Dr. Babasaheb Ambedkar Technological University, Lonere

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

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Syllabus for

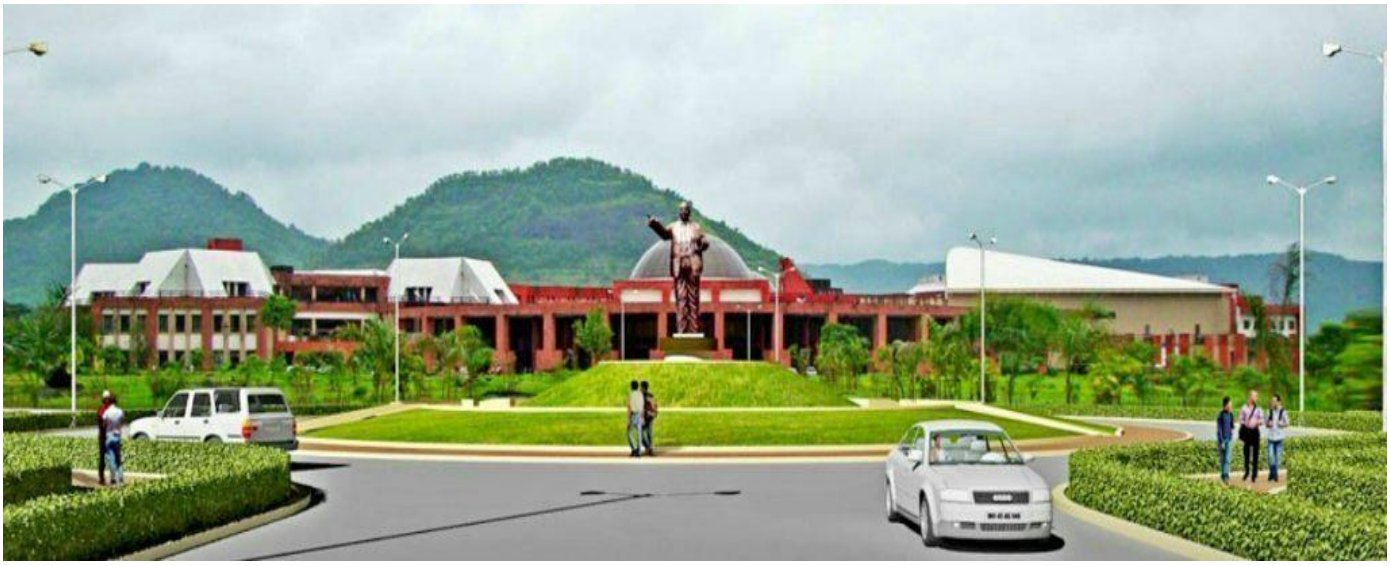
B. Tech Second Year

MECHANICAL ENGINEERING

NEP 2020 BASED CURRICULUM

ACADEMIC YEAR 2024-2025

(FOR AFFILIATED COLLEGES)



Vision

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education,looking after holistic development of students and conducting need-based research and extension.

GraduateAttributes

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

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.

ProgramOutcomes

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 globalimpactofmoderntechnologiesonindividualorganizations, 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 UG Engineering Programme with Multiple Entry and Multiple Exit options:

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

Credit Framework

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

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

- There are multiple exit options at each level. Student will be given a specific Qualification mentioned in the table depending on the level at which he/she decides to have an exit. Ex. If a student decides to exit after completion of two years (level 5.0) of the program, he will be given a Diploma in Engineering with specific exit condition mentioned in the syllabus of the specific branch. He/she can rejoin the program with the multiple entry option at the level next where he/she

chose to exit previously. (Student can join at level 5.5 if successfully completed level 5.0 previously at the time of exit).

- Minimum credit requirements of each level are mentioned in the credit framework table.
- There are 4 distinct options available at level 6.0.
- First one is basic level 6.0 option where minimum 160-maximum 176 credits are mandatory which can be completed as per the Semester-wise Credit distribution structure mentioned in the table given below.

