



SRI VENKATESWARA COLLEGE OF ENGINEERING,
(An Autonomous Institution, Affiliated to Anna University, Chennai – 600025)

B.E., Mechanical Engineering

CURRICULUM AND SYLLABUS

REGULATION – 2022

CHOICE BASED CREDIT SYSTEM

| Curriculum Revision No: | 00 | Board of Studies recommendation date : | Academic Council Approved date: | |
|--------------------------------|-----|---|---------------------------------|--|
| Salient Points of the revision | 01. | The courses "Scientific Thoughts in Tamil" in Semester I and "Heritage of Tamil" in Semester II are introduced as per the recommendations of Anna University/Government of Tamil Nadu. | | |
| | 02. | In the subject Engineering Drawing the topic "Intersection of surfaces has been included to have a better visualization of interpenetrated surfaces. | | |
| | 03. | In the course "Production Drawing Laboratory", instead of giving the assembly drawing sheet, the cut section of the model will be given where the students have to physically measure the dimensions of the component and also do the 2D drafting using AutoCAD / Fusion 360. This will enable the students to enrich their measuring skills and also will gain skill in various tolerances | | |
| | 04. | Analytical calculations have been included in the Manufacturing Processes | | |
| | 05. | The Manufacturing processes theory and laboratory is taught in II semester itself. | | |

SRI VENKATESWARA COLLEGE OF ENGINEERING,
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REGULATIONS 2022

B.E. MECHANICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES(PEOs)

- I. The graduates of Mechanical Engineering program will possess technical knowledge, skill and ethical values for working effectively as individual or team member in their career and reach higher technical, Managerial or leadership role offering solutions to engineering, environmental and societal issues in reputed organizations.
- II. The graduates of the Mechanical Engineering program will acquire higher education and emerge successful.
- III. The graduates of the Mechanical Engineering program will venture into entrepreneurship and become job creators.

PROGRAM OUTCOMES(POs)

PO PROGRAM OUTCOMES

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, review research literature, and analyse 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 approx. consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** User 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 modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practices.
7. **Environment and sustainability:** Understand the impact of 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 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 independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES(PSOs)

1. Apply the knowledge of applied mathematics and industrial standards to design, model and analyze the machine elements and systems in the field of Mechanical Engineering using latest tools.
2. Apply the knowledge of various processes in manufacturing and industrial engineering practices for the fabrication of various engineering components.
3. Apply the knowledge acquired in the field of thermal science to solve the engineering problems related to design of thermal equipment and evaluating their performance.

PEO's-PO's & PSO's MAPPING:

| | | PEOs | | |
|-----|-----|------|----|-----|
| | | I | II | III |
| PO | 1. | ✓ | | |
| | 2. | | ✓ | |
| | 3. | | | ✓ |
| | 4. | | ✓ | ✓ |
| | 5. | ✓ | ✓ | |
| | 6. | | ✓ | ✓ |
| | 7. | | ✓ | |
| | 8. | | ✓ | |
| | 9. | | | ✓ |
| | 10. | | ✓ | |
| | 11. | | ✓ | |
| | 12. | ✓ | | |
| PSO | 1. | | | ✓ |
| | 2. | ✓ | | |
| | 3. | ✓ | | ✓ |

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REGULATIONS 2022
CHOICE BASED CREDIT SYSTEM

B.E. MECHANICAL ENGINEERING

CURRICULUM AND SYLLABI FOR SEMESTERS I AND II

SEMESTER I

| SL. NO. | COURSE CODE | COURSE TITLE | CATEG ORY# | PERIODS PER WEEK | | | | TOTAL Hours | Prereq uisite | Position |
|---------------------------|-------------|--|---------------|------------------|----------|----------|-------------|-------------|------------------|----------|
| | | | | L | T | P | C | | | |
| 1. | IP22151 | Induction Program | - | - | - | - | - | - | - | - |
| Theory Subjects | | | | | | | | | | |
| 2. | HS22151 | Tamil Language and Heritage of Tamil Society (Common to all Branches) | HS | 1 | 0 | 0 | 1 | 1 | Nil | F |
| 3. | HS22152 | Communicative English (Common to all Branches) | HS | 3 | 0 | 0 | 3 | 3 | Nil | F |
| 4. | MA22151 | Applied Mathematics – I (Common to all Branches except MR) | BS | 3 | 1 | 0 | 4 | 4 | Nil | F |
| 5. | PH22152 | Engineering Physics (Common to AE, CE, ME, MN, MR) | BS | 3 | 0 | 0 | 3 | 3 | Nil | F |
| 6. | CY22152 | Engineering Chemistry (Common to AE, ME, MN) | BS | 3 | 0 | 0 | 3 | 3 | Nil | F |
| 7. | CS22151 | Programming in C (Common to ME, MN) | ES | 3 | 0 | 0 | 3 | 3 | Nil | F |
| 8. | ME22101 | Engineering drawing (Common to ME, MN, MR) | ES | 2 | 0 | 2 | 3 | 4 | Nil | F |
| Practical Subjects | | | | | | | | | | |
| 9. | PH22161 | Physics Laboratory (Common to all Branches except BT) | BS | 0 | 0 | 2 | 1 | 2 | Nil | F |
| 10. | CY22161 | Chemistry Laboratory (Common to all Branches except AD, CS, IT) | BS | 0 | 0 | 2 | 1 | 2 | Nil | F |
| 11. | CS22161 | Programming in C Laboratory (Common to ME, MN) | ES | 0 | 0 | 3 | 1.5 | 3 | Nil | F |
| Total | | | | 18 | 1 | 9 | 23.5 | 28 | | |

SEMESTER II

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY# | PERIODS PER WEEK | | | | TOTAL Hours | Prerequisite | Position |
|---------------------------|-------------|--|-----------|------------------|----------|----------|-------------|-------------|--------------|----------|
| | | | | L | T | P | C | | | |
| Theory Subjects | | | | | | | | | | |
| 1. | HS22251 | Science and Technology in Ancient Tamil Society (Common to all Branches) | HS | 2 | 0 | 0 | 2 | 2 | Nil | F |
| 2. | HS22252 | Technical English (Common to all Branches) | HS | 3 | 0 | 0 | 3 | 3 | Nil | F |
| 3. | MA22251 | Applied Mathematics – II (Common to all Branches except MR) | BS | 3 | 1 | 0 | 4 | 4 | Nil | F |
| 4. | PH22253 | Engineering Materials (Common to AE, ME, MN) | BS | 3 | 0 | 0 | 3 | 3 | Nil | F |
| 5. | ME22201 | Engineering Mechanics (Common to ME, MN, MR) | ES | 2 | 1 | 0 | 3 | 3 | Nil | F |
| 6. | EE22151 | Basic Electrical and Electronics Engineering (Common to all Branches except CH, EE, EC) | ES | 3 | 0 | 0 | 3 | 3 | Nil | F |
| 7. | ME22202 | Manufacturing Processes | PC | 3 | 0 | 0 | 3 | 3 | Nil | F |
| Practical Subjects | | | | | | | | | | |
| 8. | ME22211 | Production Drawing Laboratory (Common to ME, MN) | ES | 0 | 0 | 4 | 2 | 4 | Nil | F |
| 9. | ME22212 | Manufacturing Processes Laboratory | PC | 0 | 0 | 3 | 1.5 | 3 | Nil | F |
| 10. | EE22111 | Basic Electrical and Electronics Engineering Laboratory (Common to all Branches except EC) | ES | 0 | 0 | 2 | 1 | 2 | Nil | F |
| Total | | | | 19 | 2 | 9 | 25.5 | 30 | | |

SEMESTER III

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY# | PERIODS PER WEEK | | | | TOTAL Hours | Pre requisite | Position |
|--------------|-------------|---|-----------|------------------|----------|-----------|-----------|-------------|---------------|----------|
| | | | | L | T | P | C | | | |
| 1. | MA22357 | Transforms and Differential Equations | BS | 3 | 1 | 0 | 4 | 4 | NIL | F |
| 2. | ME22301 | Engineering Thermodynamics | PC | 2 | 1 | 0 | 3 | 3 | NIL | F |
| 3. | EE22359 | Electrical Drives and Control: Theory and Practices (Common to ME and MN) | ES | 2 | 0 | 2 | 3 | 4 | NIL | F |
| 4. | ME22302 | Mechanics of Materials (Common to ME and MN) | PC | 2 | 1 | 0 | 3 | 3 | NIL | F |
| 5. | ME22303 | Machine Tools Operations | PC | 3 | 0 | 0 | 3 | 3 | NIL | F |
| 6. | ME22309 | Industrial Metallurgy: Theory and Practices | PC | 2 | 0 | 2 | 3 | 4 | NIL | F |
| 7. | ME22311 | Machine Tools Operations Laboratory | PC | 0 | 0 | 3 | 1.5 | 3 | NIL | F |
| 8. | ME22312 | Mechanics of Materials Laboratory | PC | 0 | 0 | 3 | 1.5 | 3 | NIL | F |
| Total | | | | 14 | 3 | 10 | 22 | 27 | | |

SEMESTER IV

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY# | PERIODS PER WEEK | | | | TOTAL Hours | Pre requisite | Position |
|--------------|-------------|---|-----------|------------------|----------|-----------|-----------|-------------|---------------|----------|
| | | | | L | T | P | C | | | |
| 1. | ME22401 | Fluid Mechanics | PC | 2 | 1 | 0 | 3 | 3 | NIL | F |
| 2. | ME22402 | Kinematics of Machinery | PC | 2 | 1 | 0 | 3 | 3 | NIL | F |
| 3. | ME22403 | Thermal Engineering | PC | 2 | 1 | 0 | 3 | 3 | ME22301 | F |
| 4. | GE22451 | Environmental Science and Sustainability (Common to all Branches) | BS | 3 | 0 | 0 | 3 | 3 | NIL | F |
| 5. | MN22408 | Hydraulics and Pneumatics for Automation: Theory and Practices (Common to ME and MN) | PC | 2 | 0 | 2 | 3 | 4 | NIL | F |
| 6. | ME22409 | Design Thinking: Theory and Practices | EEC | 1 | 0 | 2 | 2 | 3 | NIL | M |
| 7. | ME22411 | Computer Aided Modeling Laboratory (Common to ME and MN) | PC | 0 | 0 | 3 | 1.5 | 3 | NIL | F |
| 8. | ME22412 | Fluid and Thermal Engineering Laboratory (Common to ME and MN) | PC | 0 | 0 | 3 | 1.5 | 3 | NIL | F |
| 9. | ME22413 | Comprehension I | EEC | 1 | 0 | 0 | 1 | 1 | NIL | F |
| Total | | | | 13 | 3 | 10 | 21 | 26 | | |

| SL. NO. | CATEGORY | CREDITS IN SEMESTER | | | | | | | | Total Credits |
|---------|--|---------------------|------|-----|----|----|-----|-----|------|---------------|
| | | I | II | III | IV | V | VI | VII | VIII | |
| 1 | Humanities and Social Sciences including Management courses (HS) | 4 | 5 | | | | | 3 | | 12 |
| 2 | Basic Science courses (BS) | 12 | 7 | 4 | 3 | | | | | 26 |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc (ES) | 7.5 | 9 | 3 | | | | | | 19.5 |
| 4 | Professional Core courses (PC) | | 4.5 | 15 | 15 | 15 | 7.5 | 11 | | 68 |
| 5 | Professional Elective courses relevant to chosen specialization/branch (PE) | | | | | 3 | 9 | 6 | | 18 |
| 6 | Open Elective subjects - Electives from other technical and /or emerging subjects (OE) | | | | | 3 | 3 | | | 6 |
| 7 | Project work, seminar, and internship in industry or elsewhere (EE) | | | | 3 | | 2.5 | 2 | 10 | 17.5 |
| 8 | Mandatory Courses (MC) | | | | | 0 | | | | 0 |
| | Semester wise Total | 23.5 | 25.5 | 22 | 21 | 21 | 22 | 22 | 10 | 167 |



**SYLLABUS
SEMESTER I**

தமிழ் மொழியும் தமிழர் மரபும்
HS22151 **Tamil Language and Heritage of Ancient Tamil Society**
(Common to all Branches)

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 0 | 1 |

பாடத்தின் நோக்கங்கள்:

1. தமிழ் மொழியின் தோற்றம் பற்றியும், திணை கருத்துக்கள் வாயிலாக வாழ்வியல் முறைகளை பற்றியும் கற்றுக் கொள்வார்கள்.
2. இந்திய தேசிய சுதந்திர இயக்கத்தில் தமிழர்களின் பங்களிப்பு மற்றும் தமிழர்களின் மேலாண்மை முறைகளை பற்றியும் கற்றுக் கொள்வார்கள்.

அலகு 1 தமிழுக்கும் தொழில் நுட்ப கல்விக்கும் உள்ள தொடர்பு 3
மொழி மற்றும் பாரம்பரியம்: இந்தியாவில் உள்ள மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழில் செம்மொழி இலக்கியம் - உ.வே. சுவாமிநாத ஐயர்., ஆறுமுக நாவலர் ஆகியோரின் பங்களிப்பு - தொழில் நுட்ப கல்வியில் தமிழ் மொழிக் கல்வியின் முக்கியத்துவம்.

LANGUAGE AND HERITAGE: Language families in India – Dravidan Languages – Tamil as a Classical language – Classical Literature in Tamil – Contribution of U. Ve. Saminathaiyar. Arumuka Navalar – Importance of Tamil language in technical education.

அலகு 2 திணை கருத்துக்கள் 9
திணை கருத்துக்கள்: ஐந்து வகை நிலங்கள், தமிழர்களின் தாவரங்கள் மற்றும் விலங்கினங்கள், கடவுள்கள், தொழில்கள், வாழ்க்கை முறை, பண், கூத்து, உணவு முறை - தொல்காப்பியம் மற்றும் சங்க இலக்கியங்களில் இருந்து அகம் மற்றும் புறம் கருத்து - தமிழ் அறம் கருத்து - சங்க காலத்தில் கல்வி மற்றும் எழுத்தறிவு - பண்டைய நகரங்கள் மற்றும் சங்க காலத்தில் துறைமுகங்கள் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - சோழ மன்னர்களின் வெளிநாட்டு வெற்றிகள்.

THINAI CONCEPTS: Five types of lands, animals, Gods, occupation, life styles, music, dance, food style, Floara and Fauna of Tamils - Agam and puram concept from Tholkappiyam and Sangam Literature – Aram concept of Tamil – Education and Literacy during Sangam Age – Ancient cities and Ports of Sangam Age – Export and Import during Sangam Age - Overseas Conquest of Choloas.

அலகு 3 தமிழரின் மரபு 3
இந்திய தேசிய சுதந்திர இயக்கம் மற்றும் இந்திய கலாச்சாரத்திற்கு தமிழர்களின் பங்களிப்பு: சுப்ரமணிய பாரதி, வாஞ்சிநாதன், சுப்பிரமணிய சிவா, வீரபாண்டிய கட்டபொம்மன், வா. ஊ. சிதம்பரம் பிள்ளை, தீரன் சின்னமலை, மருது பாண்டிய சகோதரர்கள், பூலி தேவர், திருப்பூர் குமரன், வீர மங்கை வேலுநாச்சியார் - தமிழர் இலக்கியங்களில் மேலாண்மை கருத்துக்கள் (கி. மு. 500 முதல் கி. பி 200 வரை) – அகநானூறு, புறநானூறு.

திருக்குறள் ஆகியவற்றில் மேலாண்மைக் கருத்துகள்.

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL FREEDOM MOVEMENT AND INDIAN CULTURE:

Contributions of Subramanya Bharathi, Vanchinathan, Subramaniya Siva, Veerapandiya Kattabomman, V O Chidambaram Pillai, Dheeran Chinnamalai, The Maruthu Pandiyar, Puli Thevar, Tiruppur Kumaran, Veera Mangai Velunachiyar.

மொத்தம்: 15 காலங்கள்

| பா .வெ . எண் | பாட திட்டத்தின் வெளிப்பாடு |
|-----------------|---|
| CO1 | மாணவர்கள் தமிழ் மொழி தோற்றம் பற்றி தெரிந்து கொள்வார்கள் |
| CO2 | தமிழர்களின் வாழ்வியல் முறைகளை தெரிந்து கொள்வார்கள் |
| CO3 | தமிழர்களின் சுதந்திர போராட்ட வீரர்களை பற்றியும், மேலாண்மை முறைகளை பற்றியும் தெரிந்து கொள்வார்கள் |

பாட நூல்கள்:

1. பொன். முத்துகுமாரன் (2002), “**தமிழ் மரபு**”, காந்தளகம், 68, அண்ணா சாலை, சென்னை 600 002.
2. பி. டி ஸ்ரீனிவாச ஐயங்கார் (**தமிழக்கமும் திறனாய்வும்**) புலவர் கா. கோவிந்தன் (1988), “**தமிழர் வரலாறு (முதல் பகுதி)**”, திருநெல்வேலி தென்னிந்திய சைவ சித்தாந்த நூற்பதிப்பு கழகம் ,154, TTK சாலை, சென்னை 18.
3. டாக்டர் கே கே பிள்ளை (2009), “**தமிழக வரலாறு மக்களும் பண்பாடும்**”, உலக தமிழாராய்ச்சி நிறுவனம், தரமணி , சென்னை 600113.
4. முனைவர். ச. இராஜேந்திரன் (2004), “**தமிழில் சொல்லாக்கம்**”, தஞ்சாவூர் தமிழ் பல்கலைக் கழகம் வெளியீடு.

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

COURSE OBJECTIVES:

1. Enable learners to interact fluently on everyday social contexts.
2. Train learners to engage in conversations in an academic/scholarly setting.
3. Instill confidence in learners to overcome public speaking barriers.
4. Develop learners' ability to take notes and in the process, improve their listening skills
5. Enhance learners' reading skill through reading text passages for comprehension and contemplation.
6. Improve learners' skills to write on topics of general interest and drafting correspondences for general purposes

UNIT I**19**

Listening - short video clips - conversational scenes from movies, celebrities' speeches/interviews. Speaking - several ways of introducing oneself at several situations, introducing others at several situations, inviting people for several occasions, describing people and their places. Reading - short comprehension passages - making inferences, critical analysis. Writing - completing the incomplete sentences - developing hints from the given information. Grammar - Why-Questions and Yes or No questions - Parts of speech. Vocabulary development - prefixes - suffixes - articles - countable / uncountable nouns.

UNIT II**9**

Listening - customer care voice files, short narratives - identifying problems and developing telephone etiquettes. Speaking - speaking over skype/WhatsApp, making business calls, making self-recorded informative videos, inquiring about a concept/activity, describing a concept/activity. Reading - reading the headlines on news magazines - slogans and taglines from advertisements. Writing - free writing - writing - headlines, slogans and taglines individual inspirations. Grammar - conjunctions, idioms, phrases, quotes. Vocabulary development - guessing the meanings of words in various different contexts

UNIT III**9**

Listening - courtroom scenes from movies, debates and talks from news channels, notes taking. Speaking - language and tone for arguments, discussion, deliberation, contemplation, expressing opinions, reacting to different situations in an alien country. Reading - language used in instruction manuals of household appliances, cookery and other basic instructions. Writing- understanding the structure of texts - use of reference words, discourse markers-coherence, rearranging the jumbled sentences. Grammar - adjectives - degrees of comparison, framing direct and indirect questions. Vocabulary development - concise approach, single word substitution.

UNIT IV**9**

Listening - Sports commentaries, advertisements with users' criticisms; Speaking - for social causes, for promoting a concept, negotiating and bargaining; Reading - review of a product, movie, movement or a system; Writing - writing for advertisements, selling a product; Grammar - Tenses - Simple Past, Present and Future, Continuous - Past, Present and Future; Vocabulary Development - synonyms, antonyms and phrasal verbs.

UNIT V**9**

Listening - video lectures, video demonstration of a concept; Speaking - presenting papers/concepts, delivering short speeches, discourses on health, suggesting natural home remedies, cleanliness, civic sense and responsibilities; Reading - columns and articles on home science; Writing - correspondences of requests, basic enquiry/observation and basic complaints; Grammar - modal verbs, perfect tenses - Vocabulary development - collocations.

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Acquire adequate vocabulary for effective communication | 3 |
| CO2 | Listen to formal and informal communication and read articles and infer meanings from specific contexts from magazines and news papers. | 3 |
| CO3 | Participate effectively in informal/casual conversations; introduce themselves and their friends and express opinions in English. | 4 |
| CO4 | Comprehend conversations and short talks delivered in English. | 6 |
| CO5 | Write short write-ups and personal letters and emails in English | 6 |

REFERENCES:

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers". Orient Black Swan, Chennai, 2017.
2. Downes, Colm, "Cambridge English for Job-hunting", Cambridge University Press, New Delhi. 2008.
3. Murphy, Raymond, "Intermediate English Grammar with Answers", Cambridge University Press 2000.
4. Thomson, A.J., "Practical English Grammar 1 & 2", Oxford, 1986.

E-RESOURCES:

1. <http://www.usingenglish.com>
2. <http://www.uefap.com3>
3. <https://owl.english.purdue.edu/owl/>
4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

SOFTWARE:

1. Face2Face Advance – Cambridge University Press, 2014
2. English Advance Vocabulary- Cambridge University Press
3. IELTS test preparation – Cambridge University Press 2017
4. Official Guide to the TOEFL Test with CD-ROM, 4th Edition
5. CAMBRIDGE Preparation for the TOEFL TEST- Cambridge University Press, 2017

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|------------------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | | | | | | | | | | 3 | | | | | |
| 2 | | | | | | | | | | 3 | | | | | |
| 3 | | | | | | | | | | 3 | | | | | |
| 4 | | | | | | | | | | 3 | | | | | |
| 5 | | | | | | | | | | 3 | | | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 3 | 1 | 0 | 4 |

COURSE OBJECTIVES:

1. Compute Eigen values and Eigen vectors and use in diagonalization and in classifying real quadratic forms.
2. Study differential calculus and its applications to relevant Engineering problems.
3. Compute derivatives using the chain rule or total differentials.
4. Understand the rotation of two-dimensional geometry using definite integrals.
5. Acquaint with the Mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES**12**

Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Diagonalization of matrices - Reduction of a quadratic form into canonical form by orthogonal transformation - Nature of quadratic forms.

UNIT II APPLICATION OF DIFFERENTIAL CALCULUS**12**

Curvature and radius of Curvature - Centre curvature - Circle of curvature - Evolutes - Envelopes - Evolute as Envelope of Normals.

UNIT III DIFFERENTIAL CALCULUS FOR SEVERAL VARIABLES**12**

Limits and Continuity - Partial derivatives - Total derivatives - Differentiation of implicit functions - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT IV APPLICATION OF DEFINITE INTEGRALS**12**

Integration by Parts - Bernoulli's formula for integration - Definite integrals and its Properties - Solids of Revolution - Disk Method - Washer Method- Rotation about both x and y axis and Shell method.

UNIT V MULTIPLE INTEGRALS**12**

Double integrals in Cartesian and polar coordinates - Change of order of integration - Area enclosed by plane curves - Change of variables in double integrals - Triple integrals - Volume of solids.

TOTAL: 60 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|---|------------------|
| At the end of the course, students will be able to: | | |
| CO1 | Solve the Eigen value problems in matrices. | 3 |
| CO2 | Apply the basic notion of calculus in Engineering problems and to tackle for different geometries. | 3 |
| CO3 | Perform calculus for more than one variable and its applications in Engineering problems. | 3 |
| CO4 | Apply definite integrals for design of three-dimensional components. | 3 |
| CO5 | Evaluate multiple integral in Cartesian and polar coordinates. | 3 |

TEXTBOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.

2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2018.

REFERENCES:

1. Bali. N.P, and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd., 2014.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016.
3. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2013.

E-RESOURCES:

1. <https://home.iitk.ac.in/~peeyush/102A/Lecture-notes.pdf>
2. <https://www.sydney.edu.au/content/dam/students/documents/mathematics-learning-entre/integration-definite-integral.pdf>
3. <https://home.iitk.ac.in/~peeyush/102A/Lecture-notes.pdf>

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|-----------------------------|-----|---|--|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | | | 2 | | | | | | | | | | | |
| 2 | 3 | 2 | | 2 | | | | | | | | | | | |
| 3 | 3 | 2 | | 2 | | | | | | | | | | | |
| 4 | 3 | | | 1 | | | | | | | | | | | |
| 5 | 3 | | | 2 | | | | | | | | | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| | | | |
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| L | T | P | C |
| 3 | 0 | 0 | 3 |

COURSE OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to Streams of Engineering.

UNIT I MECHANICS**9**

Moment of inertia (M.I) - Radius of gyration - Theorems of M. I - M.I of circular disc, solid cylinder, hollow cylinder, solid sphere and hollow sphere - K.E of a rotating body - M.I of a diatomic molecule - Rotational energy state of a rigid diatomic molecule - centre of mass - conservation of linear momentum - Relation between Torque and angular momentum - Torsional pendulum.

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS**9**

Fluid - definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers-forces on planes - centre of pressure - buoyancy and floatation.

Modes of heat transfer - thermal conductivity - Newton's law of cooling - Linear heat flow - Lee's disc method - Radial heat flow - Rubber tube method - conduction through compound media (series and parallel).

UNIT III ACOUSTICS AND ULTRASONICS**9**

Classification of Sound- decibel- Weber–Fechner law - Sabine's formula- derivation using growth and decay method - Absorption Coefficient and its determination –factors affecting Acoustics of buildings and their remedies. Production of Ultrasonics by Magnetostriction and Piezoelectric methods - Acoustic grating - Non-Destructive Testing - pulse echo system through transmission and reflection modes - A, B and C - scan displays, medical applications - Sonogram.

UNIT IV PHOTONICS AND FIBER OPTICS**9**

Photonics: population of energy levels, Einstein's A and B coefficients derivation - resonant cavity, optical amplification (qualitative) - Nd-YAG laser - CO₂ Laser - Applications. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, and mode) - losses associated with optical fibers - Fiber optic communication - fibre optic sensors: pressure and displacement- Endoscope.

UNIT V CRYSTAL PHYSICS**9**

Single crystalline, polycrystalline and amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - interplanar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structure (qualitative) – crystal imperfections: point defects, line defects - Burger vectors, stacking fault.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Gain knowledge in Mechanics | 2 |
| CO2 | Evaluate the concepts of properties of matter and thermal physics. | 3 |
| CO3 | Learn to solve the issues related to defects in the buildings due to acoustic design and the significance of ultrasonic waves. | 3 |
| CO4 | Develop an understanding about photonics and Fiber Optic communication system. | 2 |

| | | |
|------------|--|----------|
| CO5 | Classify and demonstrate the fundamentals of crystals and their defects. | 3 |
|------------|--|----------|

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L, "Engineering Physics", Dhanput Publications, 2015.
2. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson, 2006.
3. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
4. Arumugam M, "Materials Science", Anuradha Publications, 2015

REFERENCES:

1. David Halliday, Robert Resnick, Jearl Walker, "Principles of Physics", 10th Edition, Wiley,2015.
2. Peter Atkins and Julio De Paula, "Physical Chemistry", 10th Edition, Oxford University Press,2014.
3. Arthur Beiser, Shobhit Mahajan, Rai Choudhury S, "Concepts of Modern Physics", 7th Edition, McGraw Hill Education, 2017.
4. Raghavan V, "Materials Science and Engineering", PHI Learning Pvt. Ltd., 2010.

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|------------------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | | 2 | | | | | | 1 | | | | | |
| 2 | 3 | 2 | | 2 | | | | | | 1 | | 2 | | | |
| 3 | 3 | | 2 | | 3 | 2 | 1 | | | 1 | | | | | |
| 4 | 3 | | 2 | | 3 | 2 | 1 | | | 1 | | 2 | | | |
| 5 | 3 | 2 | 2 | | | | | | | 1 | | | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 3 | 0 | 0 | 3 |

COURSE OBJECTIVES:

1. To make the students to understand the importance of electrochemistry.
2. To appreciate the concepts of photochemistry and spectroscopy.
3. To impart knowledge on nanotechnology.
4. To understand the applications of engineering materials.
5. To familiarize the manufacture of fuels.

UNIT I ELECTROCHEMISTRY**9**

Electrodes and electrochemical cells - electrode potential, standard electrode potential, single electrode potential and its determination, types of electrodes - calomel, quinhydrone and glass electrode. Nernst equation - determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Batteries - Primary (dry battery) and secondary batteries (Lead - acid storage)

UNIT II PHOTOCHEMISTRY**9**

Laws of photochemistry - Grothuss-Draper law, Stark-Einstein law and Lambert Beer Law - determination iron by spectrophotometer. Quantum efficiency - Photo physical processes - internal conversion, inter-system crossing, fluorescence, phosphorescence and photo-sensitization-quenching of fluorescence and its kinetics, Stern-Volmer relationship. Applications of photochemistry.

UNIT III NANOCHEMISTRY**9**

Basics and scale of nanotechnology, different classes of nanomaterials, Distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Synthesis of nanomaterials, fabrication (lithography) and its applications - Basics of nanophononics and quantum confined materials (surface plasmon resonance).

UNIT IV ENGINEERING MATERIALS**9**

Abrasives: definition, classification, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties - refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Lubricants – classification, properties and applications. Basics of composite materials, properties and applications.

UNIT V FUELS AND COMBUSTION**9**

Fuel: Introduction - classification of fuels- calorific value - higher and lower calorific values - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - refining - manufacture of synthetic petrol (Bergius process)- knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - producer gas - water gas. Combustion of fuels: introduction - theoretical calculation of calorific value - calculation of stoichiometry of fuel and air ratio - flue gas analysis (ORSAT Method) - Uses of catalytic converters.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|------------------|
| At the end of the course, students will be able to: | | |
| CO1 | Identify electrochemical cells, corrosion and fundamental aspects of batteries | 2 |
| CO2 | Interpret the photochemical reactions and make use of spectroscopic | 2 |
| CO3 | Realize the structures, properties and applications of nanoparticles. | 2 |
| CO4 | Acquire knowledge on the basic properties of engineering materials and its | 2 |

| | | |
|------------|---|----------|
| | applications | |
| CO5 | Illustrate the various materials that are important both in industry and domestic | 3 |

TEXTBOOKS:

1. P.C. Jain and Monica Jain, "Engineering Chemistry", Dhanpet Rai & Sons, New Delhi, 17th Edition, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008

REFERENCES:

1. Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania., "Principles of Physical Chemistry", 47th edition, Vishal Publishing C., Jalandhar 2018.
3. P.L. Sony and H.M.Chawla, "Text Book of Organic Chemistry", Sultan Chand and Sons Publishers, New Delhi, 2000.

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|----------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 2 | 3 | | | | | | | | 3 | | | |
| 2 | 3 | 3 | | | | 3 | 3 | | | | | 3 | | | |
| 3 | 3 | 3 | 2 | | | 3 | 3 | 3 | | | | 3 | | | |
| 4 | 3 | 3 | | 3 | | | 3 | 3 | | | | 3 | | | |
| 5 | 3 | 3 | | 3 | | 3 | | 3 | | | | 3 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 3 | 0 | 0 | 3 |

COURSE OBJECTIVES:

1. Learn the basics of computers.
2. Learn the different ways of stating algorithms – step-form, Pseudocode and flow chart
3. Learn the logical operators and expressions to solve problems in engineering and real-time
4. Learn about decision type and looping type control constructs in C
5. Understand to store, manipulate and retrieve data in a single and multidimensional array
6. Understand about function and its benefits.
7. Learn to use arrays, strings, functions, pointers, structures, unions and files in C.

UNIT I INTRODUCTION**9**

Number System Conversion, Computer, Evolution of Computers, Anatomy of Computer - Hardware - Software - Data Representation, Memory Unit, Operating Systems, Computer Networks - Basic elements - Data Transmission mode – Data Transmission Media - Network Topology - Network Devices - Communication Networks (LAN,WAN,MAN), Internet – Uses –Advantages – Limitations - Services (Email, FTP, Telnet), Introduction to Programming, Algorithms and Flow Chart.

UNIT II C PROGRAMMING BASICS**9**

Introduction to ‘C’ programming – Developing program in C, A Simple C Program, Structure of a C program, Concept of a Variable, Data Types in C, Tokens, Operators and Expressions, Type Conversions, Input and Output functions, Control Statements – Conditional Execution and Selection – Iterative and Repetitive Execution – Nested Loops, Solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS**9**

One dimensional Array – Declaration - Initialization of Integer Elements - Accessing Array Elements, Searching and Sorting of array elements, Two dimensional arrays – Declaration - Initialization of Integer Elements - Accessing Array Elements, Addition, Subtraction and Multiplication of two dimensional integer elements, Strings, Arrays of strings, Solve problems with and without using string functions.

UNIT IV FUNCTIONS AND USER DEFINED DATA TYPES**9**

Concept of Function, Using Functions, Mechanism - Call by value, Call by reference, Recursion, - Structures, Unions, Enumerators.

UNIT V POINTERS AND FILES**9**

Understanding Memory Address, Address Operator, Pointers, void Pointer, NULL Pointer, Arrays and Pointers, Pointers arithmetic, Double Pointers, Using Files in C, Working with Text Files, Sequential and Random Access to Files.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|---|------------------|
| At the end of the course, students will be able to: | | |
| CO1 | Apply various problem-solving techniques and represent solutions in the form of algorithms and flow charts. | 2 |
| CO2 | Able to write C programs using the control statements of C language for simple | 2 |
| CO3 | Develop programs using of array and string operations to solve problems. | 2 |
| CO4 | Create user-defined functions , structures and unions to perform a task. | 2 |
| CO5 | Use file operations to store and retrieve data | 1 |

TEXTBOOKS:

1. Pradip Dey, Manas Ghosh, "Programming in C", First Edition, Oxford University Press, 2018.

REFERENCES:

1. Ashok N Kamthane, "Programming in C", Third Edition, Pearson, 2015
2. Kernighan, B.W and Ritchie, D.M, "The C Programming language", 2nd Edition, Pearson Education, 2015.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.
4. Paul J Deitel, Dr. Harvey M. Deitel, "C How to Program", 7th Edition, Pearson Education, 2016.

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 3 | 3 | 1 | | | | | | | 1 | | | | |
| 2 | 1 | 1 | 2 | 1 | 1 | | | | | | | | | | |
| 3 | 1 | | 2 | 1 | | | | | | | | | | | |
| 4 | 1 | | 2 | 1 | | | | | | | | | | | |
| 5 | 1 | | 2 | 1 | | | | | | | | | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

COURSE OBJECTIVES:

1. This course will introduce students to build their ability to read drawings and interpret the position and form of simple geometry.

CONCEPTS AND CONVENTIONS AND GEOMETRIC CONSTRUCTION**(Not for Examination)**

Importance of drawing in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning. Geometric construction - to draw perpendiculars, parallel lines, divide a line and circle, to draw equilateral triangle, square, regular polygons.

UNIT I CYCLOIDAL CURVES, INVOLUTE AND PROJECTIONS OF POINTS, LINES 12

Basic construction of cycloid, epicycloid, and hypocycloid - Drawing of tangents and normal to the above curves. Construction of involutes of square, pentagon and circle - Drawing of tangents and normal to the above involutes.

Orthographic projection – Introduction to Principal Planes of projections - First angle projection - projection of points. Projections of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

UNIT II PROJECTIONS OF PLANES AND PROJECTIONS OF SOLIDS 12

Projections of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

Projections of regular solids like prisms, pyramids, cylinder, cone when the axis is inclined to one of the principal planes and parallel to the other by rotating object method.

UNIT III SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Sectioning of regular solids like prisms, pyramids, cylinder and cone in vertical position when the section plane is inclined to one of the principal planes and perpendicular to the other - Drawing of sectional front and top views and true shape of section.

Development of surfaces of simple and sectioned solids - prisms, pyramids cylinders and cones.

UNIT IV ISOMETRIC PROJECTION AND INTERSECTION OF SURFACES 12

Introduction to Pictorial Projection - Principles of isometric projection - Isometric scale - isometric projection of regular solids (prisms, pyramids, cylinder, cone), truncated solids and their combination in vertical position.

Line of intersection - Determining the line of intersection between surfaces of two interpenetrating solids with axes of the solids intersecting each other perpendicularly, using line method - Intersection of two square prisms and Intersection of two cylinders are only to be considered.

UNIT V FREE-HAND SKETCHING 12

Free-hand sketching – Sketching procedures – Steps in sketching - Orthographic views (front, top and side views) of simple blocks from their Isometric view, Isometric view of simple blocks from their Orthographic views (front, top and side views)

TOTAL: 60 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Construct Engineering curves and sketch the orthographic views of lines as per drawing standards | 3 |
| CO2 | Draw orthographic projections of plane surfaces and simple solids in various positions | 3 |
| CO3 | Draw the various views of sectioned solids and develop the lateral surfaces of simple solids. | 3 |
| CO4 | Draw isometric projections of simple solids and their combinations and the orthographic projection of the intersection of surfaces of simple solids. | 3 |
| CO5 | Sketch the orthographic projections of a given isometric view and vice versa using free hand. | 3 |

TEXTBOOKS:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Venugopal K. and Prabhu Raja V., "Engineering Drawing AutoCAD", New Age International, 2011.

REFERENCES:

1. Basant Agarwal and Agarwal C, "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University Press, New Delhi, 2015.
3. Shah M, and Rana B.C., "Engineering Drawing", Pearson Education, 2nd Edition, 2009.
4. Natrajan K.V., "A Textbook of Engineering Graphics", Dhanalakshmi Publishers, 2018.

E-RESOURCES:

1. <https://nptel.ac.in/courses/112105294>
2. <https://nptel.ac.in/courses/112103019>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 2 | | | | | | | 1 | | 1 | | | |
| 2 | 3 | 1 | 2 | | | | | | | 2 | | 1 | | | |
| 3 | 3 | 1 | 2 | | | | | | | 2 | | 1 | | | |
| 4 | 3 | 1 | 2 | | | | | | | 3 | | 1 | | | |
| 5 | 3 | 1 | 2 | | | | | | | 3 | | 1 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

COURSE OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

- Determination of Wavelength, and particle size using Laser.
 - Determination of acceptance angle in an optical fiber.
- Determination of velocity of sound and compressibility of liquid - Ultrasonic Interferometer.
- Determination of wavelength of mercury spectrum - spectrometer grating.
- Determination of thermal conductivity of a bad conductor - Lee's Disc method.
- Determination of Young's modulus by Non uniform bending method.
- Determination of specific resistance of a given coil of wire - Carey Foster's Bridge.
- Determination of Rigidity modulus of a given wire - Torsional Pendulum
- Energy band gap of a Semiconductor
- Determine the Hysteresis loss of a given Specimen
- Calibration of Voltmeter & Ammeter using potentiometer.

TOTAL: 30 HOURS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|---|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Analyze the physical principle involved in the various instruments; also relate the principle to new application. | 4 |
| CO2 | Comprehend the Experiments in the areas of optics, mechanics and thermal physics to nurture the concepts in all branches of Engineering. | 3 |
| CO3 | Apply the basic concepts of Physical Science to think innovatively and also improve the creative skills that are essential for engineering. | 3 |
| CO4 | Evaluate the process and outcomes of an experiment quantitatively and qualitatively. | 3 |
| CO5 | Extend the scope of an investigation whether or not results come out as expected. | 3 |

REFERENCES:

- Physics Laboratory practical manual, 1st Revised Edition by Faculty members, 2018.

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|------------------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 2 | 3 | 2 | | | | 3 | 1 | | 2 | | | |
| 2 | 3 | 3 | | 3 | | 2 | | | 3 | 1 | | 2 | | | |
| 3 | 3 | 3 | 2 | 3 | 2 | 2 | | | 3 | 1 | | 2 | | | |
| 4 | 3 | 3 | | 3 | | | | | 3 | 1 | | 2 | | | |
| 5 | 3 | 3 | | 3 | 2 | | | | 3 | 1 | | 2 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| SL. No | ITEM DESCRIPTION | QTY |
|--------|---|-----|
| 1. | Torsional Pendulum, stop clock, suspension metallic wire: two different thickness, two identical cylindrical mass, screw gauge, wooden scale | 5 |
| 2. | Simple harmonic oscillations of cantilever: 1-meter wooden scale, G-clamp, weight hanger with slotted weights, Vernier caliper, Screw gauge, stop clock | 5 |
| 3. | Non-uniform bending: 1-meter wooden scale, two-knife edges, travelling microscope, weight hanger with slotted weights, screw gauge, Vernier caliper, pin | 5 |
| 4. | Uniform bending: 1 meter wooden scale, two-knife edges, travelling microscope, two weight hanger with slotted weights, screw gauge, Vernier caliper, pin | 5 |
| 5. | He-Ne/Diode laser (red), Green diode laser, Grating, Screen, Iron stand (3 Nos), 1m wooden scale, thread. | 5 |
| 6. | 45 ⁰ inclined glass plate set-up, two optically plane glass plates, sodium vapour lamp, travelling microscope, thin wire/thin strip of paper | 5 |
| 7. | Diode laser (green or red), fiber Optic cable, movable arrangement with a screen for measuring spot size (zig), meter scale, stand | 5 |
| 8. | Diode laser (green or red), iron stand, compact disc, 1m-wooden scale, screen, stand | 5 |
| 9. | He-Ne laser, CCl ₄ liquid or Benzene liquid, Glass cell with sample liquid (Kerosene/Toluene/Turpentine/Benzene or CCl ₄ liquid), RF oscillator fitted with a frequency meter, Piezoelectric crystal, Electrodes (crystal holder), Screen, iron stand (two numbers), 1m wooden scale, thread. | 5 |
| 10. | Ultrasonic interferometer apparatus with high frequency wave generator, cell, micrometer, PZ crystal, water, or other liquids | 5 |
| 11. | Post office box, 5V power supply, thermometer, galvanometer, semiconductor (thermistor), variable temperature bath set-up (oil, temperature controller, vessel, hot plate. | 5 |
| 12. | Photoelectric effect apparatus with necessary accessories, tungsten-halogen lamp, Cesium-type vacuum photodiode. | 5 |
| 13. | Michelson interferometer set-up, sodium vapor lamp and accessories | 5 |
| 14. | Melld's string apparatus, thread and weight pan, weight hanger and slotted weights. | 5 |
| 15. | Lattice dynamics kit with built-in audio oscillator and electrical transmission line (for mono and di-atomic lattices), general purpose CRO having XY mode. | 5 |
| 16 | Potentiometer | 15 |

CY22161

CHEMISTRY LABORATORY
(Common to all Branches except AD, CS, IT)

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 0 | 0 | 2 | 1 |

COURSE OBJECTIVES:

- To acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field.
- To appreciate the need for and importance of water quality parameters for industrial and domestic use.
- To gain the knowledge on electrochemical instrumentation techniques like potential and current measuring used in electrochemistry applications
- To impart knowledge on separation of components using paper chromatography.
- To enhance the thinking capability about polymer and properties like molecular weight.

LIST OF EXPERIMENTS

- Determination of DO content of water sample by Winkler's method.
- Determination of strength of given hydrochloric acid using pH meter
- Determination of strength of acids in a mixture using conductivity meter
- Estimation of iron content of the water sample using spectrophotometer (phenanthroline/thiocyanate method)
- Determination of total, temporary & permanent hardness of water by EDTA Method.
- Estimation of iron content of the given solution using potentiometer.
- Determination of alkalinity in water sample.
- Determination of Single electrode potential.
- Separation of components from a mixture of red and blue inks using Paper chromatography.
- Determination of molecular weight of polymer by using Ostwald's/Ubbelohde viscometer.

TOTAL: 30 HOURS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|---|------------------|
| At the end of the course, students will be able to: | | |
| CO1 | Distinguish hard and soft water, solve the related numerical problems on water, purification and its significance in industry and daily life. | 4 |
| CO2 | Interpret the knowledge of instruments to measure potential and current related parameters. | 3 |
| CO3 | Demonstrate the basic principle for separation of components using paper chromatography. | 3 |
| CO4 | Evaluate the molecular weight of polymer using Ostwald's/Ubbelohde viscometer. | 3 |

TEXTBOOKS:

- Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's "Textbook of practical organic chemistry", LBS Singapore 1994.

- Jeffery G.H., Bassett J., Mendham J. and Denny Vogel's R.C, "Textbook of quantitative analysis chemical analysis", ELBS 5th Edition. Longman, Singapore publishers, Singapore, 1996.

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Kolthoff I.M., Sandell E.B. et al. "Quantitative Chemical Analysis", McMillan, Madras 1980

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | | | | 3 | 3 | 3 | 1 | | 1 | 2 | | | |
| 2 | 3 | 2 | 1 | | | 3 | 3 | 3 | | | | | | | |
| 3 | 3 | | | | | 3 | 3 | | | | | 2 | | | |
| 4 | 3 | | | 1 | | 3 | 3 | 3 | | | | | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| SL. No | ITEM DESCRIPTION | QUANTITY |
|--------|--|----------|
| 1. | Common apparatus: Pipette, Burette, conical flask, porcelain tile, dropper | 30 each |
| 2. | Iodine flask | 30 |
| 3. | pH meter | 5 |
| 4. | Conductivity meter | 5 |
| 5. | Spectrophotometer | 5 |
| 6. | Oswald/Ubbelohde Viscometer | 30 |

| | | | |
|----------|----------|----------|------------|
| L | T | P | C |
| 0 | 0 | 3 | 1.5 |

COURSE OBJECTIVES:

1. Be exposed to the syntax of C.
2. Be familiar with programming in C.
3. Learn to use arrays, strings, functions, pointers, structures and unions in C.

LIST OF EXPERIMENTS

1. Programs using IO functions and Command line arguments – scanf(), printf(), gets(), puts(), Format specifier separated with space/comma, input through terminal
2. Programs to evaluate the expression using operators in C – Arithmetic, Logical, Relational, Bitwise, conditional and size of() operators
Scientific problem solving using decision making and looping – Find largest/smallest among numbers, Even or Odd number, Factorial, Krishnamurthy number, Armstrong number, Prime number or not, Grade of students based on marks, Leap year or Not, Fibonacci series and the sum of Geometric series
3. Simple programming for one-dimensional and two-dimensional arrays – Searching, Sorting, Replacing and Two-dimensional Matrix Operations
4. Solving problems using Strings – Palindrome, Cipher a string and Sorting the names
5. Programming using user-defined functions (Pass by value and Pass by reference) – Swapping numbers, convert a temperature from F to C, Average of marks by passing n subject marks in an array.
6. Programming using Recursion – Find factorial, sum of N numbers, sum of x^y , Number Conversion using recursion
7. Programming using Pointers – Swapping three numbers without temporary variable, double pointers
8. Programming using structures and union
9. Programming using enumerated data types
10. Programming using macros - #define, #ifdef, #if, #else and #endif
11. Programming using Files – Display the content of file and Copy from one file to other
- 12.

TOTAL: 45 HOURS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|---|------------------|
| At the end of the course, students will be able to: | | |
| CO1 | Use various arithmetic and logic operators in C | 1 |
| CO2 | Implement control statements of C language to solve scientific problems | 2 |
| CO3 | Develop programs using array and string operations to solve problems. | 3 |
| CO4 | Create user-defined functions to perform a task. | 3 |
| CO5 | Develop programs using file operations to store and retrieve data | 3 |

REFERENCES:

1. Pradip Dey, Manas Ghosh, "Programming in C", First Edition, Oxford University Press, 2018
2. Ashok N Kamthane, "Programming in C", Third Edition, Pearson, 2015

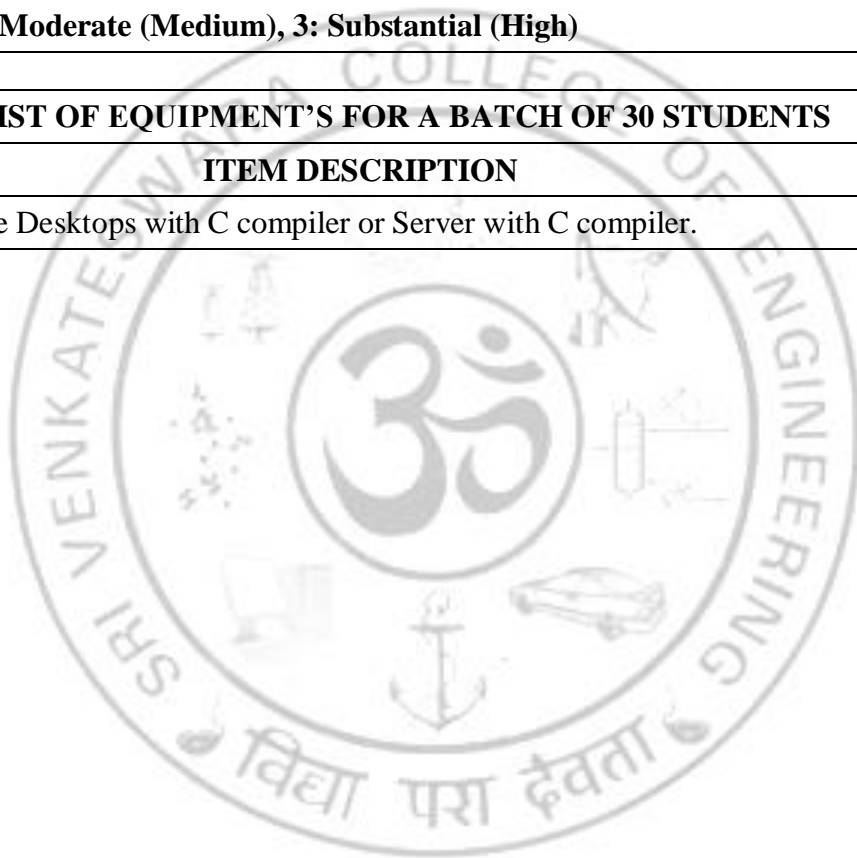
COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| 1 | 1 | | 2 | 2 | | | | | | | | | | | | |
| 2 | 2 | 1 | 2 | 2 | | | | | | | | | | | | |
| 3 | 1 | | 2 | 1 | | | | | | | | | | | | |
| 4 | 1 | 1 | 2 | 2 | | | | | | | | | | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT'S FOR A BATCH OF 30 STUDENTS

| Sl. No | ITEM DESCRIPTION | QUANTITY |
|--------|--|----------|
| 1. | Standalone Desktops with C compiler or Server with C compiler. | 30 |



SEMESTER II

HS22251 அறிவியல் மற்றும் தொழில் நுட்பத்தில் தமிழ்
Science and Technology in Ancient Tamil Society
(Common to all Branches)

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

பாடத்தின் நோக்கங்கள்:

1. அறிவியலில் தமிழின் பயன்பாடு பற்றி தெரிந்து கொள்வார்கள்.
2. தொழில்நுட்பத்தில் தமிழ் பாரம்பரியத்தின் தாக்கம் பற்றி அறிந்து கொள்வார்கள்.

அலகு 1 அறிவியல் தமிழ்

3

கருவி உருவாக்கம் - ஆராய்ச்சி மேம்பாடு - கல்வி வளர்ச்சி - அறிவியல் தமிழ் சொற்கள் உருவாக்கம்.

Scientific Tamil: Tool Development - Research Development - Educational Development - Scientific Tamil words Creation.

அலகு 2 தொழில் நுட்பத்தில் தமிழ்

12

வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம்: சங்க காலத்தில் கட்டுமானப் பொருட்கள் - சோழர்களின் பெரிய கோவில்கள் மற்றும் பிற வழிபாட்டு தலங்கள் - பல்லவர்களின் சிற்பங்கள் மற்றும் கோவில்கள் (மாமல்லபுரம்) - நாயக்கன் கால கோவில்கள் (மதுரை மீனாட்சி அம்மன் கோவில்), திருமலை நாயக்கர் மஹால், செட்டி நாட்டு வீடுகள்.

DESIGN AND CONSTRUCTION TECHNOLOGY: Building materials in Sangam age – Great temples of Cholas and other worship places – Sculptures and Temples of Pallavas (Mamallapuram) – Temples of Nayakas period (Madurai Meenakshi Amman temple), Thirumalai Nayakar Mahal, Chetti Nadu Houses.

உற்பத்தி தொழில்நுட்பம் : கப்பல் கட்டும் கலை, உலோகவியல் ஆய்வுகள், தங்கம், தாமிரம், இரும்பு பற்றிய அறிவு - தொல்பொருள் சான்றுகள் – சுட்டக் களிமண் மணிகள், சங்கு மணிகள், எலும்பு மணிகள்.

MANUFACTURING TECHNOLOGY: Art of Ship building, Metallurgical studies, Knowledge about Gold, Copper, Iron – Archeological evidence – Terracotta beads, Shell beads, Bone beads.

விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பம் : அணைகள், ஏரிகள், குளங்கள், மதகுகள், சோழர் கால குழுவி தூம்பு ஆகியவற்றின் முக்கியத்துவம் - கால்நடை பராமரிப்பு, கால்நடைகளின் பயன்பாட்டிற்காக வடிவமைக்கப்பட்ட கிணறுகள். விவசாயம் மற்றும் வேளாண் செயலாக்கம் - கடல் பற்றிய அறிவு - மீன்பிடித்தல், முத்து குளித்தல், சங்கு சேகரித்தல்.

AGRICULTURE AND IRRIGATION TECHNOLOGY: Dams, Tank, ponds, sluice, Significance of Kumuzhi Thoombu of Cholas period- Animal Husbandry, Wells designed for cattle use. Agriculture and Agro processing, - Knowledge about Sea – Fisheries, Pearl, Conche diving.

தமிழ் கணினி: அறிவியல் தமிழ் வளர்ச்சி - தமிழ் கணினி, தமிழ் புத்தகங்களின் டிஜிட்டல் மயமாக்கல், தமிழ் டிஜிட்டல் நூலகம், தமிழ்

மென்பொருள் உருவாக்கம் - தமிழ் மெய்நிகர் அகாடமி - சொற்குவை திட்டம்.

TAMIL COMPUTING: Development of Scientific Tamil – Tamil Computing, Digitization of Tamil books, Tamil Digital Library, Development of Tamil Software – Tamil virtual Academy – Sorkuvai project.

தமிழின் எதிர்காலமும் தகவல் தொழில்நுட்பமும்- உலகமயமாக்கலும் தகவல் தொழில் நுட்பமும் - கணினிக்கு தமிழ் கற்று கொடுத்தல் - தமிழ் மொழித் தொழில் நுட்பத்தில் வளங்கள்.

Future of Tamil and Information Technology- Globalization and Information Technology-Teaching Tamil for Computer-Resources in Tamil Language Technology.

மொத்தம்: 15 காலங்கள்

| பா.வெ . எண் | பாடத்திட்டத்தின் வெளிப்பாடு |
|-------------|--|
| CO1 | அறிவியலில் தமிழ் மொழியின் பயன்பாடு பற்றி தெரிந்து கொள்வார்கள் |
| CO2 | பல்வேறு தொழில்நுட்பத்தில் தமிழ் மொழியின் தாக்கம் பற்றி அறிந்து கொள்வார்கள் |

பாட நூல்கள்:

1. டாக்டர், வா.செ .குழந்தைசாமி (1985), " அறிவியல் தமிழ் " , பாரதி பதிப்பகம், 126/108, உஸ்மான் சாலை, தியாகராய நகர் , சென்னை 600017.
2. சுப. திண்ணப்பன், (1995), "கணினியும் தமிழ் கற்பித்தலும்", புலமை வெளியீடு, 38-B மண்ணத்தந்தோட்டத் தெரு, ஆழ்வார்பேட்டை, சென்னை 600018.
3. மு. பொன்னவைக்கோ, (2003), "வளர் தமிழில் அறிவியல் – இணையத்தமிழ்", அனைத்திந்திய அறிவியல் தமிழ்க்கழகம், தஞ்சாவூர் 615005
4. துரை. மணிகண்டன், (2008), "இணையமும் தமிழும்", நல் நிலம் பதிப்பகம், 7-3, சிமேட்லி சாலை, தியாகராய நகர், சென்னை 600017.

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

COURSE OBJECTIVES:

1. . To enable learners, define and understand technical communication and scientific writing
2. . To expose learners to writing for scientific purposes
3. To expose learners to drafting correspondences for business purposes
4. To expose learners to writing for documenting purposes
5. To enable students, have a holistic understanding of job interviews and recruiting process
6. To expose learners to nuances of seminar presentation, group discussion, and public speaking

UNIT I**8**

Listening – AV files pertaining to manufacturing processes of products, scientific documentaries; **Speaking**- syllable division and word stress, intonation, sharing opinions; **Reading** – news articles related to science and technology; **Writing** – definitions, instruction, recommendation, data interpretation, resume; **Grammar** – tenses and their aspects, sentence connectors - discourse markers, sequential words, active and passive voice, subject-verb agreement.

UNIT II**10**

Listening – AV pertaining to marketing strategies, peer reading and pronunciation; **Speaking** - turn taking, sharing opinions; conducting and attending a meeting, understanding the nuances of spoken communication among internal audience and external audience, **Reading** - analytical documents, descriptive documents; **Writing** - fliers, brochures, resume- letter of application, checklists; **Grammar** - modal verbs, clauses – types and uses, conditional clauses, articles.

UNIT III**8**

Listening – AV related to how to use components, scientific description, **Speaking** - speaking for motivation and initiation, speaking at a seminar presentation; Reading – scientific journals, papers; **Writing** – Technical descriptions – process description, purpose and function, PowerPoint, Google forms, user manuals; **Grammar** - phrasal verbs, prepositions, technical and scientific affixes

UNIT IV**10**

Listening - scientific debates, crisis management; **Speaking** - handling conflicts, speaking about the loss of benefits, progress or decline of business, identifying the connotative meanings, **Reading**- documented evidence of uses and functions of a product, review of a product, **Writing** – memos, follow-up letters, reports - proposal, project, progress reports, sales reports, reports on industrial visits, executive summary. **Grammar** - reported speech and tag questions, sentence structure – comparative, imperative, cause and effect, infinitive of result.

UNIT V**9**

Listening – AV of Group discussions, panel discussions, face to face interviews for recruitment purposes; **Speaking**- speaking at group discussions, interviewing a personality, answering at the interviews; **Reading** – WebPages of topnotch engineering companies, **Writing** - blogging, e-mails, letter of complaint, minutes of the meeting; Grammar - one word substitution, collocations, better word/sentence substitution (rephrasing the content/improving ideas).

TOTAL: 45 PERIODS

Suggested Activities [task based] – case study, guest lectures as models, problem solving, understanding teamwork.

Assessment:

3 Continuous assessments (reading, writing, grammar, and 3 assignments (1 assignment focuses on listening 2 assignments focus on speaking, evaluation of students' speeches and recorded clippings)

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Understand the nuances of technical communication and scientific writing | 3 |
| CO2 | Present papers and give seminars | 3 |
| CO3 | Discuss in groups and brainstorm | 3 |
| CO4 | Draft business correspondences and write for documenting purposes | 3 |
| CO5 | Face job interviews with confidence | 2 |

REFERENCES:

1. Orient Blackswan, Chennai. 2012
2. Downes, Colm, Cambridge English for Job-hunting, Cambridge University Press, New Delhi. 2008
3. Murphy, Raymond, Intermediate English Grammar with Answers, Cambridge University Press 2000
4. Thomson, A.J. Practical English Grammar 1& 2 Oxford 1986.
5. Herbert A J, The Structure of Technical English Longman, 1965

Web Link:

1. <http://www.usingenglish.com>
2. <http://www.uefap.com>
3. <https://owl.english.purdue.edu/owl/>
4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

Software:

1. Face2Face Advance – Cambridge University Press, 2014
2. English Advance Vocabulary- Cambridge University Press
3. IELTS test preparation – Cambridge University Press 2017
4. Official Guide to the TOEFL Test with CD-ROM, 4th Edition
5. CAMBRIDGE Preparation for the TOEFL TEST- Cambridge University Press, 2017

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|-----------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | | | | | | | | | | 3 | | | | | |
| 2 | | | | | | | | | | 3 | | | | | |
| 3 | | | | | | | | | | 3 | | | | | |
| 4 | | | | | | | | | | 3 | | | | | |
| 5 | | | | | | | | | | 3 | | | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

COURSE OBJECTIVES:

The Students should be made to:

1. Acquire the concepts of vector calculus needed for problems in all engineering disciplines and compute different types of integrals using Green's, Stokes' and Divergence theorems.
2. Skilled at the techniques of solving ordinary differential equations that model engineering problems.
3. Extend their ability of using Laplace transforms to create a new domain in which it is easier to handle the problem that is being investigated.
4. Explain geometry of a complex plane and state properties of analytic functions.
5. Understand the standard techniques of complex variable theory so as to apply them with confidence in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.

UNIT I VECTOR CALCULUS 12

Gradient, divergence and curl - Directional derivative - Vector identities – Irrotational and solenoidal vector fields - Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Verification and application in evaluating line, surface and volume integrals.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS 12

Differential equations of first order – Equations of the first order and first degree – Linear equations – Higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients – Applications of Linear differential equations – Oscillatory electrical circuit – Deflection of beams.

UNIT III LAPLACE TRANSFORM 12

Conditions for existence - Transform of elementary functions - Transforms of unit step function and impulse functions – Basic properties – Shifting theorems - Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Initial and final value theorems - Transform of periodic functions. Inverse Laplace transforms - Convolution theorem – Application to solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV ANALYTIC FUNCTIONS 12

Analytic functions - Necessary and sufficient conditions (Cauchy-Riemann equations) - Properties of analytic function - Harmonic conjugates - Construction of analytic functions - Conformal mapping – Mapping by functions $W = Z + C$, CZ , $1/Z$, Z^2 – Joukowski's transformation- Bilinear transformation.

UNIT V COMPLEX INTEGRATION 12

Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series expansions - Singular points - Residues - Cauchy's Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour.

TOTAL: 60 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|---|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Interpret the fundamentals of vector calculus and execute evaluation of line, surface and volume integrals using Gauss, Stokes, and Green's theorems. | 3 |
| CO2 | Solve first order linear, homogeneous differential equations and use series solution method to solve second order differential equations. | 3 |
| CO3 | Determine the methods to solve differential equations using Laplace transforms and Inverse Laplace transforms. | 3 |
| CO4 | Explain Analytic functions and Categorize transformations. | 3 |
| CO5 | Perform Complex integration to evaluate real definite integrals using Cauchy integral theorem and Cauchy's residue theorem | 3 |

TEXTBOOKS:

1. Erwin Kreyszing, Herbert Kreyszing, Edward Norminton, "Advanced Engineering Mathematics", 10th Edition, John Wiley, 2015.
2. Grewal. B.S, Grewal .J.S "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2015.

REFERENCES:

1. Dass, H.K., and Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2013.
3. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Laxmi Publication (p) Ltd., 2014.

E-RESOURCES:

1. <https://nptel.ac.in/courses/111/105/111105134/>
2. <https://nptel.ac.in/courses/111/105/111105121/>

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|-----------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | | | | | | | | | | 3 | | | |
| 2 | 3 | 3 | 2 | | | | | | | | | 3 | | | |
| 3 | 3 | 3 | 2 | | | | | | | | | 3 | | | |
| 4 | 3 | 3 | | | | | | | | | | 3 | | | |
| 5 | 3 | 3 | | | | | | | | | | 3 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

COURSE OBJECTIVES:

- To impart the knowledge about the properties of engineering and ceramic materials to the students.
- To enhance the knowledge about the electron behaviour in the semiconductor and dielectric materials.

UNIT I PHASE DIAGRAMS AND NON-FERROUS ALLOYS 8

Solid solutions - Hume Rothery's rules – Phase rule - single component system - one- component system of Iron - binary phase diagrams - Isomorphous systems - Tie-line rule - the Lever rule - application to Isomorphous system - Cu – Ni system - Eutectic phase diagram - Peritectic phase diagram - other invariant reactions - Cu – Zn system - Microstructural change during cooling.

UNIT II FERROUS ALLOYS AND HEAT TREATMENT 10

Fe-C equilibrium diagram : phases, invariant reactions - microstructure of slowly cooled steels - Eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - Diffusion in solids: Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel - Pearlite, Bainitic and Martensitic transformations - tempering of Martensitic - Heat treatment of steels : Annealing - Normalizing - Quenching and Tempering - Case hardening - Induction, Flame and Laser hardening - Carburizing, Cyaniding, Carbonitriding and Nitriding.

UNIT III SEMICONDUCTING MATERIALS 8

Introduction - classification of materials based on band theory (metals, semiconductors, and insulators) - intrinsic and extrinsic semiconductors - carrier concentration in intrinsic semiconductor (derivation) - effect of temperature on Fermi level - compound semiconductors - variation of electrical conductivity in intrinsic semiconductors with temperature - Band gap determination of intrinsic semiconductor (derivation and experiment) - Hall effect (derivation and experiment).

UNIT IV DIELECTRIC, MAGNETIC AND SUPERCONDUCTING MATERIALS 10

Dielectric materials - Dielectric constant - Polarization of dielectric materials - Types of Polarization (Polarisability) - Equation of internal fields in solid (One- Dimensional) (Derivation) - Claussius-Mosotti Relation for elemental dielectric materials - Dielectric Breakdown - Frequency dependence of dielectric constant, Dielectric Losses - Important applications of dielectric material.

Magnetic Materials: Dia, Para, and Ferro magnetic material - Domain theory for Ferro magnetic materials - Phenomena of Hysteresis and its applications - Ferrites and its structures.

Introduction to Superconductivity: Meissner effect - Properties of superconductors - Type I and Type II superconductors - BCS theory (Qualitative) - Low T_c and High T_c (alloy) superconductors - Ceramic superconductors (oxide superconductors) - Applications of Superconductors.

UNIT V CERAMIC AND NEW MATERIALS 9

Ceramics: types and applications, **Composites:** Ceramic Fibres - Fibre reinforced Plastics - Fibre reinforced Metal - **Metallic glasses:** preparation, Properties and applications.

Shape memory alloys: shape memory effect, phases, pseudo elastic effect, NiTi alloy, Properties and applications.

Nanomaterials: preparation, properties, and applications.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Know about the phase diagrams of various alloys | 3 |
| CO2 | Know about the heat treatment of alloys and alloy steels. | 3 |
| CO3 | Understand the behavior of electrons in the semiconductors. | 3 |
| CO4 | Know about the properties and engineering applications of magnetic and dielectric materials. | 3 |
| CO5 | Enhance knowledge about ceramics and smart materials. | 2 |

TEXTBOOKS:

1. Arumugam. M, "Materials Science", Anuradha Publications, 2015.
2. Rajendran. V, "Engineering Physics", Tata McGraw Hill, 2015.
3. Suresh. R and Jayakumar. V, "Materials Science", Lakshmi Publications, 2003.
4. Raghavan. V, "Materials Science and Engineering - A first course", Sixth Edition, PHI publications, 2015.

REFERENCES:

1. Gaur. R.K and Gupta. S.L, "Engineering Physics", Dhanpat Publications, 2015.
2. Avadhnaulu. M.N and Kshirsagar, "A Textbook of Engineering Physics", S. Chand & Co. 2006.
3. Kittel. C, "Introduction to Solid State Physics", 7th Edition, Wiley Eastern Ltd., 2004.
4. Azaroff. L.V and Brophy. J.J, "Electronic Processes in Materials", McGraw Hill., 1963.

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | | | | | | | 1 | | 2 | | | |
| 2 | 3 | 2 | 2 | 2 | 2 | 2 | | | 2 | 1 | | 2 | | | |
| 3 | 3 | | | | | 2 | | | | 1 | | 2 | | | |
| 4 | 3 | | 2 | | | 2 | | | | 1 | | 2 | | | |
| 5 | 3 | 2 | 2 | 2 | 2 | 2 | | | 2 | 1 | | 2 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

ME22201

ENGINEERING MECHANICS
(Common to ME, MN, MR)

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

COURSE OBJECTIVES:

1. To understand the concept of equilibrium of particles.
2. To understand the concept of equilibrium of rigid bodies.
3. To understand the concept of first and second moment of area.
4. To understand the concept of various types of frictions and applications.
5. To understand the principle of work energy method, Newton's law and impact of elastic bodies.

UNIT I BASICS AND STATICS OF PARTICLES

9

Introduction - Units and Dimensions - Laws of Mechanics - Principle of transmissibility - Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle - Lami's theorem - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces.

UNIT II STATICS OF RIGID BODIES AND ANALYSIS OF STRUCTURES

9

STATICS OF RIGID BODIES: External, Internal forces - moment of a force - Varignon's theorem - moment of a couple - resolution of a force into a force and a couple - reduction of a system of forces - reactions at supports and connections - equilibrium of a two and three force bodies - case studies.

ANALYSIS OF STRUCTURES: Simple trusses - Method of joints, method of sections - joints under special loading conditions - space trusses - analysis of frames.

UNIT III CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA

9

Centroid of areas, composite areas, Centre of Gravity- Theorems of Pappus and Guldinus- Parallel axis theorem and perpendicular axis theorem - determination of moment of inertia of plane figures, polar moment of inertia-radius of gyration - mass moment of inertia of simple solids.

UNIT IV FRICTION

9

Laws of dry friction - angles of friction-coefficient of static and kinetic friction - wedges - surface contact friction - belt friction - journal bearings - axle friction - thrust bearings - disc friction - Point contact friction - wheel friction - rolling resistance - case studies.

UNIT V DYNAMICS OF PARTICLES

9

KINEMATICS: Introduction-plane, rectilinear and rotary motion-time dependent motion -rectangular coordinates - projectile motion.

KINETICS: Newton's II law - D'Alembert's principle - Energy - potential energy - kinetic energy - conservation of energy - work done by a force - work energy method.

IMPULSE AND MOMENTUM: Concept of conservation of momentum - Impulse-Momentum principle - Impact - Direct central impact, oblique central impact, impact of a moving train on the springboard.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Understand and analyze the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D. | 2 |
| CO2 | Understand and analyze the concept of reaction forces and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. | 2 |
| CO3 | Evaluate centroid, Area moment of Inertia and Mass moment of Inertia of cross section of any structural member. | 3 |
| CO4 | Correlate the engineering problems dealing with force, displacement, velocity and acceleration equations | 3 |
| CO5 | Evaluate the problems in friction and rigid body dynamics | 3 |

TEXTBOOKS:

- Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017.
- Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.
- Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

REFERENCES:

- Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
- Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th Edition, Prentice Hall, 2013.
- Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.
- Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th Edition, Wiley student edition, 2013.
- Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5th Edition, McGraw Hill Higher Education, 2013.

E-RESOURCES:

- <https://nptel.ac.in/courses/112103108>

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|-----------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 1 | 2 | | | | | | | | 2 | | |
| 2 | 3 | 2 | 2 | 1 | 2 | | | | | | | | 2 | | |
| 3 | 3 | 2 | 3 | 1 | 3 | | | | | | | | 2 | | |
| 4 | 3 | 2 | 3 | 1 | 3 | | | | | | | | 2 | | |
| 5 | 3 | 2 | 3 | 1 | 3 | | | | | | | | 2 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

EE22151

**BASIC ELECTRICAL AND
ELECTRONICS ENGINEERING**
(Common to all Branches except CH, EE, EC)

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 3 | 0 | 0 | 3 |

COURSE OBJECTIVES:

1. To understand the basic theorems used in Electrical circuits.
2. To educate on the different concepts and functions of electrical machines.
3. To introduce electron devices and its applications.
4. To explain the principles of digital electronics.
5. To impart knowledge on the principles of measuring instruments.

UNIT I ELECTRICAL CIRCUITS

9

Ohm's Law – Kirchoff's Laws - Steady State Solution of DC Circuits using Mesh and Nodal Analysis -Introduction to AC Circuits - Waveforms and RMS Value - Power and Power factor - Single Phase and Three Phase AC Balanced Circuits.

UNIT II ELECTRICAL MACHINES

9

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single phase induction Motor, Single Phase Transformer.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS

9

Characteristics of PN Junction Diode - Zener Effect - Zener Diode - LED, Photo diode and its Characteristics-Half Wave and Full Wave Rectifiers-Voltage Regulation. Bipolar Junction Transistor- Common Emitter Configuration, Characteristics and CE as an Amplifier - Photo transistors.

UNIT IV DIGITAL ELECTRONICS

9

Number System Conversion Methods–Simplification of Boolean Expression using K-Map – Half and Full Adders – Flip-Flops – Shift Registers - SISO, SIPO, PISO, PIPO and 4-bit Synchronous and Asynchronous UP Counters.

UNIT V MEASURING INSTRUMENTS

9

Types of Signals: Analog and Digital Signals- Construction and working Principle of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters. Instrumentation Amplifier, – R-2R ladder Type D/A Converter - Flash Type and Successive Approximation Type A/D Converter.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|------------------|
| At the end of the course, students will be able to: | | |
| CO1 | Compute the electric circuit parameters for simple problems | 4 |
| CO2 | Understand the construction and characteristics of different electrical machines | 4 |
| CO3 | Describe the fundamental behavior of different semiconductor devices and circuits. | 4 |
| CO4 | Design basic digital circuits using Logic Gates and Flip-Flops | 4 |
| CO5 | Analyze the operating principle and working of measuring instruments | 4 |

TEXTBOOKS:

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, 2nd Edition, McGraw Hill Education, 2020.

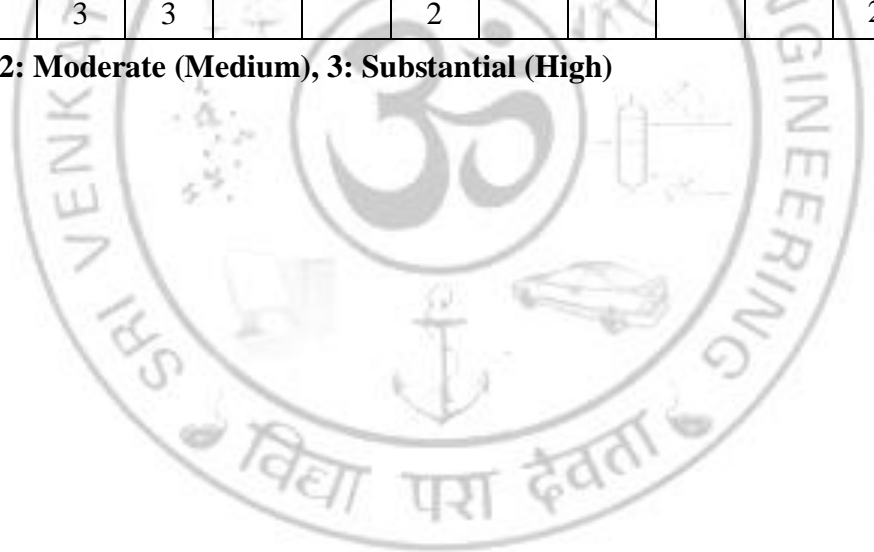
- SedhaR.S., "A Text Book of Applied Electronics", S. Chand & Co., 2014

REFERENCES:

- Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics Engineering", Tata McGraw Hill, 2013.
- MehtaVK,"Principles of Electronics", S. Chand &Company Ltd, 2010.
- M. Morris Mano, "Digital Logic & Computer Engineering", Prentice Hall of India, 2004.
- Mahmood Nahvi and Joseph A.Edminister,"Electric Circuits", Schaum' Outline Series, McGraw Hill, 4th Edition, 2007.

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|------------------------------------|------------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-------------|----------|----------|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | | | 2 | | | | | 2 | | | |
| 2 | 3 | 3 | 3 | 3 | | | 2 | | | | | 2 | | | |
| 3 | 3 | 3 | 3 | 3 | | | 2 | | | | | 2 | | | |
| 4 | 3 | 3 | 3 | 3 | | | 2 | | | | | 2 | | | |
| 5 | 3 | 3 | 3 | 3 | | | 2 | | | | | 2 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)



| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

OBJECTIVES:

1. To impart the importance of casting and its applications
2. To teach the various metal joining process and how to select the process.
3. To acquaint the various bulk deformation processes
4. To teach various sheet metal forming operations and the recent developed forming process for sheet metal
5. To understand the processing method available for thermoplastics and thermosetting plastics and the powder metallurgy process

UNIT I METAL CASTING PROCESSES 10

Introduction, Patterns – Materials, Types and Pattern allowances, Cores – Core Prints, Core making and Types of cores, Moulding sand – Properties, Melting Practices – Cupola and Induction Furnaces, Mould – Expendable and Permanent Mould, Green sand Mould preparation, Special casting Processes – Investment casting, Die casting – Hot chamber and Cold Chamber, Slush Casting, Centrifugal Casting – True, Semi and Centrifuging, Continuous Casting, Shell Moulding, CO₂ Process, Stir Casting Process– Defects in casting – solidification time calculations

UNIT II JOINING PROCESSES 10

Fusion Welding Processes – Types of Gas Welding – Flame Characteristics , Oxy Fuel Gas Welding, Types of Gas welding Technique, Arc Welding – Arc welding Equipment's, Fillers and Flux Materials, Electrodes – Coated electrode designation, Consumable Electrode – Shielded Metal Arc Welding, Submerged Arc Welding, Gas Metal Arc Welding, Flux Cored Arc Welding, Electro slag welding, Electro gas welding, Non Consumable Electrode – Gas Tungsten Arc Welding, Atomic Hydrogen Welding, Plasma Arc Welding, Electron Beam Welding, Laser Beam Welding, Solid State welding – Ultrasonic Welding, Friction Welding – Friction Stir Welding, Resistance welding – Types, Welding defects. Problems related to power calculations in welding

UNIT III BULK DEFORMATION PROCESSES 10

Metal Forming Classification, Hot working, Cold Working and Warm Working of metals, Recrystallization Temperature.
 Forging – Outline of Forging and related operations (Edging, Heading, Fullering, drawing out, Upsetting, Drawing down, Swaging, Blocking, Coining, Trimming), Special forging process - Roll Forging, Iso thermal Forging and Orbital Forging, Defects in Forging
 Extrusion Process – Types of Extrusion Process- Direct and Indirect Extrusion, Hydrostatic Extrusion, Impact Extrusion, Side extrusion, Extrusion defects
 Rolling Processes – Terminology – Blooms, Billet, Slab, Plate, sheet, Foil, Types of rolling mills, Roll Pass design, Shape rolling operations, Thread Rolling, Ring Rolling, Gear Rolling, Roll piercing process, Rolling defects
 Principles of rod, wire, and tube drawing- Seamless tubes and Tube drawing methods
 Simple problems in bulk deformation process

UNIT IV SHEET METAL FORMING PROCESSES 10

Definitions of Various Press Operations – Blanking, Punching, Shaving, Perforating, Lancing, Slitting, Trimming, Bending, Drawing, squeezing, Press working Terminology, Types of dies for Sheet metal operations, Press Tonnage calculation. Methods to reduce the cutting force - Problems Sheet Metal Forming operations – Bending and Drawing- Elastic recovery or spring back effect, Stretch forming, Rubber pad forming, Hydroforming, Metal Spinning – Types,
 High Energy Rate Forming Process – Explosive Forming, Magnetic Pulse Forming, Electro Hydraulic Forming, Superplastic Forming.

UNIT V PROCESSING OF PLASTICS AND POWDER METALLURGY 5

Types of plastics – Types of Moulding – Injection Moulding, Blow Moulding, Compression Moulding, Transfer Moulding, Rotational Moulding, Extrusion, Thermoforming, Calendaring

Powder Metallurgy – Production of metal Powders, Compaction – Sintering and Finishing, Advantages and disadvantages of powder metallurgy.

TOTAL : 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT LEVEL |
|--|---|-----------|
| At the end of the course, Students will be able to | | |
| CO1 | Select a suitable casting process for a given engineering component | 3 |
| CO2 | Given a material, the students will Apply a suitable joining process | 3 |
| CO3 | Given a part diagram & its application, students will justify a suitable bulk deformation process | 3 |
| CO4 | Students will identify the necessary operations to be performed on a sheet metal and will select a suitable process for a given application | 3 |
| CO5 | Students will justify a suitable process for thermoplastics, thermosetting plastics and for cutting tools | 3 |

TEXTBOOKS:

1. Serope Kalpakjian & Steven R. Schmid, “Manufacturing Engineering and Technology”, Pearson India Education Services Pvt. Ltd, 7th edition, 2018
2. Dr. P.C. Sharma, “A Textbook of Production Technology (Manufacturing Processes), S. Chand & Company Ltd, 8th edition, 2014

REFERENCES:

1. Mikell P. Groover, “Principles of Modern Manufacturing”, SI version, Wiley & Sons Pvt Ltd, Global Edition, 2016
2. R.K. Rajput, “A text book of Manufacturing Technology (Manufacturing Processes)”, Laxmi Publications (p) Ltd, 2016
3. Rao. P.N, “ Manufacturing Technology”, Tata McGraw Hill Publishing Co. Ltd, Volume 1, 5th edition, 2018
4. Serope Kalpakjian & Stevan R. Schmid, “Manufacturing Processes for Engineering Materials”, Pearson India Education Services Pvt. Ltd, 6th edition, 2018

E- Resources

1. http://www.ipme.ru/e-journals/RAMS/no_15418/04_15418_kawasaki.pdf
2. <https://pdfs.semanticscholar.org/6f56/4a28d39f1365f337be04922424472dcf3413.pdf>
3. <https://nptel.ac.in/courses/112107144/>

COURSE ARTICULATION MATRIX

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 1. | 3 | 1 | 2 | | | | 2 | | | | | 3 | | 3 | |
| 2. | 3 | 1 | 2 | | | | 2 | | | | | 3 | | 3 | |
| 3. | 3 | 1 | 2 | | | | 2 | | | | | 3 | | 3 | |
| 4. | 3 | 2 | 3 | | | | 2 | | | | | 3 | | 3 | |
| 5. | 3 | | 3 | | | | 3 | | | | | 3 | | 3 | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

ME22211

PRODUCTION DRAWING LABORATORY
(Common to ME and MN)

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

COURSE OBJECTIVES:

1. To introduce the concept of 2D drafting using CAD packages.
2. To improve communications through documentation, and to promote awareness for manufacturing.
3. To introduce students to understand standards of drawing in mechanical engineering
4. To acquire knowledge in Coordinate Measuring machine (CMM) for geometric features

LIST OF EXPERIMENTS

INTRODUCTION TO COMPUTER AIDED DRAFTING

1. Introduction to Computer Aided Drafting hardware – Overview of application software – 2D drafting commands like Layers, Block, Insert (Auto CAD) for simple objects – Dimensioning.

EXPERIENTIAL LEARNING ON LIMITS, FITS AND TOLERANCE THROUGH MACHINE ELEMENTS

2. Basics of Limits, fits, and Tolerance – Identification of types of fits by simple assembly of machine components – Selection of fits from standard tables – types of fits – Demonstration

GEOMETRIC DIMENSIONING

3. Basics of Geometric Dimensioning and Tolerance – Measuring of Machine components using CMM – Experiment on cylindricity, circularity, parallelism and perpendicularity.

PRACTICE ON ASSEMBLY DRAWINGS

4. Cotter joint, knuckle joint, flange coupling, universal coupling, footstep bearing, Plummer block, connecting rod ends, screw jack (any four)

NOTE:

1. Exposer to CMM for the measurement of Geometric dimensioning is Mandatory
2. Any two-assembly drawing should be practiced manually by the student.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | The students will be able to read and interpret the production drawings | 3 |
| CO2 | The students will be able to understand proper fits and tolerances. | 5 |
| CO3 | The students will generate assembly drawings for various mechanical products | 5 |
| CO4 | The students will acquire skill to measure the machine components geometry using CMM | 4 |

REFERENCES:

1. Gopalakrishna K. R., “Machine Drawing”, Subhas Publishers, Bangalore, 2013.

2. Gill P. S, "Machine Drawing", S.K. Kataria & Sons Publications, 2013
3. Bhatt. N. D, "Machine Drawing", Chorotar Publishing House, 2011.
4. Sham Tickoo, "AutoCAD 2017: A Problem-Solving Approach, Basic and Intermediate", 23rd Edition, 2017
5. James D. Bethune Boston University, "Engineering Graphics with AutoCAD 2002", Pearson Education, 2005.
6. Alan Kalameja, "AutoCAD 2008: A tutor for Engineering Graphics", Auto Desk Press 2007

E-RESOURCES:

1. <https://thesourcecad.com/autocad-tutorials/>

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|---|--|---|---|---|---|---|---|---|---|----|----|----|------|---|----------|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | | | | 3 | | | | | 2 | | 3 | 2 | | |
| 2 | 3 | | | | 3 | | | | | 2 | | 3 | 2 | | |
| 3 | 3 | | 1 | | 3 | | | | | 2 | | 3 | 2 | | |
| 4 | 3 | | | | 3 | | | | 1 | | | 3 | 2 | | |
| 5 | 3 | | | | 3 | | | | | 2 | | 3 | 2 | | |
| 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High) | | | | | | | | | | | | | | | |
| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | | | | | | | | | | | | | | |
| SL.No. | ITEM DESCRIPTION | | | | | | | | | | | | | | QUANTITY |
| HARDWARE | | | | | | | | | | | | | | | |
| 1. | Computer Server | | | | | | | | | | | | | | 1 |
| 2. | Computer systems networked to the server | | | | | | | | | | | | | | 30 |
| 3. | A3 size plotter | | | | | | | | | | | | | | 1 |
| 4. | Laser Printer | | | | | | | | | | | | | | 1 |
| SOFTWARE | | | | | | | | | | | | | | | |
| 5. | Licensed software for Drafting and Modeling & operating system | | | | | | | | | | | | | | 30 |

| | | | |
|----------|----------|----------|------------|
| L | T | P | C |
| 0 | 0 | 3 | 1.5 |

COURSE OBJECTIVES:

- To impart the practical knowledge in casting and Joining Process
- To impart the basic machining skills in lathe and to equip with the practical knowledge required in the core industries

LIST OF EXPERIMENTS**1. CASTING**

Study of various types of patterns, pattern materials, foundry tools

- Preparation of green sand mould for single piece pattern
- Preparation of green sand mould for split patterns
- Melting of nonferrous alloys and making a casting (Demonstration)

2. WELDING

Study of arc welding and gas welding equipment's, types of electrodes

- Fabrication of simple structural shapes using Gas Metal Arc Welding
- Joining of plates using Metal Inert Gas Welding / Gas Metal Arc Welding
- Demonstration of Tungsten Arc Welding, Cold Metal Transfer Welding and Friction Stir Welding

3. LATHE

Study of lathe, various mechanisms, work holding devices, tool holding devices and various Machining operations

- Plain, Turning and Taper Turning
- External & Internal Thread cutting & Knurling.
- Eccentric Turning
- Estimation of machining time for the above turning processes
- Pin and bush assembly
- Dismantling and assembly of headstock and tail stock of a lathe.

NOTE:

- Exposer to CMM for the measurement of Geometric dimensioning is Mandatory
- Any two-assembly drawing should be practiced manually by the student.

TOTAL: 45 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|------------------|
| At the end of the course, students will be able to: | | |
| CO1 | The students can be able to identify and perform the operations for a given product diagram for a lathe. | 3 |
| CO2 | The students can be able to make a green sand mould using different patterns. | 5 |
| CO3 | The students can be able to select the suitable welding parameters to make a welded component using Arc and MIG welding. The students will be able to read and interpret the production drawings | 5 |

REFERENCES:

1. Serope Kalpakjian & Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson India Education Services Pvt. Ltd, 7th edition, 2018
2. Dr. P.C. Sharma, "A Textbook of Production Technology (Manufacturing Processes)", S. Chand & Company Ltd, 8th edition, 2014

E-RESOURCES:

1. <https://thesourcecad.com/autocad-tutorials/>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | | 3 | | | | | 2 | | | | 3 | | 2 | |
| 2 | 3 | | 3 | | | | | 2 | | | | 3 | | 2 | |
| 3 | 3 | | 3 | | | | | 2 | | | | 3 | | 2 | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| SL.No. | ITEM DESCRIPTION | QUANTITY |
|-----------------|-------------------------|----------|
| HARDWARE | | |
| 1. | Centre Lathes | 7 Nos |
| 2. | Arc Welding machine | 5 Nos |
| 3. | Metal Inert Gas Welding | 1 No |

**EE22111 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
LABORATORY**

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 0 | 0 | 2 | 1 |

COURSE OBJECTIVES:

- To provide exposure to the students with hands on experience in basic of Electrical and Electronics wiring connection and measurements.
- To introduce the students to Electrical Machines and basic laws of Electrical Circuits.

LIST OF EXPERIMENTS

- Wiring – Residential house wiring and Staircase wiring.
 - AC Analysis- Measurement of electrical quantities–voltage, current, power, and power factor using RLC.
 - Study of three phase system.
- Energy conservation - Measurement and comparison of energy for incandescent lamp and LED lamp.
 - Identification of circuit components (Resistor, Capacitor, Diode and BJT) and soldering practice.
 - Signal Measurement- Measurement of peak to peak, RMS, average, period, frequency of signals using CRO.
- VI Characteristics of Solar photovoltaic panel.
 - Design of Solar PV Array and Battery sizing for Residential solar PV system.
- Design a 5V/12V Regulated Power Supply using FWR and IC7805 / IC7812.
- DC Analysis- Verification of Ohm’s Law and Kirchoff’s Laws.
- Study of Transformer and motor characteristics.

TOTAL: 30 PERIODS

| CO No. | COURSE OUTCOMES | RBT Level |
|---|--|------------------|
| At the end of the course, learners will be able to: | | |
| CO1 | Wiring of basic electrical system and measurement of electrical parameters. | 4 |
| CO2 | Verify the basic laws of Electric circuits and select various Electrical Machines. | 4 |
| CO3 | Construct electronic circuits and design solar photovoltaic system. | 4 |
| CO4 | Apply the concept of three-phase system. | 4 |
| CO5 | Construct a fixed voltage regulated power supply. | 4 |

REFERENCES:

- Mittle V.N, Arvind Mittal, "Basic Electrical Engineering", Tata Mc Graw Hill (India), Second Edition, 2013.
- Sedha R.S., "A Textbook of Applied Electronics", S. Chand & Co., 2014.

| COURSE ARTICULATION MATRIX: | | | | | | | | | | | | | | | |
|-----------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | | | | | 2 | | | 2 | | | |
| 2 | 3 | 3 | 3 | 3 | | | | | 2 | | | 2 | | | |
| 3 | 3 | 3 | 3 | 3 | | | | | 2 | | | 2 | | | |
| 4 | 3 | 3 | 3 | 3 | | | | | 2 | | | 2 | | | |
| 5 | 3 | 3 | 3 | 3 | | | | | 2 | | | 2 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| SL.No. | ITEM DESCRIPTION | QUANTITY |
|--------|---|----------|
| 1. | Verification of Ohms and Kirchhoff's Laws: DC Regulated power supply (0-30)V, Bread Board, Resistors, Multimeter, Connecting wires. | 1 set |
| 2. | Load test on DC Shunt Motor: Ammeter MC (0-20A), Voltmeter MC (0-300) V, Rheostat 7.5 Ω , 10 A, Tachometer, Field Rheostat 175 Ω , 1.5 A, Connecting wires. | 1 set |
| 3. | Load test on Self Excited DC Generator: DC shunt generator (0-300V), Ammeter (0-30 A), (0-2A), Voltmeter (0-30V), Rheostat 175 Ω , 250 Ω , Tachometer, Connecting Wires. | 1 set |
| 4. | Load test on Single phase Transformer: Ammeter (0-30) A, (0-5) A, Voltmeter (0-150) V, (0-300)V, Wattmeter – 300V, 5A, UPF, Autotransformer, Single phase transformer, Connecting wires. | 1 set |
| 5. | Load Test on Induction Motor: Ammeter MI (0-20A), Voltmeter MI (0-300) V, Wattmeter – 300V, 30 A, Tachometer – Digital, Single phase Induction motor, Connecting Wires. | 1 set |
| 6. | A. Experiment on Transistor based application circuits (Inverting and non-inverting amplifier or switching circuits): Transistor (No-BC107), Resistors- 2.2k Ω , 47K Ω , 10K Ω , 560 Ω , Capacitors - 10 μ F, 3.3 μ F, 22 μ F, Bread Board, DC Regulated Power supply (0 - 30 V) Variable, CRO, Connecting wires. B. Experiments on Operational Amplifier based Inverting and non-inverting amplifier: Function Generator 1 KHz, CRO 20 MHz, Dual RPS 0–30V, Op-Amp IC 74, Resistors R1= 100 Ω and RF= 1.5 K Ω , Connecting wires. | 1 set |
| 7. | Experiments on ADC: Resistors – 10 K Ω Resistors - 220 Ω Capacitor – 150 μ F, 10 μ F ADC -0804, Bread Board, Connecting wires, Dual RPS (0–30) V. | 1 set |
| 8. | Experiments on 555 timers: IC 555 Timer, Resistor R1, R2 47k Ω , 1k Ω , Resistor R4 220 Ω Load, Capacitor, C1 10 μ F, Capacitor, C2 0.01 μ F, Bread Board, Connecting wires, CRO 20 MHz, 9. 9. RPS (0–30) V. | 1 set |
| 9. | DSO: Measurement of Amplitude, Frequency, Time, Phase Measurement using DSO. | 1 set |

SEMESTER – III

| MA22357 | TRANSFORMS AND DIFFERENTIAL EQUATIONS | L | T | P | C |
|---|---|------------|---|---|---|
| | | 3 | 1 | 0 | 4 |
| COURSE OBJECTIVES: | | | | | |
| The student should be made to: | | | | | |
| <ul style="list-style-type: none"> • Understand the basic concepts of the Fourier series and to describe a periodic signal in terms of cosine and sine waves. • Partial differential equations are used to mathematically formulate, and thus aid the solution of, physical and other problems involving functions of several variables, such as the propagation of heat or sound, fluid flow, elasticity, electrostatics, electrodynamics. • Ordinary differential equations applications are used to calculate the movement or flow of electricity, motion of an object to and fro like a pendulum, to explain thermodynamics concepts. • Understand more clearly the nature of the boundary value problems and how to solve them. • The z-transform is useful for the manipulation of discrete data sequences and has acquired a new significance in the formulation and analysis of discrete-time systems. | | | | | |
| UNIT I | FOURIER SERIES | 9+3 | | | |
| Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis. | | | | | |
| | | 9+3 | | | |
| UNIT II | PARTIAL DIFFERENTIAL EQUATIONS | | | | |
| Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients | | | | | |
| UNIT III | APPLICATION OF ORDINARY DIFFERENTIAL EQUATIONS | 9+3 | | | |
| Applications of Differential Equations of First Order-Geometrical Applications-Orthogonal Trajectories-Physical Applications-Application of Linear Differential Equations-Simple Harmonic Motions-Deflection of Beams-Applications of Simultaneous Linear Differential Equations. | | | | | |
| UNIT IV | BOUNDARY VALUE PROBLEMS | 9+3 | | | |
| Classification of PDE – Method of separation of variables - Solution of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges) | | | | | |
| UNIT V | Z-TRANSFORMS | 9+3 | | | |
| Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction, long division method and residue technique) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform. | | | | | |
| TOTAL: (L45 + T:15): 60 PERIODS | | | | | |
| | | | | | |

| CO No. | COURSE OUTCOMES | RBT Level |
|--|---|-----------|
| At the end of the course, the student will be able to: | | |
| CO1 | Model any arbitrary periodic signal with a combination of sines and cosines. | 4 |
| CO2 | Mathematically formulate, and thus aid the solution of, physical and other problems involving functions of several variables. | 4 |
| CO3 | Understand the theory of ordinary differential equations through applications. | 3 |
| CO4 | Learn analytical methods for solving boundary value problems | 4 |
| CO5 | Use the Z-transform as a mathematical tool which is used to convert the difference equations in time domain into the algebraic equations in z-domain. | 4 |

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah. G "Advanced Mathematics for Engineering Students" Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998.

REFERENCES:

1. Bali. N. P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.
3. Ray Wylie. C and Barrett. L. C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd. 7th Edition, New Delhi, 2012.
5. Veerarajan. T., "Transforms and Partial Differential Equation", Tata McGraw Hill Publishing Company Limited, New Delhi, 2012

E-RESOURCES:

1. <https://youtu.be/LwhWZzZzZsU>
2. <https://youtu.be/GeJZcfP9A98>

COURSE ARTICULATION MATRIX

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 2 | | |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 2 | | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)



| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

COURSE OBJECTIVES:

To familiarize the students to understand the fundamentals of

1. First Law of thermodynamics and its applications to various thermal engineering devices
2. Second Law of thermodynamics and its applications to various thermal engineering devices
3. Steam formation and its application in power generation
4. Ideal & real gas behavior and thermodynamic relations
5. Psychrometry and gas mixtures.

UNIT I BASIC CONCEPTS AND FIRST LAW 9

Basic concepts -concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive properties, total and specific quantities. System and their types. Thermodynamic Equilibrium, State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work, P-V diagram. Zeroth law of thermodynamics—concept of temperature and thermal equilibrium—relationship between temperature scales –new temperature scales. First law of thermodynamics—application to non-flow and steady systems—unsteady flow processes (Descriptive only).

UNIT II SECOND LAW AND AVAILABILITY ANALYSIS 9

Heat reservoirs -source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot and reversed Carnot cycles – Performance. Clausius inequality. Concept of entropy, T-S diagram, Tds Equations Entropy change for ideal gases-different processes, principle of increase in entropy. Applications of Second Law. High- and low-grade energy. Available and unavailable energy. Exergy and Irreversibility (Descriptive Only). First law and second law Efficiency

UNIT III PROPERTIES OF PURE SUBSTANCE 9

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of First and Second law for pure substances. Ideal and actual Rankine cycles, Cycle improvement methods-Reheat and Regenerative cycles

UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9

Properties of Ideal gas -Ideal and real gas comparison-Equations of state for ideal and real gases-Reduced Properties-Compressibility factor-Principle of Corresponding states-Simple Calculations using Generalized Compressibility Chart. Maxwell relations, TDS Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes

UNIT V GAS MIXTURES AND PSYCHROMETRY 9

Mole and Mass fraction, Dalton's, and Amagat's Law. Properties of gas mixture—Molar mass, gas constant, density, change in internal energy, enthalpy, entropy, and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapor mixtures by using charts and

expressions. Psychrometric process –adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

TOTAL: 45 PERIODS

| CO No. | OUTCOMES: | RBT Level |
|--|--|-----------|
| At the end of the course, Students will be able to | | |
| CO1 | Apply first law of thermodynamics in various energy transferring and transforming devices. | 3 |
| CO2 | Apply second law of thermodynamics in various energy transferring and transforming devices. | 3 |
| CO3 | Analyze the performance of steam power plant cycle with the help of steam table and charts. | 4 |
| CO4 | Predict different thermodynamic relations and equations for ideal and real gases. | 3 |
| CO5 | Analyze the properties of Gas mixtures and various Psychrometric process and its applications. | 4 |

TEXTBOOKS:

1. Nag P.K “Basic and Applied Thermodynamics” 2nd Edition, Tata McGraw-Hill, New Delhi 2009
2. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.

REFERENCES:

1. Rajput R.K., “Thermal Engineering”, Laxmi Publications, Tenth Edition, 2017
2. Yunus A. Cengel and Michael A.Boles “Thermodynamics an engineering approach”, 9th Edition Tata McGraw hill Publications. 2019.
3. Holman J.P., “Thermodynamics”, 4th Edition, McGraw – Hill 1995.
4. Rathakrishnan E “Fundamentals of Engineering Thermodynamics” 2nd Edition, Prentice –Hall of India Pvt.Ltd, 2006
5. Chattopadhyay.P “Engineering Thermodynamics” 2nd Edition Oxford University Press 2016.
6. Arora C.P “Thermodynamics” Tata McGraw – Hill, New Delhi 2003
7. Gordon J Van Wylen and Richard E Sonntag, “Fundamentals of Classical Thermodynamics” Wiley Eastern, 1987
8. Venkatesh A. “Basic Engineering Thermodynamics” Universities Press (India) Limited 2007

E- Resources:

1. <https://nptel.ac.in/courses/112105123>
2. <https://archive.nptel.ac.in/courses/112/106/112106310/>
3. <https://nptel.ac.in/courses/112104113>
4. <https://archive.nptel.ac.in/courses/127/106/127106135/>

COURSE ARTICULATION MATRIX

| COs | POs | | | | | | | | | | | | PSOs | | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| 1. | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 2. | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 3. | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 4. | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 5. | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)



**EE22359 ELECTRICAL DRIVES AND CONTROLS:
THEORY AND PRACTICES
(Common to ME and MN)**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

COURSE OBJECTIVES:

1. To understand the basic concepts of electrical machines and their performance.
2. To obtain an overview of different dc and ac motors and special electrical machines.
3. To apply various speed control techniques for DC motor drives, AC motor drives

UNIT I INTRODUCTION

10

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – classes of duty – Preventive maintenance of electrical drive systems- Industrial Hazards and Safety Measures.

UNIT II DRIVE MOTOR CHARACTERISTICS & SPECIAL MACHINES

10

DC motors: principle, classification, characteristics, merits & demerits, applications–Three phase Induction motors: principle, classification, characteristics, merits & demerits, applications–Principle, classification, construction and characteristics of stepper motor, BLDC motor, Servo motor.

UNIT III CONVENTIONAL AND SOLID STATE SPEED CONTROL OF DC AND AC DRIVES

10

Speed control of DC series and shunt motors – Armature and field control, Ward Leonard control system - Using controlled rectifiers and DC choppers –Speed control of three phase induction motor– Inverter fed induction motor drive – Slip power recovery scheme.

TOTAL: 60 PERIODS

LABORATORY COMPONENT

OBJECTIVES:

1. To validate the principles studied in theory by performing experiments in the laboratory.

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. Speed control of DC shunt motor (Armature, Field control)
3. AC to DC half & fully controlled converter.
4. Speed control of DC motor using Power Electronic Drive
5. Characteristics of DC and AC servo motors
6. Load test on three phase squirrel cage Induction motor.
7. Speed control of three phase slip ring Induction Motor
8. Load test on single phase Induction Motor.
9. V/F control of three-phase induction motor using Power Electronic Drive.

| CO No | COURSE OUTCOMES | RBT Level |
|---|---|-----------|
| At the end of the course, Students will be able to: | | |
| CO1 | Describe the structure of electric drive systems and their role in various applications | 3 |
| CO2 | Select DC and AC motor for practical applications based on its characteristics. | 3 |

| | | |
|------------|--|---|
| CO3 | Understand the operation of converters, choppers, inverters and ac voltage controllers for DC and AC drives. | 3 |
| CO4 | Perform speed characteristics of different electrical machine. | 3 |
| CO5 | Analyze the performance of AC, DC motor using power electronic drive | 3 |

TEXTBOOKS:

1. Gopal K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2001
2. Vedam Subrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw-Hill, 2017.
3. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 1998.

REFERENCES:

1. Pillai.S.K, "A first course on Electric drives", Wiley Eastern Limited, 1998
2. Singh.M.D. K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 19983.
3. Partab. H., "Art and Science and Utilisation of Electrical Energy", DhanpatRai and Sons, 1994.
4. Philip Kiameh "Electrical Equipment Handbook: Troubleshooting & Maintenance", McGraw-Hill, 2003.

E-RESOURCES

1. <https://archive.nptel.ac.in/courses/108/104/108104140/>
2. <https://nptel.ac.in/courses/108108077>
3. <https://nptel.ac.in/courses/108104011>

COURSE ARTICULATION MATRIX

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 1 | 2 | | 1 | | | | | | 2 | 2 | 1 | |
| 2 | 3 | 1 | 1 | 2 | | | | | | | | 2 | 2 | 1 | |
| 3 | 3 | 1 | 1 | 2 | | | | | | | | 2 | 2 | 1 | |
| 4 | 3 | 1 | 1 | 2 | | | | | 2 | | | 2 | 2 | 1 | |
| 5 | 3 | 1 | 1 | 2 | | | | | 2 | | | 2 | 2 | 1 | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| S.No. | Description of Equipment | Qty |
|-------|--|-----|
| 1. | DC Shunt Motor with loading arrangement | 3 |
| 2. | DC Series Motor with loading arrangement | 1 |
| 3. | Three Phase cage Induction Motor with loading arrangement | 4 |
| 4. | Three phase slip ring Induction Motor with loading arrangement | 2 |
| 5. | Single Phase Induction Motor with loading arrangement | 2 |
| 6. | Single phase SCR based half controlled converter and fully controlled converter along with built-in/separate/firing circuit/module and meter | 2 |
| 7. | AC drive for speed control of Induction Motor | 1 |

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 2 | 1 | 0 | 3 |

COURSE OBJECTIVES:

1. To understand the relationship between the forces, internal stresses and the deformations induced in the non-rigid bodies.
2. To familiarize the student in calculating shear force, bending moment, deflection, and slopes in various types of beams for different loading conditions.
3. To solve industrial problems related to springs and shafts.
4. To understand the concepts of thin cylinder and applications related to biaxial stresses.

UNIT I STRESS AND STRAIN**9**

Definition of stress and strain, tension, compression, shear stress and strain – Stress and strain relationship, Hooke's law, Poisson's ratio, Elastic constants and their relations, thermal stresses. Composite bars for static load condition.

UNIT II MEMBERS SUBJECTED TO FLEXURAL LOADS**9**

Types - Transverse Loading in Beams - Shear Force and Bending Moment in Beams – Cantilevers - Simply Supported and Overhanging Beams - Point of contraflexure. Stresses in Beams: Theory of Simple Bending – Analysis of Stress due to bending - Load carrying capacity of Beams.

UNIT III DEFLECTION OF BEAMS AND COLUMNS**9**

Governing differential equation – Double Integration Method - Macaulay's method – Computation of slopes and deflections in beams.

Columns: End Condition – Equivalent Length of Column – Euler's Equation – Slenderness Ratio – Rankine's Formula for Columns.

UNIT IV TORSION OF SHAFTS AND SPRINGS**9**

Torsion - formulation of stresses, deformation in circular and hollow shafts, Stepped shafts. Deflection in shafts for different end conditions - Stresses in helical springs - Deflection of helical springs subjected to tension, and leaf springs.

UNIT V ANALYSIS OF STATE OF STRESS**9**

Biaxial State of Stress – Thin Cylinders– Deformation in Thin Cylinders. Biaxial Stresses: Stresses at a Point on Inclined Planes – Principal Planes and Stresses – Mohr's Circle for Biaxial Stress- Maximum Shear Stress.

TOTAL: 45 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|--|--|------------------|
| At the end of the course, Students will be able to | | |
| CO1 | Predict the behavior of the materials for different loading and support conditions | 3 |
| CO2 | Select suitable cross sections for the beams under different loading conditions | 4 |
| CO3 | Identify the methodology to find the deflections occurred in beams under different loading conditions. | 3 |
| CO4 | Select suitable dimensional parameters for the shafts under torsional loads and springs based on calculated stresses, deflection under different conditions. | 4 |

| | | |
|------------|---|---|
| CO5 | Calculate safe dimension for a Pressure vessel based on the parameters and conditions | 4 |
|------------|---|---|

TEXTBOOKS:

1. Bansal, R. K., "A Textbook of Strength of Materials", Laxmi Publications (P) Ltd., 2018
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

1. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2017
2. Ferdinand P. Beer, Russell Johnson, Jr. and John J. Dewole "Mechanics of Materials", McGraw Hill Education, 8th edition, 2019
3. Rattan, "Strength of Materials", McGraw Hill Education, 3rd Edition, 2017
4. Egor. P. Popov "Engineering Mechanics of Solids" Pearson, 2010

E-RESOURCES:

1. <https://nptel.ac.in/courses/112107146>
2. <https://nptel.ac.in/courses/112106141>
3. <https://archive.nptel.ac.in/courses/105/105/105105108/>

COURSE ARTICULATION MATRIX

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1. | 3 | 3 | | 1 | 1 | | | | | | | | 3 | | |
| 2. | 3 | 3 | | 2 | 1 | | | | | | | | 3 | | |
| 3. | 3 | 3 | | | | | | | | | | | 3 | | |
| 4. | 3 | 3 | | 2 | | | | | | | | | 3 | | |
| 5. | 3 | 3 | | | | | | | | | | | 3 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

COURSE OBJECTIVES:

1. To acquire knowledge about the theory of chip formation, and relationships among force-power-energy, cutting speed-temperature and cutting speed-tool life.
2. To select suitable machine tools and operations to manufacture a given work piece.
3. To familiarize the different gear manufacturing methods, machine tools for machining planar surfaces and finishing processes
4. To familiarize the working principles of non-traditional machining processes.

| | | |
|---------------|---|----------|
| UNIT I | THEORY OF METAL MACHINING, CUTTING TOOL TECHNOLOGY AND MACHINING ECONOMICS | 9 |
|---------------|---|----------|

Importance of machining – Classification of material removal processes – Chip formation – Orthogonal cutting model – types of chip formation – Forces in metal cutting – Merchant's circle diagram and equations – Power and energy relationships in machining Cutting temperature and its measurement – Tool wear – Taylor's tool life equation -Tool materials -Single point tool geometry -ASA and OR systems – chip breakers-Cutting fluids – Types, Application methods - flood, mist, MQL - Machinability – Tolerance in Machining - Selection of cutting conditions – Feed and depth of cut – Optimizing cutting speed for maximum production rate and minimum production cost.

| | | |
|----------------|---|----------|
| UNIT II | LATHE AND DRILLING MACHINE TOOLS | 9 |
|----------------|---|----------|

Lathe – Classification, Specifications, Operations – Taper turning methods, Thread cutting methods and other operations, Machining time and power estimation, Work holding devices. Capstan and turret lathes – Construction, Work holding devices in turret lathes, Operations – External and internal thread cutting, Production of hexagonal bolt and other simple components -Tooling scheduling chart – Machining cost

Drilling Machines - Classification, Specifications, Work holding devices, Operations – Drilling, Reaming, Boring, Tapping and other operations, Machining time in drilling.

| | | |
|-----------------|--|-----------|
| UNIT III | SHAPING, MILLING, BROACHING MACHINE TOOLS OPERATIONS AND GEAR MANUFACTURING | 12 |
|-----------------|--|-----------|

Shaper – Classification, