburizing: solid, gas, and liquid carburizing; Nitriding: mechanism, white layer, advantages and limitations; Carbo-nitriding: process details; Flame hardening: various methods; Induction hardening: principle, types, advantages and drawbacks.

Unit 5: Metallography

Introduction: Definition, importance; Microscopy: Specimen preparation: Procedure, Metallographic polishing abrasives, Metallographic polishing clothes; Mounting of specimens; Etching: Mechanism for single- and two-phase alloys, procedure and reagents; Optical metallurgical microscope: Principle of working, construction, important terms.

Macroscopy: Procedure and methods; Macro tests: Sulphur printing, flow lines observation, Examination of fractures: fatigue, tensile, fibrous; Spark test.

Texts:

1. V. D. Kodgire, S.V. Kodgire; Material Science and Metallurgy for Engineers, Everest Publishing House, Pune, 24th edition, 2008.
2. W. D. Callister; Materials Science and Engineering: An Introduction, John Wiley and Sons, 5th edition, 2001.
3. V. Raghvan; Material Science and Engineering, Prentice Hall of India Ltd.,1992.

4. S. H. Avner; Introduction to Physical Metallurgy, Tata McGraw Hill, 2nd edition, 1997.
5. R. A. Higgins; Engineering Metallurgy: Part I, ELBS, 6th edition, 1996.

References:

1. V. B. John; Introduction to Engineering Materials, ELBS, 6th edition, 2001.
2. G. F. Carter, D. E. Paul; Materials Science and Engineering, ASM International, 3rd edition, 2000.
3. T. E. Reed-Hill, R. Abbaschian; Physical Metallurgy Principles, Thomson, 3rd edition, 2003.

Course Code: 25AF1624PC304
Course Title: Analog and Digital Electronics

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./ week Tutorial: 1 hr./ week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours.)

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

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents

Unit 1: **Introduction to Analog Circuits**

Introduction to Operational Amplifier: Ideal v/s practical Op Amp, Performance Parameters, Operational Amplifier Application Circuits: Peak Detector Circuit, Comparator, Active Filters, Non-Linear Amplifier, Relaxation Oscillator, Current-To-Voltage Converter, Voltage-To Current Converter.

Unit 2: **Basic Gates**

Review of Basic Logic gates, Combinational Logic Circuits: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications, Don't care Conditions, Product-of-sums Method, Product-of-sums simplifications, Simplification by Quine-McClusky Method, Hazards and Hazard covers.

Unit 3: **Data-Processing Circuits**

Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD to Decimal Decoders, Seven Segment Decoders, Encoders, Exclusive-OR Gates, Parity Generators and Checkers, Magnitude Comparator, Programmable Array Logic, Programmable Logic Arrays, Arithmetic Building Blocks, Arithmetic Logic Module.

Unit 4: **Flip- Flops**

FLIP-FLOP Timing, JK Master-slave FLIP-FLOP, Switch Contact Bounce Circuits, Various Representation of FLIP-FLOPs, Registers: Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out, Universal Shift Register, Applications of Shift Registers.

Unit 5: **Counters**

Decade Counters, Preset table Counters, Counter Design as a Synthesis problem, A Digital Clock, Counter, D/A Conversion and A/D Conversion: Variable, Resistor Networks, Binary Ladders, D/A Converters, D/A Accuracy and Resolution, A/D Converter-Counter Method, Continuous A/D Conversion, A/D Techniques, Dual slope A/D Conversion, A/D Accuracy and Resolution.

Texts/ References:

1. A. K. Main & Nakul Maini, Analog Electronics, Khanna Book Publishing House (2018).
2. A. S. Sedra & K. C. Smith, Microelectronics Circuits, Oxford University Press (1997).
3. A. P. Malvino, Electronic Principles, Tata McGraw Hill Publications.
4. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory.
5. **William Kleitz, Digital Electronics, Prentice Hall International Inc.**

Course Code: 25AF1612PC304
Course Title: Machine Drawing and Computer Aided Drafting

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/ week Credits: 2	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 04 Hours)

Pre-requisites: Engineering Graphics

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

CO1	Interpret the object with the help of given sectional and orthographic views.
CO2	Construct the curve of intersection of two solids
CO3	Draw machine element using keys, cotter, knuckle, bolted and welded joint
CO4	Assemble details of any given part. i. e. valve, pump, machine tool part etc.
CO5	Understand various creating and editing commands in AutoCAD

Mapping of course outcomes with program outcomes:

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

Course Contents

Unit 1: Sectional Views

Full section, half section, partial section, off-set section, revolved sections, removed sections, auxiliary section, guidelines for hatching, examples on all above types of sections of machine elements.

Unit 2: Study of Machine Elements

Study of simple machine elements and components such as screwed fasteners, shaft couplings, pipe joints, riveted and welded joints, bearings, gears, etc.

Unit 3: Interpenetration of Surfaces (Emphasis on Applied Cases)

Line or curve of intersection of two penetrating cylinders, Cone and cylinder, prism and a cylinder, cone and prism, Forged ends, etc.

Unit 4: Drawing of Assembly and Details

Part drawing of standard machine components such as valves, components of various machine tools, pumps, shaft couplings, joints, pipe fittings, engine parts, etc.
Production drawings and reading of blue prints, size and shape description, limits, fits and tolerances, surface roughness and surface roughness symbols.