  Here, the Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with multidisciplinary minor (min.160-max.176 Credits) i.e. "**B. Tech in Mechanical Engineering with Computer Engineering**" (160-176 credits) enables students to take up five-six or required additional courses of 14 credits in the discipline other than Mechanical Engineering distributed over semesters III to VIII. Here in the case of "**B. Tech in Mechanical Engineering with Computer Engineering**" (160-176 credits) student is supposed to take up 50% or more courses to complete the 50% or more credits (from assigned 14 credits) from **Computer Engineering minor bucket**. The remaining courses to complete the assigned 14 credits can be covered from other discipline's minor buckets.
- Remaining three level 6.0 options are the advanced options where the student is given an opportunity to get extra qualification by earning some extra credits (18-20 extra credits). These three options are given below:
- Level 6.0: The **Bachelor's Engineering Degree with Honours** in chosen Major Engg./ Tech. Discipline i.e. in Mechanical Engineering with Honours with Multidisciplinary Minor (180-194 credits) enables students of Mechanical Engineering to take up five-six additional courses of 18 to 20 credits in the Mechanical Engineering discipline distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are over and above the min.160-max.176 Credits prescribed for the duration of four years will be taken by Academic Authorities of University.**Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree with Research** in i.e. in 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 semesters VII to VIII. **Student must have CGPA equal to or greater than 7.5 at the end of sixth semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary and Specialization Minor, 180-194 credits), i.e. "**B.Tech in Mechanical Engineering with *other selected discipline in* Engineering (as MDM) with Specialization Minor in Computer Engineering**" (180-194 credits) enables students to take up five-six additional courses of 14 credits in the discipline other than Mechanical Engineering(for completion of multidisciplinary minor) and 18 to 20 extra credits in the **Computer Engineering discipline** distributed over semesters III to VIII. Here, the ***other selected discipline* in Engineering should be different from Specialization Minor i.e. Computer Engineering**. This enables students to take up five-six or required additional courses of 18 to 20 credits in the **Computer Engineering** discipline

distributed over semesters III to VIII, which are over and above the min.160-max.176 Credits. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, prescribed for the duration of four years will be taken by Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.

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

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

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

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

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, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.

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 the 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 DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

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

Evaluation System:

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

Percentage of marks	Letter Grade	Grade Point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0

71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

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

CGPA for pass is minimum 5.0	
CGPA upto<5.50	Pass class
CGPA ≥ 5.50	Second Class
&<6.00	First Class
CGPA ≥ 6.00	Distinction
[Percentage of Marks =CGPA*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

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

- It is mandatory for every student of B. Tech to score a minimum of 40 marks out of 100, M. Tech to score a minimum of 45 marks out of 100 with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

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

5. Description of Grades

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

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

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

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

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

6. Evaluation of Performance

a. Semester Grade Point Average (SGPA)

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

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

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 performance as per the above table.

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

b. Cumulative Grade Point Average (CGPA):

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

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

Where,

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

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

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

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

7. Attendance Requirements:

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

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

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 he shall show it to the student, if and when required.

8. Transfer of Credits:

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

a. 20 % of the total credit will be considered for respective calculations.
b. Credits transferred will be considered for overall credits requirements of the programme.
c. Credits transfer can be considered only for the course at same level i.e. UG, PG etc.
d. A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance

letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e. A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.
f. Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.
g. In exceptional cases, the students may opt for higher credits than the prescribed.

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

Semester III (with effect from AY 2025-26)

Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BSC		Engineering Mathematics- III	2	1	-	20	20	60	100	3
PCC		Material Science and Metallurgy	3	-	-	20	20	60	100	3
PCC		Thermodynamics	2	1	-	20	20	60	100	3
PCC		Machine Drawing and CAD	2	-	-	20	20	60	100	2
OE		Renewable Energy Sources	3	-	-	20	20	60	100	3
		Introduction to Automation								
		Product Design Engineering								
MDM		MDM**	3	-	-	20	20	60	100	3
VEC		Constitution of India (Audit)	2	-	-	50	-	-	50	AUDIT
IKS		Life of Bharat Ratna Dr. Babasaheb Ambedkar	1	-	-	50	-	-	50	1
VSEC		Material Science and Metallurgy Lab	-	-	2	60	-	40	100	1
VSEC		Machine Drawing and CAD Lab	-	-	4	60	-	40	100	2
		Total	**18**	**2**	**6**	**340**	**120**	**440**	**900**	**21**

MDM to be offered to other departments: Basic Thermodynamics

MDM** (the students will have to choose the MDM course being offered by other disciplines available/offered at the college)

Semester IV (with effect from AY 2025-26)

Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
PCC		Production Processes – I	3	-	-	20	20	60	100	3
PCC		Fluid Mechanics	2	1	-	20	20	60	100	3
PCC		Strength of Materials	2	1	-	20	20	60	100	3
OE		Entrepreneurship Development	2	-	-	20	20	60	100	2
		Numerical Methods in Engineering								
		Introduction to Artificial Intelligence								
		Python Programming								
MDM		MDM**	2	-	-	20	20	60	100	2
VEC		Universal Human Values-II	3	-	-	20	20	60	100	3
IKS		Life of Chatrapati Shivaji Maharaj	1	-	-	50	-	-	50	1
AEC		Modern Indian Language (Marathi/Hindi/Sanskrit)	2	-	-	20	20	60	100	2
VSEC		Workshop Practices II	-	-	2	60	-	40	100	1
VSEC		Fluid Mechanics Lab	-	-	2	60	-	40	100	1
VSEC		Strength of Materials Lab	-	-	2	60	-	40	100	1
		Total	**17**	**2**	**6**	**370**	**140**	**540**	**1050**	**22**

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

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

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

Engineering Mathematics- III

		Engineering Mathematics- III	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture:3hrs/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 $\text{i.e} \frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$

Module 5: 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.

Materials Science and Metallurgy

		Materials Science and Metallurgy	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lectures: 3hrs/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:

Unit1: Structure of Materials [9 Hours]

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 [9 Hours]

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.

Unit3: Equilibrium Diagrams [9 Hours]

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.

Unit4: Heat Treatment [8 Hours]

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 [8 Hours]

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 PublishingHouse,Pune,24th edition,2008.
2. W. D. Callister, "Materials Science and Engineering: An Introduction", John Wileyand 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: PartI", 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.

Thermodynamics

		Thermodynamics	3-0-0	3 Credits

TeachingScheme:	**ExaminationScheme:**
Lecture:2hrs/week Tutorial:1hr/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, 5th edition, 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.

Machine Drawing and Computer Aided Drafting

		Machine Drawing and Computer Aided Drafting	2-0-0	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture:2 hrs/week Tutorial: 0 hr/week Credits: 2	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (04 Hours)

Pre-Requisites: None

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

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

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

Mapping of course outcomes with program outcomes

Course Contents:

Unit 1: Sectional Views [04 Hours]

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 [04 Hours]

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

Unit 3: Interpenetration of Surfaces (Emphasis on Applied Cases) [04 Hours]

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 [04 Hours]

Part drawing of standard machine components such as valves, components of various machine tools, pumps, shaft couplings, joints, pipe fittings, engine parts, etc.

Production drawings and reading of blue prints, size and shape description, limits, fits and tolerances, surface roughness and surface roughness symbols

Unit 5: Computer Aided Drafting [04 Hours]

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

Texts:

1. N. D. Bhatt,"Engineering Drawing", Charotar Publishing House, Anand, India.
2. N. D. Bhatt, "Machine Drawing", Charotar Publishing House, Anand, India.
3. Ajeet Sing, "Working with Auto CAD 2000", Tata McGraw Hill, New Delhi.
4. George Omura, "ABC of AutoLISP", BPB Publications, New Delhi.

References:

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

Renewable Energy Sources

		Renewable Energy Sources	3-0-0	3 Credits

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

Pre-Requisites: None

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

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

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Solar Energy **[07 Hours]**

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

Unit 2: Solar Collectors **[07 Hours]**

Flat Plate Solar Collectors: Construction of collector, material, selection criteria for flat plate collectors, testing of collectors, Limitation of flat plate collectors, Introduction to ETC.

Concentrating type collectors: Types of concentrators, advantages, paraboloid, parabolic trough,Heliostat concentrator, Selection of various materials used in concentrating systems, tracking.

Unit 3: Solar Energy Applications **[07 Hours]**

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

Unit 4: Wind Energy and Biomass **[07 Hours]**

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

Unit 5: Other Renewable Energy Sources **[07 Hours]**

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

Texts:

1. Chetan singh Solanki, “Renewable Energy Technologies”, Prentice Hallo India, 2008.

References:

1. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, Tata Mc Graw-Hill Publications,New Delhi,1992.

2. G. D.Rai, “SolarEnergyUtilization”,KhannaPublisher,Delhi,1992.

Introduction to Automation

		Introduction to Automation	3-0-0	3 Credits

Pre-Requisites: None

Teaching Scheme:	Examination Scheme:
Lecture:3hrs/week Tutorial:1 hr/week	Continuous Assessment:20Marks Mid Semester Exam: 20 Marks End Semester Exam: 60Marks (Duration03 hrs)

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

CO1	Understand and learn about fundamentals of automation systems.
CO2	Understand and learn Architecture of Automation Systems
CO3	Understand and learn sensing and auction of automation systems
CO4	Understand and learn advanced tolls used in automation systems

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Introduction **[07 Hours]**

Definition, history, need and scope for automation, Industrial Automation vs. Industrial Information Technology, Role of automation in industry, Economy of Scale and Economy of Scope, Types of production systems, Types of Automation Systems, Automation Strategies, Components of an industrial automation system, Effects of industrial automation on people, society and environment.

