Dr. Babasaheb Ambedkar Technological University, Lonere

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

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Syllabus for

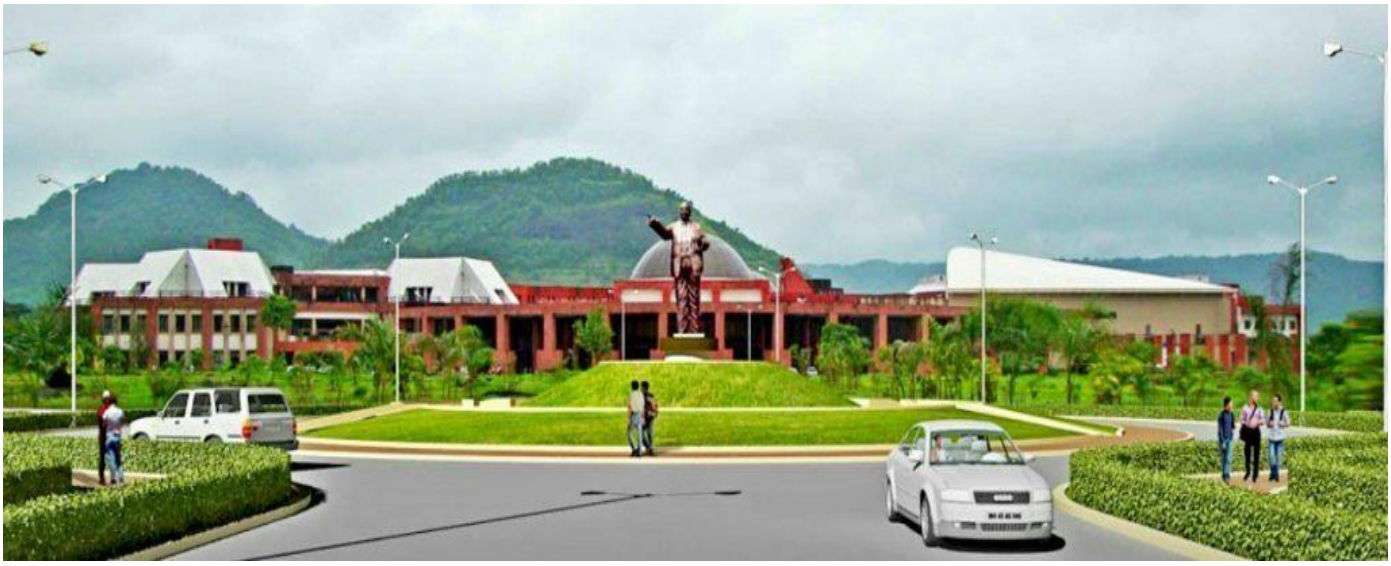
B. Tech Second Year

MECHANICAL ENGINEERING

NEP 2020 BASED CURRICULUM

ACADEMIC YEAR 2024-2025

(FOR UNIVERSITY DEPARTMENT ONLY)



	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
University Department of Mechanical Engineering
Second year Course Structure for B. Tech. Program w.e.f. 2024-25 as per NEP 2020

Semester III										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	**No. of Credits**
BSC	24UD1000BS301	Engineering Mathematics-III	3	-	-	20	20	60	100	3
PCC	24UD1612PC302	Materials Science and Metallurgy	3	-	-	20	20	60	100	3
PCC	24UD1612PC303	Fluid Mechanics	2	1	-	20	20	60	100	3
PCC	24UD1612PC304	Thermodynamics	2	1	-	20	20	60	100	3
OE	24UD1612OE 305A/ 24UD1612OE305B/ 24UD1612OE305C	Open Elective Bucket** 1. Numerical Methods in Engineering 2. Introduction to Automation 3. Innovations and Design Thinking	2	-	-	20	20	60	100	2
MDM	24UD1612MDM306	MDM Bucket## Basic Thermodynamics	3	-	-	20	20	60	100	3
VEC	24UD1COIVE307	Constitution of India (Audit)	2	-	-	50	-	-	50	AU
VEC	24UD1000VE308B	Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	-	50	-	-	50	1
PCC	24UD1612PC309	Machine Drawing	2	-	-	20	20	60	100	2
PCC Lab	24UD1612PCL310	MSM Lab	-	-	2	60	-	40	100	1
	24UD1612PCL311	FM Lab	-	-	2	60	-	40	100	1
PCC Lab	24UD1612PCL312	Machine Drawing Lab	-	-	3	60	-	40	100	1
FP		Field /Industrial Training-I (To be started)	-	-	4	-	-	-	-	-
		Total	**20**	**2**	**11**	**420**	**140**	**540**	**1100**	**23**

**** Refer Open Elective Bucket for additional courses**
Refer Multidisciplinary Minor Bucket (MDM Bucket)

Semester IV										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	**No. of Credits**
PCC	24UD1612PC401	Manufacturing Processes – I	3	-	-	20	20	60	100	3
PCC	24UD1612PC402	Theory of Machines-I	2	1	-	20	20	60	100	3
PCC	24UD1612PC403	Strength of Materials	2	1	-	20	20	60	100	3
CEP	24UD1612CEP404	Technical Project for Community Services	-	-	2	60	-	40	100	1
OE	24UD1612OE405A/ 24UD1612OE405B/ 24UD1612OE405C	Open Elective Bucket[##] 1. Entrepreneurship Development 2. Biology for Engineers 3. Introduction to Standards	2	-	-	20	20	60	100	2
MDM	24UD1612MDM406A/ 24UD1612MDM406B	MDM Bucket** Strength of Materials/ Material Science & Metallurgy	2	-	-	20	20	60	100	2
VEC	24UD1UHVVE407	Universal Human Values-II	3	0		20	20	60	100	3
VEC	24UD1000VE408A	Life of Chatrapati Shivaji Maharaj	1	-	-	50	--	--	50	1
VSEC	24UD1612VSEL409	Fab Lab	-	-	2	60	-	40	100	1
AEC	24UD1612HM410A 24UD1612HM410B 24UD1612HM410C 24UD1612HM410D	Indian Languages: - Marathi, - Hindi, - Sankrit, - Pali	2	-	-	20	20	60	100	2
PCC Lab	24UD1612PCL411	MP-I Lab	-	-	2	60	-	40	100	1
	24UD1612PCL412	ToM- I Lab			2					1
	24UD1612PCL413	SoM Lab			2					1
FP		Field /Industrial Training –I (To be completed)	-	-	4	-	-	-	-	-
		Total	**17**	**2**	**14**	**350**	**120**	**540**	**1050**	**24**