Unit 5: Computer Aided Drafting

Introduction to Computer Aided Design and Drafting (CADD), Advantages of CADD, study of preliminary Auto CAD commands like drawing, dimensioning, viewing commands. Drawing 3-D views in AutoCAD.

Texts:

1. N. D. Bhatt; Engineering Drawing, Charotar Publishing House, Anand, India.
2. N. D. Bhatt; Machine Drawing, Charotar Publishing House, Anand, India.
3. Ajeet Sing; Working with Auto CAD 2000, Tata McGraw Hill, New Delhi.

References:

1. Narayana, Kannaiah, Reddy; Machine Drawing, New Age International Publishers.
2. Auto CAD and AutoLISP manuals from Autodesk Corp. U.S.A.
3. IS Code: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Course Code: 25AF1612OE305A
Course Title: Renewable Energy Sources

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	Explain the difference between renewable and non-renewable energy
CO2	Describe working of solar collectors
CO3	Explain various applications of solar energy
CO4	Describe working of other renewable energies such as wind, biomass, nuclear etc.

Mapping of course outcomes with program outcomes:

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

Course Contents

Unit 1: Solar Energy

Energy resources, Estimation of energy reserves in India, Current status of energy conversion Spectral distribution, Solar geometry, Attenuation of solar radiation in Earth's atmosphere, Measurement of solar radiation, Properties of opaque and transparent surfaces.

Unit 2: Solar Collectors

Flat Plate Solar Collectors: Construction of collector, material, selection criteria for flat plate collectors, testing of collectors, Limitation of flat plate collectors, Introduction to ETC.
Concentrating type collectors: Types of concentrators, advantages, paraboloid, parabolic trough, Heliostat concentrator, Selection of various materials used in concentrating systems, tracking.

Unit 3: Solar Energy Applications

Air/Water heating, Space heating/cooling, solar drying, and solar still, Photo-voltaic conversion.

Unit 4: Wind Energy and Biomass

Introduction to wind energy, Types of wind mills, Wind power availability, and wind power development in India. Evaluation of sites for bio-conversion and Introduction to biomass resources, Location of plants, Biomass conversion process.

Unit 5: Other Renewable Energy Sources

Tidal, Geo-thermal, OTEC, hydro-electric, Nuclear energy.

Text:

1. Chetan Singh Solanki; Renewable Energy Technologies, Prentice Hall of India, 2008.

References:

1. S. P. Sukhatme; Solar Energy: Principles of Thermal Collection and Storage, Tata Mc Graw-Hill Publications, New Delhi,1992.
2. G. D. Rai; Solar Energy Utilization, Khanna Publisher, Delhi, 1992.

Course Code: 25AF1624OE305B

Course Title: Internet of Things

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents

Unit 1: IoT and Cloud Computing

Introduction, Physical design of IoT, Logical design of IoT, IoT enabling technologies, Domain specific IoTs, IoT design methodology, logical design, IoT physical devices (such as Raspberry Pi, pcDuino, Beaglebone black, Cubieboard), Introduction to cloud computing: cloud models, cloud service examples, cloud-based services & applications, Cloud service and platform

Unit 2: Applied Machine to Machine Communication

Introduction to M2M, Description of M2M Market, Segments/Applications – Automotive, Smart Telemetry, Surveillance and Security, M2M Industrial Automation, M2M Terminals and module.

Unit 3: Information Systems in Manufacturing

Manufacturing organizations, management, and the networked enterprises, Globalization challenges and opportunities, Dimensions of Information systems, Approaches to study information system, Technical and Behavioral approach, Information Technology Infrastructure.

Unit 4: Introduction to Smart Manufacturing

Introduction; Demand-Driven and Integrated Supply Chains; Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations); Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG), Online Predictive, Modelling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes.

Unit 5: Privacy, Security and Governance for Internet of Things

Introduction, Overview of Governance, Privacy and Security Issues, Security, Privacy and Trust in IoT- Data-Platforms for Smart manufacturing, First Steps Towards a Secure Platform, Data Aggregation for the IoT in Smart manufacturing.

Text:

Bahga and V. Madisetti, Internet of Things, A Hands-on Approach, Create Space Independent Publishing Platform, 1st edition, 2014, ISBN: 978-0996025515.

References:

1. Bahga and V. Madisetti, Cloud Computing, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2013, ISBN: 978-1494435141
2. D. Boswarthick, O. Elloumi, and O. Hersent, M2M communications: A systems approach, Wiley, 1st edition, 2012, ISBN: 978-1119994756
3. J. Edward Carryer, et al., Introduction to Mechatronic Design, Prentice Hall, 1st edition,2010, ISBN: 978- 8131788257.
4. K. Laudon and J. Laudon, Management Information Systems, 14th edition, Pearson Higher Education, 2016, ISBN: 9780136093688.

Course Code: 25AF1624OE305C
Course Title: Fluid Mechanics

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Fluid Properties and Fluid Statics:

Fluid Properties: Definition of fluid, Fluid as a continuum, Properties of fluid, Viscosity, Types of fluid, Compressibility, Surface tension, Capillarity and vapor pressure.
Fluid Statics: Pascal's law, Hydrostatic law of pressure, Total Pressure, Centre of Pressure, Buoyancy, Meta center, Condition of Equilibrium of floating and submerged bodies.