Unit 2: Architecture of Automation Systems **[07 Hours]**

The Functional Elements of Industrial Automation, Sensing and Actuation Elements, Industrial Sensors and Instrument Systems, the Architecture of Elements: The Automation Pyramid.

Unit 3: Actuation and Control systems **[07 Hours]**

Fundamentals of pneumatics and Hydraulics, Industrial Actuator Systems, Industrial Control Systems, Continuous Control, Sequence / Logic Control, Supervisory Control, Production Control.

Unit 4: Introduction to Process Control **[07 Hours]**

Introduction, Characteristics of a Process, General Modeling Principles, Mathematical Modeling procedure, some modelling examples. Feedback and feed forward control.

Unit5: Advanced Automation systems & Tools **[07 Hours]**

IOT, Expert system, PLC Scada, Artificial Intelligence, Machine learning, machine vision.

Texts:

1. F.Ebel, S.Idler, G.Prede, D.Scholz Fundamentals of automation technology (Technical Book) FESTO, Reinhard Pittschellis, Edition :1/2008.

2. Ravindra Sharma,Advanced Industrial Automation And Its Applications, Laxmi Publications, first edition

3. A.K. Gupta,S.K .Arora,Industrial Robotics and Automation, University Science Press.

4. Groover, Mikell P, Automation, production systems, and computer-integrated manufacturing Publisher: Pearson, Year: 2014; 2019

5. Khushdeep Goyal, Industrial Automation & Robotics, Publisher S.K. Kataria

6. Qusay F. Hassan, Internet of Things A to Z: Technologies and Applications, IEEE Press, Wiley pub.

References:

a. Richard L. Shell, Ernest L.Hall, Handbook Of Industrial Automation,CRC Press,2000
b. KokKiongTan, AndiSudjanaPutra, Drives and Control for Industrial Automation, Publisher Springer London, first edition.
c. Manesis, Introduction to Industrial Automation,CRC Press, 2018.

Product Design Engineering

		Product Design Engineering	3-0-0	3 Credits

Pre-Requisites: None

Teaching Scheme:	Examination Scheme:
Lecture:3hrs/week Tutorial:1 hr/week	Continuous Assessment:20Marks Mid Semester Exam: 20 Marks End Semester Exam: 60Marks (Duration03 hrs)

•**Pre-requisites**: Knowledge of Basic Sciences, Mathematics and Engineering Drawing

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

CO 01. Understand the need for product design
CO 02. Apply various methods of idea generation
CO 03. Understand various types of prototypes and testing methods
CO 04. Understand the product economics at production scale
CO 05. Appreciate the environmental concerns in product life cycle

Course Contents:

Unit 1: Introduction to Engineering Product Design [07 Hours]

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

Unit 2: Ideation & Conceptualization [07 Hours]

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

Unit 3: Testing and Evaluation Prototyping: [07 Hours]

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

Unit 4: Manufacturing [07 Hours]

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

Unit 5: Environmental Concerns [07 Hours]

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

Reference:

1. Model Curriculum for "Product Design Engineer – Mechanical", NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7)
2. Eppinger, S., & Ulrich, K.(2015). Product design and development. McGraw-Hill Higher Education.
3. Green, W., & Jordan, P. W. (Eds.).(1999).Human factors in product design: current practice and future trends. CRC Press.
4. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGRAW-HILL book company.
5. Roozenburg, N. F., &Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.
6. Lidwell, W., Holden, K., & Butler, J.(2010). Universal principles of designs,revised and updated: 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design. Rockport Pub.

Basic Thermodynamics (MDM)

		Basic Thermodynamics (MDM)	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture:2hrs/week Tutorial:1hr/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, Entropy and Irreversibility, Entropy principle and its application, combined I and II law, Entropy and direction,

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.

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,

Texts:

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

References:

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

Constitution of India

		Constitution of India	2-0-0	Audit

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 with related 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: IntroductionandBasicInformationaboutIndianConstitution

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, latest edition.
2. Granville Austin: The Indian Constitution: Corner stone 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. P M 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. B L Wadehra: Patents, Trademarks, Designs and Geological Indications. Universal Law Publishing-Lexis Nexis.
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.,Study1,4 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, AIR1973SC1461.
2. Maneka Gandhi V.Union of India AIR,1978 SC597.
3. S. R. Bammai V. Union of India, AIR1994 SC1918.
4. Kuldip Nayyar V. Union of India, AIR2006SC312.
5. A. D. M. Jabalpur V.Shivkant Shakla, AIR1976SC1207.
6. Remshwar Prasad V. Union of India, AIR2006SC980.
7. Keshav Singhinre,AIR1965 SC745.
8. Union of India V.Talsiram, AIR1985SC1416.
9. Atiabari Tea Estate Co.V.State of Assam, AIR1961SC232.
10. SBP & Co.Vs. Patel Engg. Ltd. 2005(8) SCC618.
11. Krishna Bhagya JalaNigam Ltd.Vs.G.Arischandra Reddy (2007)2SCC720.
12. Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE92 – 185.

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

1. Information Technology Act, 2000 with latest amendments.
2. RTI Act 2005withlatestamendments.
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.

Life of Bharat Ratna Dr. Babasaheb Ambedkar

		Constitution of India	1-0-0	1 Credit

Teaching Scheme:	**Examination Scheme:**
Lecture: 1hrs/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

Materials Science and Metallurgy Lab

		Materials Science and Metallurgy Lab	0-0-2	1 Credit

PracticalScheme:	**ExaminationScheme:**
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 HardnessTest
2. Rockwell Hardness test
3. Erichsen Cupping Test
4. Specimen Preparation for Microscopy
5. Spark Test
6. Study and drawing of micro structures of plain carbon steels of varying carbon percentage
7. Study and drawing of micro structures of heat-treated steels

Machine Drawing and CAD Lab

		Machine Drawing and CAD Lab	0-0-4	2 Credit

PracticalScheme:	**ExaminationScheme:**
Practical: 4 hrs/batch Credits: 02	Continuous Assessment: 60 Marks External Exam: 40 Marks

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

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

Mapping of course outcomes with program outcomes

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

List of Practical's/ Experiments/ Assignments (minimum six assignments should be completed)

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

Texts:

1. N. D. Bhatt, “Engineering Drawing”, Charotar Publishing House, Anand, India.
2. N. D. Bhatt, “Machine Drawing”, Charotar Publishing House, Anand, India.
3. Ajeet Sing, “Working with AutoCAD 2000”, Tata McGraw Hill, New Delhi.
4. George Omura, “ABC of AutoLISP”, BPB Publications, New Delhi. References:
1. Narayana, Kannaiah, Reddy, “Machine Drawing”, New Age International Publishers.
2. AutoCAD and AutoL ISP manuals from Autodesk Corp. U.S.A.
3. IS Code: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Semester IV

Production Processes – I

	Production Processes - II		2-1-0	3 Credits

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

Pre-Requisites: PP-I

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

CO1	Understand the mechanics of metal cutting w.r.t. orthogonal and oblique cutting
CO2	Analyse the machinability of materials
CO3	Illustrate the mechanism of abrasive processes
CO4	Identify the various operations involved in the powder metallurgy
CO5	Compare various polymer processing techniques.

Mapping of course outcomes with program outcomes

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Engg. knowledge	Prob. analysis	Design/ dev. of solutions	Investigate complex problems	Modern tool usage	Engineer and society	Environ. and sustain.	Ethics	Team work	Commu-nication	Project Mgt. and Finance	Life Long learning
CO1	3	1	1	1								
CO2	3	2	1	1	1		1					
CO3	3	1	1	1								
CO4	3	1	1	1			1					
CO5	3	2	1	1								

Course Contents:

Unit 1: Mechanics of Metal Cutting [06 Hours]

Geometry of single point cutting tools, terms and definitions; chip formation, forces acting on the cutting tool and their measurement; specific cutting energy; plowing force and the "size effect"; mean shear strength of the work material; chip thickness: shear angle theories Merchant and Lee & Shaffer, friction in metal cutting.

Unit 2: Thermal aspects, Tool wear, and Machinability [09 Hours]

Temperature in Metal Cutting: Heat generation in metal cutting; temperature distribution in metal cutting, effect of cutting speed on temperatures, measurement of cutting temperatures.

Tool life and tool wear: progressive tool wear; forms of wear in metal cutting: crater wear, flank wear, tool-life criteria; **Cutting tool materials:** Basic requirements of tool materials, major classes of tool materials: high speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings.

Work material and machinability rating; Cutting fluids.

Unit 3: Abrasive Machining and Finishing Operations [07 Hours]

Introduction; Abrasives and Bonded Abrasives: Grinding Wheels, Bond Types, Wheel Grade and Structure; Grinding Process and its parameters: Grinding forces, specific energy, and temperature; Grinding-wheel wear, Grinding Ratio, Dressing, Truing and Shaping of Grinding Wheels, Grindability of Materials and Wheel Selection; Grinding Operations and Machines, Finishing Operations: Honing, lapping, and superfinishing.

Unit 4: Processing of Powder Metals [07 Hours]

Introduction; Production of Metal Powders: Methods of Powder Production, Particle Size, Shape, and Distribution, Blending Metal Powders; Compaction of Metal Powders: Equipment, Isostatic Pressing, Sintering; Secondary and Finishing Operations.

Unit 5: Processing of Polymers [05 Hours]

Introduction; Extrusion: Miscellaneous Extrusion Processes, Production of Polymer Reinforcing Fibers; Injection Molding: Reaction-injection Molding; Blow Molding; Rotational Molding; Thermoforming; Compression Molding; Transfer Molding; Processing Elastomers.

Texts:

1. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6th edition, 2009.
2. Geoffrey Boothroyd, Winston Knight, "Fundamentals of Machining and Machine Tools", Taylor and Francis, 3rd edition, 2006.

References:

1. Milkell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and ystems", 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.
3. M. C. Shaw, "Theory of Metal Cutting", Oxford and I.B.H. Publishing, 1st edition, 1994

Fluid Mechanics

	Fluid Mechanics		2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture:2hrs./week Tutorial:1hr./week Credits: 3	ContinuousAssessment: 20 Marks MidSemester Exam: 20 Marks EndSemesterExam: 60 Marks (Duration 03hrs.)

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

Strength of Materials

	Strength of Materials		2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture:2hrs./week Tutorial:1hr./week Credits: 3	Continuous Assessment: 20 Marks MidSemester Exam: 20 Marks EndSemesterExam: 60 Marks (Duration 03 hrs.)

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

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

Mapping of course outcomes with program outcomes

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

Course Contents

Unit 1: Simple Stresses and Strains [07 Hours]

Mechanical properties of materials, analysis of internal forces, simple stresses and strains, stressstrain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress,

bulk modulus, shear modulus, relationship between elastic constants. Principal Stresses and Strains, Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principal stresses and principal planes, principal strains, shear strains, strain rosettes.

Unit 2: Strain energy, resilience and Combined Stresses [08 hours]

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

Unit 3: Stresses in Beams [10 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. Torsion: Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

Unit 4: Shear Force and Bending Moment Diagram [10 Hours]

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

Unit 5. Deflection of beams [08 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 areamoment 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.

Text-books

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. 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.

Entrepreneurship Development

	Entrepreneurship Development		2-0-0	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2hrs/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 asianperpective.- 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.

Numerical Methods in Engineering

	Numerical Methods in Engineering		2-0-0	2 Credits

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

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:

Unit1: Error Analysis **[06 Hours]**

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.

Unit2: Roots of Equations **[05 Hours]**

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

Unit3: Numerical Solution of Algebraic Equations **[05 Hours]**

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

Unit4: Numerical Integration and Differentiation **[05 Hours]**

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

Unit5: Curve, Fitting and Interpolation and Computer Programming [06 Hours]

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 McGraw Hill Publications,2010.
2. E. Balagurusamy, "Numerical Methods" Tata McGraw HillPublications,1999.

References:

1. V. Rajaraman, "Fundamental of Computers" Prentice Hall of India,NewDelhi,2003.
2. S. S. Sastri, "Introductory Methods of Numerical Methods", Prentice Hall of India, New Delhi, 3rdedition,2003.
3. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley,1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, Ne

Introduction to Artificial Intelligence

		Artificial Intelligence	2-0-0	3 Credits

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

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

CO 1	Understand the basics of Artificial Intelligence and its historical development.
CO 2	Learn problem-solving techniques using search algorithms and heuristics.
CO 3	Apply logical reasoning and knowledge representation methods in AI.
CO 4	Design intelligent agents capable of planning and acting in uncertain environments.
CO 5	Explore various learning algorithms, including decision trees, neural networks, and reinforcement learning
CO 6	Develop practical applications in natural language processing, image processing, and robotics.

Mapping of course outcomes with program outcomes

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

Course Content:

Unit I: **[06 Hours]**

Artificial Intelligence

Introduction – What is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of The Art. Intelligent Agents – Introduction, How Agents should act, Structure of Intelligent Agents, Environments.