**** Refer Open Elective Bucket for additional courses**
[##] Refer Multidisciplinary Minor Bucket (MDM Bucket)

Exit Option-II: Qualifier for UG Diploma

1. CNC Programming-II
2. AutoCAD Drafting of Mechanical Components

- *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.*

24UD1000BS301: Engineering Mathematics- III

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: - Credits: 3	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (03 Hours)

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

CO1	Able to comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions
CO2	Able to apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients
CO3	Able to conceptualize the definitions and properties of Fourier transforms, to solve boundary value problems using Fourier transforms
CO4	Able to find the solutions of partial differential equations governing real-world problems
CO5	Able to 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:

Module 1: Laplace Transform [9 Hours]

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

Module 2: Inverse Laplace Transform [9 Hours]

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.

Module 3: Fourier Transform [7 Hours]

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.

Module 4: Partial Differential Equations and Their Applications [9 Hours]

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

i. e $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$

Module 5 Title: Functions of Complex Variables [9 Hours]

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).

Textbooks:

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

Reference Books:

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

24UD1612PC302: Materials Science and Metallurgy

Teaching Scheme:	Examination Scheme:
Lectures: 3 hrs/week Tutorial: - Credits: 3	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

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.

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.

Textbooks:

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 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.

Reference Books:

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.

24UD1612PC303: Fluid Mechanics

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 03 hrs.)

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

CO1	Explain basic properties of fluid, fluid statics, kinematics and dynamics.
CO2	Identify various types of flow, flow patterns and their significance.
CO3	Explain concepts of flow through pipes, boundary layer theory, forces on immersed bodies and dimensionless parameters.
CO4	Derive various equations in fluid mechanics such as Euler's, Bernoulli's, Momentum, Continuity etc.
CO5	Solve the problems related to properties of fluid, fluid kinematics, fluid dynamics, laminar flow, pipe flow, dimensional analysis, boundary layer theory, and forces on immersed bodies.

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	2											
CO3	2	2										
CO4	3	2										
CO5	3	2	2									

Course Contents:

Unit 1: Fluid Properties and Fluid Statics: [07 Hours]

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 (No Numerical Treatment on fluid Statics)

Unit 2: Fluid Kinematics and Dynamics [07 Hours]

Fluid Kinematics: Eulerian and Langragian approach of fluid flow, Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, Compressible, incompressible, rotational, Irrotational 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.

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 3: Laminar Flow and Turbulent Flow [07 Hours]

Laminar Flow: Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation and numerical.

Turbulent Flow: Major and minor losses. Loss of energy due to friction (Darcy's and Chezy's equation). Minor energy losses in transition, expansion and contraction. Concept of HGL and TEL, flow through syphon, flow through pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes, Power transmission through pipes. Moody's Diagram.

Unit 4: Forces on Immersed Bodies and Boundary Layer Theory [07 Hours]

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.

Boundary Layer Theory: Boundary layer thickness, its characteristics, laminar and turbulent boundary layers, separation, boundary layer control.

Unit 5: Dimensional analysis [07Hours]

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis-Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment)

Textbooks:

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, 5thedition.
3. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , Laxmi Publication, Delhi, 2005

References Books:

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

24UD1612PC304: Thermodynamics

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: 1 hr/week Credits: 3	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (03 Hours)

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

CO1	Understand and conceptualize the basic concepts of thermodynamics including Heat and work, pressure and its measurement
CO2	Understand and conceptualize all the three laws including temperature measurement
CO3	Understand the concept of Entropy and availability
CO4	Understand the concept of properties of pure substance and Ideal gases
CO5	Applied the 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		1	3									
CO3		2	3									
CO4	1	1										
CO5	3											

Course Contents:

Unit 1: Fundamental Concepts and Definitions [07 Hours]
Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process.
Work and heat Transfer: Work transferred and other types of work, Heat transfer, temperature and its measurement (principle of measurement, various instruments etc.). Zeroth law of thermodynamics, specific heat and latent heat, relationship between CP and CV.

Unit 2: First Law of Thermodynamics [07 Hours]
First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume. Application of first law of steady flow processes (nozzle, turbine, compressor, pump, boiler, throttle valve etc.)

Unit 3: Second Law of Thermodynamics [07 Hours]
Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence, Reversibility and Irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.
Entropy: Introduction, Clausius theorem, T-s plot, Clausius inequality, Entropy and Irreversibility, Entropy principle and its application, combined I and II law, Entropy and direction, Entropy and disorder.

Unit 4: Ideal gas [10 Hours]
Availability and un-availability, Second law efficiency, Availability balance, Measure of irreversibility, Applications in thermal systems, Calculations of maximum available energy and second law efficiency.

Boyle's law, Charl's law, Avogadro's law, universal gas constant, ideal processes with question, other equation of states.

Unit 5: Properties of Pure Substance [07 Hours]

Phase change phenomenon of pure substance, phase diagram of pure substance, p-v, T-s, and h-s diagrams properties of steam, critical point parameters, triple point, property table, representation of processes of steam on p-v, T-s, and other diagrams, Dryness fraction and its measurement.

Texts:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill, New Delhi, 3rd edition, 2005.
2. Y. A. Cengel, M. A. Boles, "Thermodynamics - An Engineering Approach", Tata McGraw Hill, 5thedition, 2006.

References:

1. G. J. Van Wylen, R. E. Sonntag, "Fundamental of Thermodynamics", John Wiley and Sons, 5thedition, 1998.
2. J. Moran, H. N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 4th edition, 2004.

24UD1612OE305A: Numerical Methods in Engineering

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: - Credits: 02	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End-SemesterExam:60 Marks (03 hrs)

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

CO1	Understand the concepts of errors in numerical analysis
CO2	Understand concepts of Numerical Methods including the curve fitting
CO3	Understand the numerical solutions of ODE
CO4	Applied 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, Hen'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 Mc Graw Hill Publications,2010.
2. E. Balagurusamy, “Numerical Methods” Tata McGraw HillPublications, 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.
4. M.J. Maron, “Numerical Analysis: A Practical Approach”, Macmillan, Ne

24UD1612OE305B: Introduction to Automation

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: - Credits: 02	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End-SemesterExam:60 Marks (03 hrs)

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

CO1	To understand basic principles of Automation
CO2	To identify correct hardware for a given automation requirement
CO3	To understand use of robot in automation
CO4	To understand various systems for automated material handling
CO5	To understand the concept of programmable automation

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											
CO2		1		3								
CO3	1		2									
CO4	1					3						
CO5	1			2								

Course Contents:

Unit 1: Introduction to Automation

Need for automation, types of industries and automation suitable for various types of industries, Basic Elements of an Automated System, Automation and Artificial Intelligence, IoT for manufacturing industry, Industry 4.0

Unit 2: Hardware Components for Automation and Process Control

Sensors, Actuators, Analog—Digital Conversions, Input/Output Devices for Discrete Data, Automated Production Lines, Fundamentals of Automated Production Lines, Fundamentals of Automated Assembly Systems

Unit 3: Flexible and Programmable Automation

CNC systems, use of robotics for material processing and manufacturing systems, AGVs, Automated material handling.

Texts:

1. Automation, Production Systems, and Computer-integrated Manufacturing by Mikell P. Groover Pearson international edition 2008

24UD1612OE305C: Innovations and Design Thinking

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: - Credits: 02	Internal Assessment:20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (3 hrs)

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

CO1	One can understand Design Thinking as a method to solve problems using a process that is structured and systematic.
CO2	To solve problems and find creative innovative solutions in any field or domain e.g. apply Design Thinking to solve problems in arts, social sciences, law, medicine, engineering, business, etc.
CO3	Identify problems and be able to find solutions and apply Design Thinking processes and methods to solve various problems.
CO4	To nurture students' curiosity and enhance their explorative abilities and be able to apply it to foster creativity and innovation in students in any field.
CO5	The students will also be able to realize their ideas as prototypes, test it and get feedback from users so that they can iteratively improve their solutions.

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		1
CO2				2					1	2	3	
CO3					1	2		2		1		3
CO4						1	1	1		3		
CO5												1

Course Contents:

Unit 1: Design Thinking for User-centered

Innovation, Introduction to Design Thinking – Observation, discovery, analysis, experience, collaboration, and reflection, Design Thinking as a problem-solving tool for solving wicked problems across different sectors, Roots of Design Thinking in Human Centric Design Process Design Thinking Process: Five Stages, Tools and Techniques for Design Thinking process, Design Thinking case studies in Indian companies/ organizations

Unit 2: Empathies with Users

Understanding the user and context of use, User research to access unmet and unarticulated needs of users, Types of user research. From user-centric to users as partners, Interviewing (Stories, Anecdotes), Observational Research, Ergonomics and Human Factors

Unit 3; Opportunity Identification and Evaluation

Opportunity identification and product/service selection – Generation and screening the project ideas – Market analysis, technical analysis, Cost benefit analysis and network analysis- Project formulation – Assessment of project feasibility- Dealing with basic and initial problems of setting up of Enterprises.

Unit 4: Defining a Problem and Creative Ideation

Analysis of user data to gain deeper insights**,** Insights to design ideas and action**,** Affinity analysis**,** Empathy

map, Persona, Divergence and Convergence, Collaborative ideation, Creative ideation techniques, Sketching, Visualization, Storytelling.

Unit 5: Prototyping and Testing Ideas

Ideas to presentable concepts, Storyboards, developing mock-ups, models, and Prototypes, Quick and Dirty Prototyping, Checking back with users-needs and aspirations, Presenting and communicating design, Presenting Prototypes, testing prototypes, obtaining feedback to refine products, Usability and ergonomic testing

E-Resources:

1. https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
2. https://archive.nptel.ac.in/courses/107/101/107101086/

24UD1COIVE307: Constitution of India

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: - Credits: Audit	Internal Assessment:20 Marks Mid Term Test: 20 Marks End Semester Exam: --

Course Objective:

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

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.

Suggested Readings:

1. Brij Kishore Sharma: Introduction to the Indian Constitution, PHI, New Delhi, latestedition.
2. Granville Austin: The Indian Constitution: Cornerstone of a Nation. 1966, Oxford Clarendon Press.
3. Subhash C. Kashyap: Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT, 2018.
4. PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.
5. V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)
6. Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi-88
7. P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
8. Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.
9. BL Wadehra: Patents, Trademarks, Designs and Geological Indications.Universal Law Publishing - LexisNexis.
10. Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)
11. Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and 36). https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
12. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e-Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

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

Referred Case Studies:

1. Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
2. Maneka Gandhi V. Union of India AIR, 1978 SC 597.
3. S.R. Bammai V. Union of India, AIR 1994 SC 1918.
4. Kuldip Nayyar V. Union of India, AIR 2006 SC312.
5. A.D.M. Jabalpur V. ShivkantShakla, AIR 1976 SC1207.
6. Remshwar Prasad V. Union of India, AIR 2006 SC980.
7. Keshav Singh in re, AIR 1965 SC 745.
8. Union of India V. Talsiram, AIR 1985 SC 1416.
9. Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
10. SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
11. Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
12. Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.

****(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.

24UD1000VE308B: Life of Bharat Ratna Dr. Babasaheb Ambedkar

Teaching Scheme:	Examination Scheme:
Lecture: 1 hrs/week Tutorial: - Credits: 1	Internal Assessment:50 Marks Mid Term Test: -- End Semester Exam: --

Course Objective:

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												

Unit 1: Introduction [5 Hrs]

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** [05 Hrs]

Contributions to the Constitution of India, Vision for social justice and empowerment

Unit 3 Legacy and relevance today [05 Hrs]

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

References:

24UD1612PC309: Machine Drawing

Practical Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: - Credits: 2	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (Duration: 04hrs)

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

CO1	Follow the standards to create machine drawings.
CO2	Apply limits and tolerances to assemblies and choose appropriate fit.
CO3	Develop solid models of machine components and assembly, and Construct sectional and orthographic views of components.
CO4	To draw the assembly and details of machine parts and Create bill of materials.

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: 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 screw threads, screwed fasteners, shaft couplings, pipe joints, riveted and welded joints, bearings, gears, etc.

Unit 3: Interpenetration of surfaces
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
Assembly and detail part drawing of standard machine components such as valves, components of various machine tools, pumps, shaft couplings, joints, pipe fittings, engine parts, etc.

Unit 5: Production Drawing and Reading Blueprints
Types of production drawings, Type of geometrical tolerances, its representation, size, shape and description, limits, fits and tolerances, surface roughness and surface roughness symbols, reading the blueprints.

Textbooks:

1. Bhatt, Panchal, “Engineering Drawing” Charottar publishing House, Anand, India.
2. Bhatt, Panchal, “Machine Drawing” Charottar Publishing House, Anand, India
3. Ajeet Singh, “Working with AutoCAD 2000, “Tata McGraw Hill
4. George Omura, “ABC of Autolisp “ BPB Publications, New Delhi

References Books:

5. Narayana, Kannaiah, Reddy, “Machine Drawing” New Age International Publishers
6. AutoCAD and AutoLISP manuals from Autodesk Corp. U.S.A
7. IS Code: SP 46- 1988, Standard Drawing Practices For Engineering Institutes.

24UD1612PCL310: Materials Science and Metallurgy Lab

Practical Scheme:	Examination Scheme:
Practical: 2 hrs/batch Credits: 01	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: Materials Science and Metallurgy Theory

Course Outcomes:

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

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		

List of Experiments (Any 5 experiments from the 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

24UD1612PCL311: Fluid Mechanics Lab

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch Credits: 01	Continuous Assessment: 60 Marks External Exam: 40 Marks

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

CO1	Understand laminar and turbulent flow and determine Critical Reynolds number using Reynolds Apparatus.
CO2	Verify Bernoulli's theorem.
CO3	Determine pressure drop in flow though pipes and pipe fittings.
CO4	Verify momentum equation using impact of jet apparatus.
CO5	Determine viscosity using viscometer
CO6	Do calibration of pressure gauges, rotameter
CO7	Use manometers for pressure measurement.

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	3	1				1	2		1
CO2	1	1	1	3	1				1	2		1
CO3	1	1	1	3	1				1	2		1
CO4	1	1	1	3	1				1	2		1
CO5	1	1	1	3	1				1	1		1
CO6	1	1	1	3	1				1	2		1
CO7	1	1	1	3	1				1	2		1

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Verification of Bernoulli's theorem
2. Determination of Critical Reynolds number using Reynolds Apparatus
3. Determination of pressure drop in pipes of various cross-sections
4. Determination of pressure drops in pipes of various pipe fittings etc.
5. Viscosity measurement using viscometer (at least one type)
6. Verification of momentum equation using impact of jet apparatus
7. Determination of metacentric height of a floating body
8. Calibration of a selected flow measuring device and Bourdon pressure gauge
9. Gauge and differential pressure measurements using various types of manometers,
10. Bourdon type pressure gauge.
11. Demonstration of measurement using these instruments Lab.
12. Experiment to study hydraulic jump.

24UD1612PCL312: Machine Drawing Lab

Practical Scheme:	Examination Scheme:
Practical: 3 hrs/batch Credit: 01	Continuous Assessment: 60 Marks External Exam: 40 Marks

Course Outcomes:

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												

Practical:

1. One full imperial drawing sheet consisting of 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 related sketches.

2. One full imperial drawing sheet consisting of assembly of any one standard component such as valves, components of various machine tools, pumps, shaft couplings, joints, pipe fittings, engine parts etc.

3. One full imperial drawing sheet consisting of details of any one standard component such as valves, components of various machine tools, pumps shaft couplings, joints, pipe fittings, engine parts etc.

4. Assignment of AutoCAD:
   Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engines such as Connecting rod, Piston etc. with it's three views with dimensioning and detailing.

5. 3-D model of at least one simple machine component.

Field /Industrial Training- I

(to be started)

Teaching Scheme:	Examination Scheme:
Practical: 4 hr/week	Continuous Assessment: 60 Marks External Exam: Evaluation in V Semester (40 Marks)

Course Outcomes:

CO1	To become aware of the industrial culture and organizational setup
CO2	To know about the technical report writing.

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			2		1			3	3
CO2		1	1			2		1			3	2

Course Contents

Students will have to undergo 2 weeks of training programme in the industry during the summer vacation after IIIrd and IVth semester examinations. It is expected that students should understand the organizational structure, various sections and their functions, products/services, testing facilities, safety and environmental protection measures etc.
They will have to submit a detailed report about the training programme to the faculty coordinator soon after joining in the third year B. Tech. Programme. They will have to give a power point presentation in front of the group of examiners and will be evaluated in the V semester

Semester IV

24UD1612PC401: Manufacturing Processes – I

Teaching Scheme:	Examination Scheme:
Lectures: 3 hrs/week Tutorial: - Credits: 03	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

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

CO1	Identify castings processes, working principles and applications and list various defects in metal casting
CO2	Understand the various metal forming processes, working principles and applications
CO3	Classify the basic joining processes and demonstrate principles of welding, brazing and soldering.
CO4	Study center lathe and its operations including plain, taper turning, work holding devices and cutting tool.
CO5	Understand milling machines and operations, cutters and indexing for gear cutting.
CO6	Study shaping, planning and drilling, their types and related tooling's

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				1		1
CO2	2	2	1		1	1				1		1
CO3	2	1	1		1	1				1		1
CO4	1		1		1	1				1		1
CO5	2		1		1	1				1		1
CO6	1				1	1				1		1

Course Contents:

Unit 1: Introduction and Casting Processes [07 Hours]

What is manufacturing? Selection of manufacturing processes, Introduction to casting; solidification of metals: Pure metals, Alloys; fluid flow; fluidity of molten metal; heat transfer: Solidification time, Shrinkage; defects: Porosity; Metal casting processes: Introduction; sand casting, shell molding, investment casting; Permanent-mold casting, vacuum casting, die casting, centrifugal casting.

Unit 2: Metal Forming [07Hours]

Rolling and Forging Processes: Introduction to Rolling; Flat-rolling Process: Roll Force, Torque, and Power Requirements, Geometric Considerations; Flat-rolling Practice: Defects in Rolled Plates and Sheets; Rolling Mills; Various Rolling Processes and Mills.

Introduction to forging, Open-die forging; Impression-die and Closed-die forging; various forging Operations; Forging Defects; Forging Machines.

Extrusion and Drawing: Introduction; Extrusion Process; Hot Extrusion; Cold Extrusion: Impact extrusion, Hydrostatic Extrusion; Extrusion Defects; Extrusion Equipment; Drawing Process; Drawing Practice; Drawing Defects and Residual Stresses; Drawing Equipment.

Unit 3: Joining Processes [07 Hours]
Oxy-fuel-gas Welding; Arc-Welding Processes: Non consumable Electrode; Arc-welding Processes: Consumable Electrode, Shielded Metal-arc Welding, Submerged-arc Welding, Gas Metal-arc Welding; Electrodes for Arc Welding; The Weld joint, Quality, and Testing: Weld Quality, Weldability, Testing of Welds.
Introduction to solid state welding, Friction Welding, Resistance Welding: Spot, Seam, Projection Welding. Introduction to brazing and soldering.

Unit 4: Machining Processes: Turning and Hole Making [07Hours]
Introduction; The Turning Process; Lathes and Lathe Operations: Lathe Components, Work holding Devices and Accessories, Lathe Operations, Types of Lathes. Types of chips, Boring and Boring Machines; Drilling Machines: Drills, Drill Materials and Sizes, Drilling Practice, Drilling Machines, Reaming operation and Reamers; Tapping and Taps.

Unit 5: Machining Processes: Milling, Broaching and Gear Manufacturing [07 Hours]
Introduction, Milling and Milling Machines: Peripheral Milling, Face Milling, End Milling, Other Milling Operations and Milling Cutters, Tool holders, Milling Process Capabilities, Milling Machines; Planning and Shaping; Broaching and Broaching Machines; Gear Manufacturing by Machining: Form Cutting, Gear Generating, Cutting Bevel Gears, Gear-finishing Processes.

Text Books:

1. Serope KalpakJian and Steven R. Schmid, “Manufacturing Engineering and Technology”, Addison Wesley Longman (Singapore) Pte. India Ltd., 6th edition, 2009.

Reference Books:

1. Milkell P. Groover, “Fundamentals of Modern Manufacturing: Materials, Processes, and Systems”, John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul DeGarmo, J.T. Black, Ronald A. Kohser, “Materials and Processes in Manufacturing”, Wiley, 10th edition, 2007.

24UD1612PC402: Theory of Machines - I

Teaching Scheme:	Examination Scheme:
Lectures: 2 hrs./week Tutorial: 1 hr./week Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Engineering Mechanics

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

CO1	Define basic terminology of kinematics of mechanisms
CO2	Classify planar mechanisms and calculate its degree of freedom
CO2	Perform kinematic analysis of a given mechanism using various methods
CO4	Understand role of friction & lubrication with their types.
CO5	Study various types of cams, follower & follower motions.
CO6	Understand balancing of unbalance forces in rotating masses, different types of single/multi cylinder reciprocating engines in different positions.

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	3	3	2	2	2	2	1	2	2	2	1
CO2	3	3	3	2	2	2	2	1	2	2	2	1
CO3	3	3	3	2	2	2	2	1	2	2	2	1
CO4	3	3	3	2	2	2	2	1	2	2	2	1
CO5	3	2	3	2	2	2	2	1	2	2	2	1
CO6	3	2	3	2	2	2	2	1	2	2	2	1

Course Contents:

Unit 1:Introduction [07 Hours]

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, pantograph, Geneva mechanism, steering gear mechanisms.

Unit 2: Velocity & Acceleration Analysis [07 Hours]

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, Corioli's component of acceleration. Velocity and acceleration of slider crank mechanism by analytical method and Klein's construction.

Unit 3: Friction and Lubrication [07 Hours]

Dry friction, friction between nut and screw with different types of threads, Uniform wear theory and uniform pressure theory, Frication at pivot and collars, Friction in turning pair, Friction circle and friction axis, Friction in mechanisms.
Lubrication, Viscosity, Viscous flow, Boundary lubrication, Thick film lubrication, Hydrostatic and hydrodynamic lubrications.

Unit 4: Cams and Followers **[07 Hours]**

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 5: Balancing **[07 Hours]**

Balancing of rotating masses in one and several planes, Balancing of reciprocating, masses in single and multi-cylinder engine viz., inclined, radial and v-type engines, Primary and secondary balancing analysis, Concept of direct and reverse cranks, Balancing of locomotive engines, Effect of partial balancing, Static and dynamic balancing.

Textbooks:

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.

References Books:

1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, Delhi.
2. J. E. Shigely, J. J. Uicker, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.

24UD1612PC403: 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 03 hrs)

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

CO1	Understanding and Application of Basic Mechanical Properties and Stress-Strain Relationships
CO2	Analyze structural members under combined stresses (axial and flexural loads) using mechanics and material science principles to ensure structural integrity and safety.
CO2	Evaluate and design structural beams by calculating moments of inertia, bending stresses, and shear stresses to ensure efficient and safe structural performance under various loading conditions.
CO4	Evaluate and design structural beams by calculating moments of inertia, bending stresses, and shear stresses to ensure efficient and safe structural performance under varied loading conditions.
CO5	Analyze the behavior of structural elements subjected to torsional loading, including circular shafts, to calculate stresses, deformations, and ensure design integrity in engineering applications.
CO6	Advanced analysis and design of mechanical components subjected to various loading conditions to ensure structural integrity and functionality

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: Simple Stresses and Strains [7 Hours]
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, Mohr's circle for stresses and strains.

Strain energy and resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to

gradual, sudden and impact loadings, shear resilience, strain energy in terms of principal stresses.

Unit 2: Combined Stresses [7 Hours]
Combined axial and flexural loads, middle third rule, kernel of a section, load applied off the axes of symmetry.
Shear and Moment in Beams: Shear and moment, interpretation of vertical shear and bending moment, relations among load, shear and moment.

Unit 3: Stresses in Beams [7 Hours]
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.

Unit 5: Beam Deflections [7 Hours]
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.

Unit 6: Torsion [7 Hours]
Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation

Texts:

1. S. Ramamrutham, "Strength of Materials", Dhanpat Rai and Sons, New Delhi.
2. F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
3. S. 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 Structure", Charotar Publishers, Anand.
4. B. C. Punmia, Ashok Jain, Arun Jain, "Strength of Materials", Laxmi Publications.

24UD1612CEP404: Technical Project for Community Services

Teaching Scheme:	Examination Scheme:
Practical: 2 hrs./week Credits: 1	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

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

CO1	Visit nearby places to understand the problems of the community
CO2	Select one of the problems for the study, state the exact title of the project and define scope of the problem
CO3	Explain the motivation, objectives and scope of the project
CO4	Evaluate possible solutions of the problem
CO5	Design, produce, test and analyze the performance of product/system/process
CO6	Modify, improve the product/system/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						2	1	1		2		1
CO2		2								2	1	
CO3						1				2	1	
CO4		1	2				1	2				
CO5	1	1	2	3	1	1	1	2	1	1	1	
CO6			2	1	1		1	1				

Rationale:
The role of technical institutes in giving technical and advisory services to the surrounding community need not be emphasized. It is desirable faculty members and students are involved in rendering services to community and economy. Moreover, as envisaged in the Act of this University, technical services to community, particularly the backward areas, is one of the basic objects of the University. In view of this, "Technical Project on Community Services" has been included in the curriculum. This will ensure the participation of each student as well as faculty in the Department in this activity. The nature of this mini-project will be as follows:

Course Contents:
The projects may be of varying nature such as a technical study/survey, design/development of an "appropriate technology" solution for an identified need, infusion/transfer of technology, etc. For instance, projects can be done on topics such as development of a low-cost mango harvester, bike- and hand-powered water pump, ground nut stripping device, cashew nut breaker, snake catching device, energy efficient chulha, etc.

All this will be within the ambit of technology, expertise and resources available within the Department and the University. The student may form small groups, typically of 2 to 3 students, and carry out the project under the supervision of a faculty member.

24UD1612OE405A: Entrepreneurship Development

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: - Credits: 2	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

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

CO1	To enable the students to understand the concept of Entrepreneurship and
CO2	To learn the professional behavior expected of an entrepreneur.
CO3	To identify significant changes and trends which create business opportunities and to analyze the environment for potential business opportunities.
CO4	To provide conceptual exposure on converting idea to a successful entrepreneurial firm.

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**						**3**				
CO2	**1**	**1**						**3**				
CO3				**3**	**2**	**2**						
CO4							**3**					
CO5												

Course Contents:

Unit 1: Introduction to Entrepreneurship

Entrepreneur: Meaning of entrepreneurship – Types of Entrepreneurship – Traits of entrepreneurship – Factors promoting entrepreneurship- Barriers to entrepreneurship- the entrepreneurial culture- Stages in entrepreneurial process – Women entrepreneurship and economic development- SHG.

Unit 2: Developing Successful Business Ideas

Recognizing opportunities – trend analysis – generating ideas – Brainstorming, Focus Groups, Surveys, Customer advisory boards, Day in the life research – Encouraging focal point for ideas and creativity at a firm level-Protecting ideas from being lost or stolen – Patents and IPR.

Unit 3: Opportunity Identification and Evaluation

Opportunity identification and product/service selection – Generation and screening the project ideas – Market analysis, Technical analysis, Cost benefit analysis and network analysis- Project formulation – Assessment of project feasibility- Dealing with basic and initial problems of setting up of Enterprises.

Unit 4: Business Planning Process

Meaning of business plan- Business plan process- Advantages of business planning- preparing a model project report for starting a new venture (Team-based project work).

Unit 5: Funding

Sources of Finance- Venture capital- Venture capital process- Business angles- Commercial banks- Government Grants and Schemes.

Textbooks:

1. Reddy, Entrepreneurship: Text & Cases - Cengage, New Delhi.
2. Kuratko/rao, Entrepreneurship: a south asian perpective.- Cengage, New Delhi.
3. Leach/Melicher, Entrepreneurial Finance – Cengage. , New Delhi.
4. K.Sundar – Entrepreneurship Development – Vijay Nicole Imprints private Limited
5. Khanka S.S., Entrepreneurial Development, S.Chand & Co. Ltd., New Delhi, 2001.
6. Sangeeta Sharma, Entrepreneurship Development, PHI Learning Pvt. Ltd., 2016.

Reference Books:

1. Barringer, B., Entrepreneurship: Successfully Launching New Ventures, 3rd Edition, Pearson, 2011.
2. Bessant, J., and Tidd, J., Innovation and Entrepreneurship, 2nd Edition, John Wiley &Sons, 2011.
3. Desai, V., Small Scale Industries and Entrepreneurship, Himalaya Publishing House, 2011.
4. Donald, F.K., Entrepreneurship- Theory, Process and Practice, 9th Edition, Cengage Learning, 2014.
5. Hirsch, R.D., Peters, M. and Shepherd, D., Entrepreneurship, 6th Edition, Tata McGraw-Hill Education Pvt.Ltd., 2006.
6. Mathew, J.M., Entrepreneurship Theory at Cross Roads: Paradigms and Praxis, 2nd Edition, Dream Tech, 2006.
7. Morse, E., and Mitchell, R., Cases in Entrepreneurship: The Venture Creation Process, Sage South Asia, 2008.
8. Nagendra and Manjunath, V.S., Entrepreneurship and Management, Pearson, 2010.
9. Reddy, N., Entrepreneurship: Text and Cases, Cengage Learning, 2010.
10. Roy, R., Entrepreneurship, 2nd Edition, Oxford University Press, 2011.
11. Stokes, D., and Wilson, N., Small Business Management and entrepreneurship, 6th Edition, Cengage Learning, 2010.

24UD1612OE405B: Biology for Engineers

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: - Credits: 2	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

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

CO1	Explain origin of life and Evolution, Cells
CO2	Understand Biomolecules
CO3	Understand Cell structure and function and cell cycle
CO4	Explain Mendelian genetics
CO5	Understand and Explain DNA structure, DNA replication, Transcription, Translation

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		1		1			1		1
CO2	1	2	3		1		1			1		1
CO3	1	2	3		1		1			1		1
CO4	1	2	3		1		1			1		1
CO5	1	2	3		1		1			1		1

Course Contents:

Unit 1: **[07 Hours]**

Introduction, Origin of life and Evolution, Cells

Unit 2: Biomolecules **[07 Hours]**

Carbohydrates, Amino acids and proteins, Enzymes, Nucleotides, Lipids,
Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching

Unit 3: Cell structure **[07 Hours]**

Cell structure and function, Eukaryotes

Unit 4: Cell cycle **[07 Hours]**

Cell division, mitosis, meiosis

Unit 5: Genetics and DNA **[07 Hours]**

Mendelian genetics, genetic disorders, Mendelian inheritance principle, non-Mendelian inheritance DNA, DNA structure, DNA replication, Transcription, Translation.

Texts:

1. Arthur T. Johnson, “Biology for Engineers”, CRC Press.

References:

1. N. A. Campbell, J. B. Reece, “Biology”, International edition, Benjamin Cummings, New York,

2. 7th edition or later, 2007 or later.
3. G. Karp, “Cell and Molecular Biology: Concepts and Experiments”, Wiley, New York, 7th edition, 2013.

24UD1612OE405C: Introduction to Standards

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: - Credits: 2	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

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

CO1	Understand the concept and importance of standards
CO2	Understand the functioning and purpose of BIS
CO2	Understand the relation of standards, safety, sustainability and comfort
CO4	Understand and need of International Standard

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	
CO2										2		
CO3						3	2					
CO4									1			

Course Contents:

Unit 1: Introduction

History, Standardization – The essence of civilization, Standardization safety comfort and manufacturing, Standardization nomenclature

Unit 2: Bureau of Indian Standards

Overview, Functions, Objectives, Functioning, activities, Development of standards including a mini project, Bureau of Indian Standard Act, roles and function, marking and certification of articles and processes

Unit 3: Standard and sustainability

Importance of standards to the industry, Policy Makers, Environmental aspects, sustainability, Scraps reduction, Sustainable design,

Unit 4: Recent trends

new immerging areas of standardizations, changing technology

Unit 5: Introduction of International standards

Textbooks & Reference Books:

1. Reference material from BIS, Handouts, and booklets expert talks etc.
2. A world built on standards: A Textbook on higher Education, Danish standard foundation
3. SO/IES Guide 59 BIS Standard Formulation Manual

24UD1UHVVE407: Universal Human Values- II

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: -- Credits: 3	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Objectives:

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

Course Outcomes: 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												

Module 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

Module 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

Module 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

Module 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

Module 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

READINGS:

Text Book and Teachers Manual

a. The Textbook

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

b. The Teacher's Manual

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

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

24UD1000VE408A: Life of Chatrapati Shivaji Maharaj

Teaching Scheme:	Examination Scheme:
Lecture: 1 hrs/week Tutorial: - Credits: 1	Internal Assessment:50 Marks Mid Term Test: -- End Semester Exam: --

Course Objective:

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												

Unit 1 [5 Hrs]

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: [05 Hrs]

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 [05 Hrs]

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

References:

24UD1612VSEL409: Fab Lab

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/week Credits: 1	Continuous Assessment: 60 Marks External Exam: 40 Marks

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

CO1	Understand and read the blueprint drawing with geometric dimensioning and tolerancing
CO2	Create the CAD model using object scanning and use of CAD software
CO3	Develop the process plan and appropriate sequence for the fabrication process
CO4	Fabricate a physical prototype using digital or conventional manufacturing process
CO5	Understand and test the job/product using inspection and measuring equipment

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		2		2		1		2	1
CO2	1		2	1	2		1				2	1
CO3	1		2	1	2		1				2	1
CO4	1		2	1	2		1				2	2
CO5	1		2	1	2		1				2	2

Students should undergo the following activities in the laboratory:

- Blueprint reading and understanding of geometric dimensioning and tolerances of a product drawing
- Scanning of the given object/Part and model development using modeling software's like CREO, CATIA, etc.
- Preparation of the appropriate process plan for the given job and selection of suitable equipment
- Development of CNC part programme using CNC simulator and fabrication of the physical prototype using digital process such as 3D Printing or conventional manufacturing like CNC Turning/Milling
- Measurement and inspection of the fabricated part/object using CMM/VMM or measuring instruments

24UD1612HM410A: 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 तत्त्वे, 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

24UD1612HM410B: 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 भाषाओिं 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)

24UD1612HM410C: 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.

24UD1612PCL411: Manufacturing Processes - I Lab

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs./week Credits:1	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

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

CO1	Apply the step turning, taper turning and thread cutting concepts on a lathe
CO2	Do gear cutting on a milling machine
CO3	Make a simple component by sand casting using a split pattern
CO4	Cut a steel plate using oxyacetylene flame cutting /plasma cutting
CO5	Do shearing operation, blanking and drawing operation
CO6	Make a butt joint using TIG/MIG Welding

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					
CO2	3			1			1					
CO3	3			1			1					
CO4	3			1			1					
CO5	3			1			1					
CO6	3			1			1					

List of Practical (Any four jobs):

1. Making a job with a process plan involving plain, step and taper turning as well as thread cutting as operations on a Centre Lathe.
2. Preparation of process planning sheet for a job including operations in milling.
3. Preparation of process planning sheet for a job including operations in drilling
4. Making a spur gear using universal dividing head on milling machine.
5. Making a simple component by sand casting using a split pattern.
6. Cutting of a steel plate using oxyacetylene flame cutting /plasma cutting.
7. Making a butt joint on two stainless steel plates using TIG/MIG Welding.
8. An experiment on shearing operation.
9. An experiment on blanking operation.
10. An experiment on drawing operation

24UD1612PCL412: Theory of Machines Lab - I

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch Credits:1	Continuous Assessment: 60 Marks External Exam: 40 Marks

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

CO1	Perform graphically kinematic analysis of any planar mechanism using ICR, RV & Klein's construction methods.
CO2	Sketch polar diagram for a Hooke's joint.
CO3	Demonstrate use of graphical differentiation method for kinematic analysis of slider crank mechanism or any other planar mechanism with a slider.
CO4	Understand the effect of Coriolis component of acceleration.
CO5	Measure jumping speed of follower
CO6	Perform balancing of rotating masses

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	3	3	2	2	2	1	2	2	2	1
CO2	2	2	3	3	2	2	2	1	2	2	2	1
CO3	2	2	3	3	2	2	2	1	2	2	2	1
CO4	2	2	3	3	2	1	2	1	2	2	2	1
CO5	2	2	3	3	2	2	1	1	1	1	1	1
CO6	2	2	3	3	2	2	1	1	2	2	2	1

List of Practical's/Experiments/Assignments

1. Four sheets (half imperial size)
Graphical solution of problems on velocity, acceleration in mechanisms by relative velocity method, instantaneous center of rotation method and Klein's construction. At least one problem containing Corioli's component of acceleration.

2. To draw cam profile for various types of follower motions.

3. Experiments
a) Experimental determination of velocity and acceleration of Hooke's joint.
b) Determination of displacement of slider-crank mechanism with the help of model and to plot velocity and acceleration curves from it.
c) Experiment on Corioli's component of acceleration.
d) To study Static and Dynamic Balancing.
e) To determine jumping speed of a follower using Cam-follower apparatus.

4. Assignment
Develop a computer program for velocity and acceleration of slider-crank mechanism.

24UD1612PCL413: Strength of Materials Lab

Teaching Scheme:	Examination Scheme:
Practical: 2 hrs./week Credits:1	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

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

CO1	Hands-on Learning: Conducting experiments allows students to apply theoretical knowledge in a practical setting, enhancing their understanding of material behavior and properties
CO2	Skill Development: Through performing various tests such as tension, compression, and shear, students develop essential laboratory skills including sample preparation, data collection, and analysis.
CO3	Material Characterization: Experiments enable students to characterize the mechanical properties of different materials, helping them comprehend material selection criteria for engineering applications.
CO4	Critical Analysis: Students learn to critically analyze experimental results, identify trends, and draw conclusions, fostering analytical thinking and problem-solving abilities.
CO5	Interdisciplinary Understanding: By exploring topics such as strain measurement, impact testing, and computational analysis, students gain a holistic understanding of materials science and engineering principles, preparing them for diverse engineering challenges.

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											
CO2					1				2		3	
CO3			1				2					
CO4				1		2		3				
CO5									1	2		3

List of Practical's/Experiments/Assignments

1. Tension test on ferrous and non-ferrous alloys (mid steel/cast iron/aluminum, etc.
2. Compression test on mild steel, aluminum, concrete, and wood
3. Shear test on mild steel and aluminum (single and double shear tests)
4. Impact Test – Charpy
5. Impact Test- Izod
6. Deflection test on mild steel and wooden beam specimen
7. Determination Of Young's Modulus Using Simply Supported Beam Setup
8. Graphical solution method for principal stress problems
9. Strain measurement involving strain gauges/ rosettes
10. Assignment involving computer programming for simple problems of stress, strain Computations.