Unit 2: Fluid Kinematics

Eulerian and Langragian approach of fluid flow, Types of flow, Definition of steady, Unsteady, Uniform, Non-uniform, Laminar, Turbulent, Compressible, incompressible, rotational, ir-rotational flow, 1D-2D flows, Stream line, Streak line, Path line, concept of Velocity, potential & stream function flow net (no numerical treatment), Continuity equation for steady, Unsteady, Uniform, non-uniform, Compressible, incompressible.

Unit 3: Fluid Dynamics

Euler's equation, Bernoulli's equation along a streamline for incompressible flow, Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter.

Unit 4: Forces on Immersed Bodies and Boundary Layer Theory

Forces on Immersed Bodies: Lift and Drag, Drag on a flat plate and on aerofoil. Types of drags, Development of lift. (Magnus effect) stalling condition of aerofoil.

Unit 5: Dimensional analysis

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers.

Texts:

1. P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10th edition, 1991.
2. Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5th edition.
3. Dr. R. K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publication, Delhi, 2005

References:

1. V. L. Streeter, K. W. Bedford and E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9th edition, 1998.
2. S. K. Som, G.Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2nd edition, 2003.

Course Code: 25AF1612OE305C

Course Title: Product Design Engineering

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	Understand the need for product design
CO2	Apply various methods of idea generation
CO3	Differentiate various types of prototypes and testing methods
CO4	Understand the product economics at production scale
CO5	Appreciate the environmental concerns in product life cycle

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Course Contents

Unit 1: Introduction to Engineering Product Design

Trigger for Product/Process/System, Problem solving approach for Product Design, disassembling existing product(s) and understanding relationship of components with each other, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept,

Unit 2: Ideation and Conceptualization

Generation of ideas, funneling of ideas, short-listing of ideas for product(s) as an individual or group of individuals, Market research for need, competitions, Product architecture, designing of components, Drawing of parts and synthesis of a product from its component parts, 3-D visualization,

Unit 3: Testing and Evaluation Prototyping

Design Automation, Prototype testing and evaluation, working in multidisciplinary teams, Feedback to design processes, Process safety and materials, Health and hazard of process operations.

Unit 4: Manufacturing

Design models and digital tools, Decision models, Prepare documents for manufacturing in standard format, Materials and safety data sheet, Final Product specifications sheet, Detail Engineering Drawings (CAD/CAM programming), Manufacturing for scale, Design/identification of manufacturing processes

Unit 5: Environmental Concerns

Product life-cycle management, Recycling and reuse of products, Disposal of product and waste. Case studies.

Text:

Eppinger, S., & Ulrich, K.; Product Design and Development. McGraw-Hill Publication, 2015

References:

1. Model Curriculum for "Product Design Engineer – Mechanical", NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7).
2. Green, W., & Jordan, P. W.; Human Factors in Product Design: Current Practice and Future Trends; CRC Press, 1999.
3. Sanders, M. S., & McCormick, E. J.; Human Factors in Engineering and Design, McGraw-Hill Publication, 1993.
4. Roozenburg, N. F., & Eekels, J.; Product Design: Fundamentals and Methods (Vol. 2). John Wiley & Sons Inc., 1995.

Course Code: 25AF1CIVE3407
Course Title: Constitution of India

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./ week Audit Course	Continuous Assessment: 50 Marks

Course Objectives:

3. 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.
4. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
5. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
6. To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework.
7. To make students learn about role of engineering in business organizations and e-governance.

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

CO1	Identify and explore the basic features and modalities about Indian constitution.
CO2	Differentiate and relate the functioning of Indian parliamentary system at the 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

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

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

Course Contents

Unit 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.

Unit 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, Lok-Ayukta, The Lokpal and Lok-Ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Unit 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.

Unit 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.

Unit 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.

References:

6. Brij Kishore Sharma; Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
7. Granville Austin; The Indian Constitution: Corner stone of a Nation. 1966, Oxford Clarendon Press.
8. Subhash C. Kashyap; Our Constitution: An Introduction to India's Constitution and

constitutional Law, NBT, 2018.
9. P. M. Bakshi; The Constitution of India, Latest Edition, Universal Law Publishing.
10. V. K. Ahuja; Law Relating to Intellectual Property Rights (2007)
11. Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi-88
12. P. Narayan; Intellectual Property Law, Eastern Law House, New Delhi
13. Prabudh Ganguli; Gearing up for Patents: The Indian Scenario, Orient Longman.
14. B. L. Wadehra; Patents, Trademarks, Designs and Geological Indications. Universal Law Publishing-Lexis Nexis.
15. Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)
16. 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/webmodules/publications/Company%20Law.pdf
17. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e-Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf
18. 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

Referred Case Studies:

1. Keshavanand Bharati Vs. State of Kerala, AIR1973SC1461.
2. Maneka Gandhi Vs. Union of India AIR,1978 SC597.
3. S. R. Bammai Vs. Union of India, AIR1994 SC1918.
4. Kuldip Nayyar Vs. Union of India, AIR2006SC312.
5. A. D. M. Jabalpur Vs. Shivkant Shukla, AIR1976SC1207.
6. Remshwar Prasad Vs. Union of India, AIR2006SC980.
7. Keshav Singh, AIR1965 SC745.
8. Union of India Vs. Talsiram, AIR1985SC1416.
9. Atiabari Tea Estate Co. Vs. State of Assam, AIR1961SC232.
10. SBP & Co. Vs. Patel Engg. Ltd. 2005(8) SCC618.
11. Krishna Bhagya JalaNigam Ltd. Vs. G. Arischandra Reddy (2007)2SCC720.
12. Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE92 – 185.

****(Other relevant case studies can be consulted by the teacher as per the topic).**

Prescribed Legislations:

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

Suggested aid for Students and Pedagogic purpose:

1. RSTV debates on corporate law, IPR and patent issues
2. NPTEL lectures on IPR and patent rights

Episodes of 10-part mini-TV series "Samvidhan: The Making of Constitution of India" by RSTV.

Course Code: 25AF1DBAIK308
Course Title: Life of Bharat Ratna Dr. Babasaheb Ambedkar

Teaching Scheme	Examination Scheme
Lecture: 1 hr./ week Credit: 1	Continuous Assessment: 50 Marks

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

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.

Course Code: 25AF1612L309
Course Title: Materials Science and Metallurgy Lab

Practical Scheme	Examination Scheme
Practical: 2 hrs./ batch Credit: 1	Continuous Assessment: 60 Marks Practical/Oral Exam: 40 Marks

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

CO1	Measure hardness of given material using Brinell Hardness test
CO2	Measure hardness of given material using Rockwell Hardness test
CO3	Evaluate stretchability of given sheet metal samples of different thicknesses using Erichsen Cupping Test
CO4	Prepare specimen for observing the microstructure of the material
CO5	Sort out plain carbon steel samples based on their carbon percentages using spark test
CO6	Understand and draw the microstructures of plain carbon steels of varying carbon percentage
CO7	Understand and draw the microstructures of heat-treated steels
CO8	Demonstrate the use of Non-destructive test

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1			3		1	1	1	1	1		
CO2	1			3		1	1	1	1	1		
CO3	1			3		1	1	1	1	1		
CO4	1			3		1	1	1	1	1		
CO5	1			3		1	1	1	1	1		
CO6	1			3		1	1	1	1	1		
CO7	1			3		1	1	1	1	1		
CO8	1			2		1	1	1	1	1		

List of Experiments (Expt. No. 4 is compulsory. Any 5 experiments from 1 to 3 and 5 to 8 from the following list):

1. Brinell Hardness Test
2. Rockwell Hardness Test
3. Erichsen Cupping Test
4. Specimen Preparation for Microscopy
5. Spark Test
6. Study and drawing of microstructures of plain carbon steels of varying carbon percentage
7. Study and drawing of microstructures of heat-treated steels
8. Experiment on any one of the Non-Destructive Tests.

Course Code: 25AF1612L310
Course Title: Machine Drawing and CAD Lab

Practical Scheme	Examination Scheme
Practical: 4 hrs./batch Credits: 2	Continuous Assessment: 60 Marks Practical/Oral Exam: 40 Marks

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

CO1	Draw Conventional representation of standard machine components, welds, materials etc.
CO2	Draw sectional view of a given machine component.
CO3	Develop Assemble view from details of given component i.e. valve, pump, machine tool part, etc.
CO4	Combine details of given machine component and draw assembled view
CO5	Use various AutoCAD commands to draw orthographic projection

Mapping of course outcomes with program outcomes:

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

List of Drawing Sheets/ Assignments

1. One full imperial drawing sheet consisting the drawing/sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc., surface finish symbols and grades, limit, fit and tolerance sketches.
2. Two full imperial drawing sheets, one consisting of assembly and the other consisting of details of any one standard component such as valves, components of various machine tools, pumps, joints, engine parts, etc.
3. Two assignments on AutoCAD: Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engineers such as connecting rod, Piston, etc.; with dimensioning and detailing of three views of components.
4. 3-D model using AutoCAD of at least one simple machine component.

Texts:

1. N. D. Bhatt, “Engineering Drawing”, Charotar Publishing House, Anand, India.
2. N. D. Bhatt, “Machine Drawing”, Charotar Publishing House, Anand, India.
3. Ajeet Sing, “Working with AutoCAD 2000”, Tata McGraw Hill, New Delhi.

References:

1. Narayana, Kannaiah, Reddy, “Machine Drawing”, New Age International Publishers.
2. AutoCAD and AutoLISP manuals from Autodesk Corp. U.S.A.
3. IS Code: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Course Code: 25AF1624L311
Course Title: Analog and Digital Electronics Lab

Practical Scheme	Examination Scheme
Practical: 2 hrs./batch Credit: 1	Continuous Assessment: 60 Marks Practical/Oral Examinations: 40 Marks

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

CO1
CO2
CO3
CO4
CO5
CO6
CO7

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												

List of Experiments: (Any Eight Experiments)

1. Design, construction and testing of inverting amplifier using Op-Amp
2. Design, construction and testing of non-inverting amplifier using Op-Amp
3. Design, construction and testing of voltage follower amplifier using Op-Amp
4. Design and implement Basic gates.
5. Design and implement Universal gates.
6. Design and implement Half adder and Full Adder using basic gates.
7. Design and implement Half Subtractor and Full Subtractor using basic gates.
8. Design and Verification of truth table of J-K Flip Flop.
9. Design and Verification of truth table of D Flip Flop.
10. Design and Implementation of encoder using logic gates.
11. Design and Implementation of 4x1 multiplexer using logic gates.
12. Design and Implementation of decoder using logic gates.

Semester IV

Course Code: 25AF1624PC401
Course Title: Theory of Machines

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./ week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Introduction

Definition of link, pair, kinematics chain, inversions, inversions of single and double slider crank chain, kinematic diagrams of mechanisms, equivalent linkage of mechanism, degree of freedom. Study of various mechanisms such as straight-line mechanisms, Geneva mechanism, steering gear mechanisms.

Unit 2: Velocity Acceleration Analysis

Instantaneous centre of rotation, body and space centrodes, Kennedy's theorem. Velocity and acceleration analysis and its purpose, velocity and acceleration diagrams using relative velocity method. Velocity and acceleration of slider crank mechanism by analytical method and Klein's construction.

Unit 3: Cams and Followers

Types of cams and followers, Analysis of motion, Jump and ramp of cam, Determination of cam profiles for a given follower motion, Circular arc cam, Tangent cam, Cycloidal cam.

Unit 4: Gears

Gears – terminology, fundamental law of gearing, involute profile, Interference and undercutting, minimum number of teeth, contact ratio, bevel helical, spiral and worm gears.

Unit 5: Balancing

Gear Trains – simple, compound and epicyclic gear trains; sliding gear boxes and synchronous gear boxes.

Texts:

1. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
2. S. S. Rattan, "Theory of Machines", Tata McGraw Hill, New Delhi.

Course Code: 25AF1624PC402
Course Title: Drives and Control

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./week	Continuous Assessment: 20 Marks
Tutorial: 1 hr./week	Mid Semester Exam: 20 Marks
Credits: 3	End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	Recognize common manufacturing processes of Sheet Metal Fabrication
CO2	Understand the principles of design and fabricate of sheet metal products and recognize common material used in the industry
CO3	Distinguish Shearing, Drawing and Pressing etc. processes.
CO4	Know types of dies and formability.
CO5	Select mechanical or hydraulic presses for the given process

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Introduction

Basic Elements – Advantages of Electrical Drives Types of Electric Drives – factors influencing the choice of electrical drives, heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

Unit 2: Drive Motor Characteristics

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

Unit 3: Starting Methods

Types of D.C. Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

Unit 4: Conventional and Solid-State Speed Control of D.C. Drives

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications

Unit 5: Conventional and Solid-State Speed Control of A.C. Drives

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications

Texts:

1. B. R. Gupta, V. Singhal, Fundamentals of Electric Drives And Control, Publisher: S. K. Kataria & Sons; Reprint 2013 edition
2. U. A. Bakshi, M. V. Bakshi Electrical Drives and Control, Technical Publications, Pune.
3. Dr. N. Dhanasekar, Electrical Drives and Controls, ARS Publications.

References:

1. Pillai. S. K "A First Course on Electric Drives", Wiley Eastern Limited, 1998,
2. Singh. M. D., K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill.

Course Code: 25AF1612PC403
Course Title: Strength of Materials

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./week Tutorial:1 hr./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, principal stresses, etc.
CO2	Analyze the stresses and strain energy in different load cases
CO3	Design the columns based on deflection
CO4	Design a beam based on bending and shafts based on torsion
CO5	Analyze given beam for calculations of SF and BM

Mapping of course outcomes with program outcomes:

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

Course Contents

Unit 1: Simple Stresses and Strains

Mechanical properties of materials, analysis of internal forces, simple stresses and strains, stress strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants. Principal Stresses and Strains, Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principal stresses and principal planes, principal strains, shear strains, strain rosettes.

Unit 2: Strain Energy, Resilience and Combined Stresses

Strain energy, resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loading, shear resilience, Combined axial and flexural loads, middle third rule, kernel of a section, eccentrically applied load. Columns and Struts: Concept of short and long Columns, Euler and Rankine's formulae, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members.

Unit 3: Stresses in Beams

Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections-rectangular, solid circular, I-section, other sections design for flexure and shear. Torsion: Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

Unit 4: Shear Force and Bending Moment Diagram

Introduction to different types of beams, different types of supports & loads. Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple. Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple and compound beams, defining critical and maximum value and position of point of contra flexure. Construction of BMD and load diagram from SFD, Construction of load diagram and SFD from BMD.

Unit 5: Deflection of Beams

Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, theorem of area moment method (Mohr's theorems), moment diagram by parts, deflection of cantilever beams, deflection in simple supported beams, mid-span deflection, conjugate beam method, deflection by method of superstition.

Texts:

5. S. Ramamrutham, "Strength of Materials", Dhanpat Rai and Sons, New Delhi.
6. F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
7. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:

1. E. P. Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
2. S. H. Crandall, N. C. Dahl, T. J. Lardner, "An Introduction to the Mechanics of Solids", Tata McGraw- Hill Publications, 1978.
3. S. B. Punmia, "Mechanics of Structures", Charotar Publishers, Anand.

Course Code: 25AF1624OE404A
Course Title: Process Instrumentation

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./ week Credits: 2	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Process Characteristics

Types of Processes (Dead time, single and multi-capacity, Self and non-self-regulating, interacting and non-interacting, linear and nonlinear processes). Process gains, process reaction curve, process time constant and constant step analysis method for finding time constant, Dead time. Dynamic elements in control loops. PID control of processes. Process simulators.

Unit 2: Analysis and Properties of Some Common Loops

Flow, pressure level, temperature, composition, pH etc. Linear and nonlinear controllers, review of PID with limitations (offset, saturation in D, & reset windup) rate before reset, PID variations, and tuning, Digital controller (position and velocity algorithms, effect of sampling g time) hardware structures, features and specification. Single loop and multiloop controllers and the application programs, Non-linear controller-two state, three state, proportional time, dual mode, optimal switching

Unit 3: Multi-loop and Multivariable Process Control Systems

Feedback, feed forward Control, cascade control, ratio control, auto selective control, spit range control. Predictive control systems and Adaptive control systems. Interaction and decoupling, Relative gain analysis, procedure to calculate relative gain, and its applications.

Unit 4: Numerical Integration and Differentiation

Boiler instrumentation and Optimization, boiler equipment safety interlocks, Boiler efficiency and dynamics, boiler controls, combustion control, air to fuel ratio control. 3 element drum level control, steam pressure control, steam temperature control. Burner management and control boiler optimization. Furnace control of heat exchangers, steam and fired heaters control. Reboilers, vaporization, heat exchanger and condensers.

Unit 5: Curve, Fitting and Interpolation and Computer Programming

Instrumentation design for Pumps and compressor controls, Instrumentation design for multi effect evaporators, distillation, dryer, chemical reactor and cooling tower. Instrumentation design for size reduction, extruder, crystallizer, chiller.

Texts:

1. Process Control Systems by F. G. Shinskey (TMH).
2. Process Control by B. G. LIptak (Chilton).
3. Computer Based Industrial Control by Krishna Kant (PHI).
4. Distributed Computer Control for Industrial Automation by Popovic and Bhatkar (Dekker)
5. Chemical Process Control by G. Stephanopoulos (PHI).
6. Distillation Column Control by F. G. Shinskey (TMH).
7. Process control Instrumentation – C.D. Johnson (8) Process control designing processes and control system for dynamic processes Thomes E. narlin
8. Analog and Digital control – Ramakant Gaikwad
9. Distributed computer control for industrial automation, Ppovik Bhatkar, Dekkar Pub.

Course Code: 25AF1612OE404B
Course Title: Numerical Methods in Engineering

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./ week Credits: 2	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	Understand the concepts of errors in numerical analysis
CO2	Apply curve fitting to the given data sets
CO3	Solve the ODE using numerical technique
CO4	Apply the Numerical methods in real life practical engineering applications

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2		3	2									
CO3		2	2									
CO4	3											

Course Contents

Unit 1: Error Analysis

Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of error sin computer programming.

Unit 2: Roots of Equations

Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

Unit 3: Numerical Solution of Algebraic Equations

Motivation, Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit 4: Numerical Integration and Differentiation

Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method.

Unit 5: Curve, Fitting and Interpolation and Computer Programming

Motivation, Least Square Regression: Linear Regression, Polynomial regression. Interpolation: Newton's Divide Difference interpolation, engineering applications; Solution to Ordinary

Differentiation Equations: Motivation, Euler' sand Modified Euler's Method, Heun's Method, Runge– Kutta Method, engineering applications.

Computer Programming: *Overview of programming language, Development of at least one computer program, based on each unit.*

Texts:

1. Steven C Chapra, Reymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill Publications, 2010.
2. E. Balagurusamy, "Numerical Methods" Tata McGraw Hill Publications, 1999.

References:

1. V. Rajaraman, "Fundamental of Computers" Prentice Hall of India, New Delhi, 2003.
2. S. S. Sastri, "Introductory Methods of Numerical Methods", Prentice Hall of India, New Delhi, 3rd edition, 2003.
3. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley, 1978.

Course Code: 25AF1612OE404C
Course Title: Introduction to Artificial Intelligence

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

Course Outcomes: After learning the course, the students should be able to:

CO1	Understand the basics of Artificial Intelligence and its historical development.
CO2	Learn problem-solving techniques using search algorithms and heuristics.
CO3	Apply logical reasoning and knowledge representation methods in AI.
CO4	Design intelligent agents capable of planning and acting in uncertain environments.
CO5	Explore various learning algorithms, including decision trees, neural networks, and reinforcement learning
CO6	Develop practical applications in natural language processing, image processing, and robotics.

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3			2						1		
CO2			2									
CO3							3		2			
CO4		2							2			
CO5					2					2		
CO6				2								

Course Contents

Unit 1: Introduction

Introduction to AI, the foundations of Artificial Intelligence, history of Artificial Intelligence, AI Agents, structure of Intelligent Agents, nature of environments.

Unit 2: Problem Solving

Problem-Solving agents, searching solutions, various uninformed and informed (Heuristic) search techniques, Constraint Satisfaction Problems.

Unit 3: Planning

Planning – A Simple Planning Agent, Problem Solving to Planning, Planning in Situation Calculus, Basic Representations for Planning, A Partial- Order Planning Example & Algorithm, Planning with Partially Instantiated Operators, Knowledge Engineering for Planning.

Unit 4: Reasoning

Uncertain Knowledge and reasoning: Uncertainty – Acting under Uncertainty, Basic Probability Notation, the Axioms of Probability, Bayes' Rule and Its Use. Probabilities Reasoning systems
Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks, Inference in Belief Networks, Inference in Multiply Connected Belief Networks.

Unit 5: Learning

Learning: Learning from Observations – A General Model of Learning Agents, Inductive Learning, and Learning Decision Trees, Using Information Theory, Learning General Logical Descriptions, and Computational Learning Theory. Learning in Neural and Belief Networks – working of human Brain, Neural Networks, Perceptions, Multilayer Feed-forward Networks, Applications of Neural Networks.

Text:

Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, Prentice Hall, 2003.

Course Code: 25AF1612OE404D
Course Title: Python Programming

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./week Credits: 2	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit 1: Introduction to Python Programming

Introduction to the Python Programming Language, Working with Python, Numeric Data Types, String Data Type and Operations, Standard Data Types, Data Type Conversions, Commenting in Python, Understanding Python Variables, Multiple Variable Declarations, Python Basic Statements, Python Basic Operators, Precedence of Operators, Expressions.

Unit 2: Control Flow and Loops

Conditional Statements, if statements and its variations, Loops in Python, If While Loop, for loop, Loop Manipulation, Break and Continue statements.

Unit 3: Functions

Defining functions, calling functions, passing parameters and arguments, Python function arguments, anonymous functions (Lambda functions), fruitful functions (function returning values), scope of variables in a function, powerful lambda functions in Python.

Unit 4: I/O and Error Handling in Python

Introduction to I/O (Input/Output), Writing Data to a File, Reading Data from a File, Additional File Methods, Introduction to Errors and Exceptions, Handling I/O Exceptions, Runtime Errors and Handling Multiple Exceptions.

Unit 5: Classes in Python

Applications of classes, Creating classes in Python, Instance methods, inheritance, exemption classes and custom exemptions.

Computer Programming Practice
Overview of programming language, Development of at least one computer program, based on each unit.

Texts:

1. R. Nageswara Rao; Core Python Programming, Dreamtech Press, 2016.
2. Allen B. Downey; Think Python: How to Think Like a Computer Scientist, 2nd Edition, Shroff Reilly Publishers, 2016.
3. Vamsi Kurama; Python Programming: A Modern Approach, Pearson Education.

Course Title: 25AF1UHVVE406
Course Title: Universal Human Values- II

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./ week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration: 3 Hours)

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

CO1	
CO2	
CO2	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents

Unit 1: Introduction to Value Education

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

Unit 2: Harmony in the Human Being

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

Unit 3: Harmony in the Family and Society

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

Unit 4: Harmony in the Nature (Existence)

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

Unit 5: Implications of the Holistic Understanding – a Look at Professional Ethics

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

Texts:

1. 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
2. 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

References:

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

Course Code: 25AF1CSMIK407
Course Title: Life of Chatrapati Shivaji Maharaj

Teaching Scheme	Examination Scheme
Lecture: 1 hr./ week Credit: 1	Continuous Assessment: 50 Marks

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

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 and religious views. His views on Democracy & Nationalism.

Course Code: 25AF1000AE408A
Course Title: Indian Languages – Marathi

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./ week Credits: 2	Continuous Assessment: 50 Marks

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

CO1	विद्यार्थी मराठी भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
CO2	शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
CO3	विविध प्रकारच्या लेखन शैली आत्मसात करून सृजनशील, विश्लेषणात्मक आणि औपचारिक लेखन करू शकतील.
CO4	अचूक, स्पष्ट आणि भाषिक - सांस्कृतिक दृष्टीकोनातून योग्य भाषांतर करू शकतील.
CO5	व्यावसायिक आणि साहित्यिक भाषांतरात प्रावीण्य मिळवू शकतील.

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Objectives

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

Course Contents

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 इतिहास दर्शन.
- 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 मीतडया आणि ई-साहित्य.
- मराठी भाषा संरक्षणासाठी उपाययोजना.
- शिक्षणव्यवस्थेतील मराठीचा वापर.
- जागतिक स्तरावर मराठी भाषेचा प्रभाव.

घटक-३. मराठी लेखनाचे नियम आवण व्याकरण

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

घटक-४. लेखन कौशल्य

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

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

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

संदर्भ साहित्य:

1. प्रशासनिक लेखन, भाषा संचालनालय , महाराष्ट्र शासन , मुंबई १९६६
2. सुगम मराठी व्याकरण व लेखन - मो. रा. वाळंबे
3. "अनुवाद सिद्धांत आणि प्रयोग" – डॉ. भालचंद्र नेमाडे (लोकवाङ्मय गृह प्रकाशन)
4. मराठी भाषा आणि साहित्याचा इतिहास – वि.का. राजवाडे प्रकाशक : राजवाडे संशोधन मंडळ, धुळे
5. भाषांतर: सिद्धांत आणि प्रयोग – डॉ. अशोक केळकर प्रकाशक : लोकवाङ्मय गृह, मुंबई

Course Code: 25AF1000AE408B
Course Title: Indian Languages – Hindi

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/ week Credits: 2	Continuous Assessment: 50 Marks

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

CO1	विद्यार्थी हिंदीभाषा के ऐतिहासिक और आधुनिक विकास को समझेंगे।
CO2	हिंदी व्याकरण और लेखन के नियमों में दक्षता प्राप्त करेंगे।
CO3	व्यावसायिक , प्रशासनिक और तकनीकी लेखन में हिंदी का प्रयोग कर सकेंगे।
CO4	अनुवाद के सिद्धांतों को सीखकर अंग्रेजी और हिंदीके बीच प्रभावी अनुवाद कर सकेंगे।

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

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

अपेक्षित परिणाम (Course Outcomes):
- विद्यार्थी हिंदीभाषा के ऐतिहासिक और आधुनिक विकास को समझेंगे।
- हिंदी व्याकरण और लेखन के नियमों में दक्षता प्राप्त करेंगे।
- व्यावसायिक , प्रशासनिक और तकनीकी लेखन में हिंदी का प्रयोग कर सकेंगे।
- अनुवाद के सिद्धांतों को सीखकर अंग्रेजी और हिंदीके बीच प्रभावी अनुवाद कर सकेंगे।

Course Contents

इकाई – १. हिंदी भाषा का उद्भव और स्रोत
- हिंदी भाषा की उत्पत्ति और स्वरूप
- संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास
- हिंदी की प्रमुख बोलियाँ (ब्रज, अवधी , खडी बोली, भोजपुरी, राजस्थानी आदि)
- हिंदी पर फारसी , अरबी और अिंग्रेजी भाषाओं का प्रभाव

इकाई - २. स्वातंत्र्योत्तर काल में हिंदी भाषा
- प्रशासन , शिक्षा और संचार माध्यमों में हिंदी की भूमिका
- राजभाषा के रूप में हिंदी– संवैधानिक स्थिती और व्यावहारिक उपयोग
- हिंदी का वैश्वीक 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 चिन्हों का प्रयोग
- पर्यायवाची शब्द
- विलोम शब्द

इकाई - ४. लेखन कौशल

- पत्र लेखन
- प्रतिवेदन (रिपोर्ट) लेखन
- विज्ञाप्ती , नोटीस और परिपत्र लेखन
- निबंध लेखन
- सार लेखन

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

- अनुवाद : सिद्धांत और परंपरा
- अनुवाद : क्षेत्र, प्रकार
- पारिभातषक शब्दावली
- अंग्रेजी से हिंदीऔर हिंदीसे अंग्रेजी अनुवाद

संदर्भ ग्रंथ:

- "हिंदी भाषा का उद्भव और विकास " – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
- "हिंदी भाषा का इतिहास " – डॉ. रामविलास शर्मा (राजकमल प्रकाशन)
- "भारत में राजभाषा हिंदी " – डॉ. विश्वनाथ प्रसाद (भारतीय राजभाषा परिषद)
- "हिंदी व्याकरण और रचना" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
- "हिंदी लेखन कौशल " – डॉ. रमेश गुप्ता (साहित्य भवन)
- "अनुवाद विज्ञान और सिद्धांत" – डॉ. ओमप्रकाश (राजकमल प्रकाशन)

Course Code: 25AF1000AE408C
Course Title: Indian Languages – Sanskrit

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./ week Credits: 2	Continuous Assessment: 50 Marks

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

CO1	विद्यार्थी संस्कृत भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
CO2	शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
CO3	विविध प्रकारच्या लेखन शैली आत्मसात करून लेखन करू शकतील.

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

Course Objectives:

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

Course Contents

Unit 1: Introduction to Sanskrit

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

Unit 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).

Unit 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.

Unit 4: Selected Sanskrit Shlokas and Subhashitas

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

Unit 5: Reading and Writing Practice

- Reading simple Sanskrit texts
- Writing small paragraphs in Sanskrit.

Course Code: 25AF1624L409
Course Title: Theory of Machines Lab

Practical Scheme	Examination Scheme
Practical: 2 hrs./batch Credit: 1	Continuous Assessment: 60 Marks Practical/Oral Exam: 40 Marks

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

List of Experiments/Assignments:

1. Minimum Two sheets (half imperial size) based on graphical solution of problems on velocity, acceleration in mechanisms by relative velocity method, instantaneous center of rotation method and Klein's construction.
2. To draw cam profile for various types of follower motions.
3. Determination of displacement of slider-crank mechanism with the help of model and to plot velocity and acceleration curves from it.
4. To draw conjugate profile for any general shape of gear tooth
5. To generate gear tooth profile and to study the effects under cutting and rack shift using models.

Course Code: 25AF1624L410
Course Title: Drives and Control Lab

Practical Scheme	Examination Scheme
Practical: 2 hrs./ batch Credit: 1	Continuous Assessment: 60 Marks Practical/Oral Exam: 40 Marks

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

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												

Course Contents

List of Experiments:

1. DC Motor Speed Control: Speed control of DC motors using single-phase and three-phase thyristor converters (half-controlled and fully controlled).
2. Speed control of DC motors using choppers (DC-DC converters).
3. Closed-loop speed control of DC motors using feedback from tacho-generators.
4. Study of Ward-Leonard system for DC motor speed control.
5. Induction Motor Speed Control:
    a. Speed control of three-phase induction motors using variable stator voltage (AC voltage regulators).
    b. Speed control of three-phase induction motors using variable frequency (V/f control).
    c. Speed control of three-phase induction motors using rotor resistance control (slip-ring motors).
6. Simulation of induction motor speed control using software like MATLAB/Simulink.

Course Code: 25AF1612L411
Course Title: Strength of Materials Lab

Practical Scheme	Examination Scheme
Practical: 2 hrs./week Credit:1	Continuous Assessment: 60 Marks Practical/Oral Exam: 40 Marks

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4												
CO5												

List of Experiments/Assignments:

Any Six Experiments/Assignments to be completed from the following list:

1. Tension test on mid steel/ aluminum specimen.
2. Compression test on concrete/ wood specimen.
3. Shear test on mild steel/ aluminum (single and double shear tests).
4. Charpy/Izod Impact Test on given specimen.
5. Deflection test on mild steel/wooden beam specimen.
6. Determination of Young's modulus using simply supported beam set-up.
7. Assignment on graphical solution for principal stress problems.
8. Strain measurement involving strain gauges/ rosettes.

****** END ******