Unit II: **[07 Hours]**

Knowledge and reasoning: Agents that Reason Logically – A Knowledge-Based Agent, the Wumpus World Environment, Representation, Reasoning and Logic, Propositional Logic, First Order Logic – Syntax and Semantics, Extensions and Notational Variations, Using First-Order Logic, Logical Agents for Wumpus World, , General Ontology, the Grocery Shopping World.

Unit III: **[07 Hours]**

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

Unit IV: **[07 Hours]**

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

Unit V: **[07 Hours]**

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

Books Recommended:

1) Artificial Intelligence A Modern Approach – By Stuart J. Russell and Peter Norvig, John F. Canny, Jitendra M. Malik, Douglas D.

2) Artificial Intelligence for Dummies by John Mueller

3) Artificial Intelligence Basics: A Non-Technical Introduction by Tom Taull

Python Programming

		Python Programming	2-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 Hrs./week	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	Read, write, execute by hand simple Python programs
CO2	Structure simple Python programs for solving problems
CO3	Decompose a Python program into functions
CO4	Represent compound data using Python lists, tuples, dictionaries
CO5	Read and write data from/to files in Python Programs

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 TO PYTHON PROGRAMMING **[07 Hours]**

Introduction to the Python Programming Language, Working with Python, Numeric Data Types, String Data Type and Operations, Standard Data Types, Data Type Conversions, Commenting in Python

Unit 2: VARIABLES AND OPERATORS **[07 Hours]**

Understanding Python Variables, Multiple Variable Declarations, Python Basic Statements, Python Basic Operators, Precedence of Operators, Expressions

Unit 3: CONTROL FLOW AND LOOPS **[07 Hours]**

Conditional Statements, Loops in Python, While Loop, Loop Manipulation

Unit 4: FUNCTIONS **[07 Hours]**

Defining Your Own Functions, Calling Functions, Passing Parameters and Arguments, Python Function Arguments, Anonymous Functions (Lambda Functions), Fruitful Functions (Function Returning Values), Scope of Variables in a Function, Powerful Lambda Functions in Python

Unit 4: I/O AND ERROR HANDLING IN PYTHON [07 Hours]
Introduction to I/O (Input/Output), Writing Data to a File, Reading Data from a File, Additional File Methods, Introduction to Errors and Exceptions, Handling I/O Exceptions, Runtime Errors and Handling Multiple Exceptions

Unit 5: CONTROL FLOW AND LOOPS [08 Hours]
Introduction to I/O (Input/Output), Writing Data to a File, Reading Data from a File, Additional File Methods, Introduction to Errors and Exceptions, Handling I/O Exceptions, Runtime Errors and Handling Multiple Exceptions

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

Text Book(s)

1. Core Python Programming" by R. Nageswara Rao (Dreamtech)
2. Think Python: How to Think Like a Computer Scientist" (2nd Edition) by Allen B. Downey (Shroff/O,,Reilly Publishers, 2016)
3. Python Programming: A Modern Approach" by Vamsi Kurama (Pearson)
4. Data Structures and Algorithmic Thinking with Python" by Narasimha Karumanchi

Reference Books

1. "Core Python Programming" by Wesley J. Chun (Pearson)

2. Introduction to Python" by Kenneth A. Lambert (Cengage) "Learning Python" by Mark Lutz (O'Reilly)

Universal Human Values- II

	Universal Human Values- II		3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3hrs/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

3.2 Reference Books

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

Life of Chatrapati Shivaji Maharaj

	Life of Chatrapati Shivaji Maharaj		1-0-0	1 Credits

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

Subject Title: Indian Languages – Marathi

	Indian Languages – Marathi		2-0-0	2 Credits

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

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												

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 Outcomes:

- विद्यार्थी मराठी भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील .
- शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल .
- विविध प्रकारच्या लेखन शैली आत्मसात करून सृजनशील, विश्लेषणात्मक आणि औपचारिक लेखन

करू शकतील .
- अचूक, स्पष्ट आणि भाषिक - सांस्कृतिक दृष्टीकोनातून योग्य भाषांतर करू शकतील .
- व्यावसायिक आणि साहित्यिक भाषांतरात प्रावीण्य मिळवू शकतील .

घटक- १. मराठीचा उगम आणि विकास
- मराठीचा उगम आणि विकास
- मराठी भाषेवर संत परंपरेचा प्रभाव - ज्ञानेश्वर , तुकाराम, नामदेव आणि एकनाथ यांच्या रचनांचा अभ्यास .
- मराठीत बखरी लेखन व 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

Subject Title : Indian Languages – Hindi

	Indian Languages – Hindi		2-0-0	2 Credits

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

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												

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।

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

इकाई - २. स्वातंत्र्योत्तर काल में हिंदी भाषा
- प्रशासन , शिक्षा और संचार माध्यमों में हिंदी की भूमिका
- राजभाषा के रूप में हिंदी– संवैधानिक स्थिती और व्यावहारिक उपयोग
- हिंदी का वैश्वीक विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिती
- प्रशासन और संचार माध्यमों में हिंदी

इकाई - ३. हिंदी भाषा लेखन के नियम और व्याकरण
- वर्णमाला
- शब्द-भेद
- संधि
- वाक्य रचना
- वर्तनी
- उपसर्ग , प्रत्यय और शब्द निर्माण की प्रक्रिया
- विराम चिन्हों का प्रयोग
- पर्यायवाची शब्द
- विलोम शब्द

इकाई - ४. लेखन कौशल
- पत्र लेखन
- प्रतिवेदन (रिपोर्ट) लेखन
- विज्ञाप्ती , नोटीस और परिपत्र लेखन
- निबंध लेखन
- सार लेखन

इकाई - ५. अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी)
- अनुवाद : सिद्धांत और परंपरा
- अनुवाद : क्षेत्र, प्रकार
- पारिभातषक शब्दावली
- अंग्रेजी से हिंदीऔर हिंदीसे अंग्रेजी अनुवाद

संदर्भ ग्रंथ:

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

Subject Title: Indian Languages – Sanskrit

	Indian Languages – Sanskrit		2-0-0	2 Credits

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												

Course Objectives:

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

Course Outcomes:

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

1. Introduction to Sanskrit

- Importance and history of Sanskrit
- Sanskrit alphabets (Varnamala)

- Swaras (Vowels)
- Vyanjanas (Consonants)
- Pronunciation and script (Devanagari)

2. Basic Grammar

- Nouns, pronouns, Grammatical numbers, Grammatical genders, Grammatical person
- Verbs, Tenses, Sandhi (Combination of letters)
  Karaka (Case system) – Nominative, Accusative, Instrumental, etc.
- Vibhakti (Declensions of nouns and pronouns)
- Linga (Gender: Masculine, Feminine, Neuter)
- Vakya Rachana (Sentence construction)

3. Simple Vocabulary and Sentence Formation

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

4. Selected Sanskrit Shlokas and Subhashitas

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

5. Reading and Writing Practice

- Reading simple Sanskrit texts

Writing small paragraphs in Sanskrit

Workshop Practices II

	Workshop Practices II		0-0-2	1 Credit

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

Course Description:
This course is designed to make aware the students about different machining processes and understand the effect of sped, feed depth of cut. Also they will learn Welding processes and the parameters associated with welding process.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Demonstrate effect of variables such as speed, feed and depth of cut on machining process
2. Produce given joint by MIG welding process.
3. Produce welding run on S.S. by TIG welding.
4. Produce given job with proper taper and V threading within dimensional tolerances ±0.2 m.m. on diameter and ± 0.5 m.m. on length. (Job-A)

List of Experiments:	**1. Advance Welding Shop**	**2. Lathe Operations**
	One Job TIG Welding. One Job MIG Welding. Demonstration of Stainless Steel & Aluminum Welding. One Job Stainless Steel Welding One Job Aluminum Welding Job on Plasma Arc Cutting Job on Submerged Arc Welding. Job on Soldering Job on Brazing	Job Involving Tool Grinding, Job Involving Facing, Step Turning, Taper Turning, Knurling & 'V' Threading Operations

Reference Books: -
1) Hajra Choudhary, Element of Workshop Technology vol. II, Media promoters and Publications, 8th edition, 1992.
2) Hajra Choudhary, Element of Workshop Technology vol. 1, Media promoters and Publications, 8th edition, 1992.
3) Raghuvansrii, Workshop Technology, vol. II, Dhanpat Rai, 9th Edition, 2006
4) WA. J. Chapman, Workshop Technology, Part II, Oxford and IBH publishing Co., 4th Edition, 1986.
W A. J. Chapman, Workshop Technology, Part II, Oxford and IBH publishing Co., 5th Edition, 1986.

Fluid Mechanics Lab

	Fluid Mechanics Lab		0-0-2	1 Credit

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.

Strength of Materials Lab

	Strength of Materials Lab		0-0-2	1 Credit

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.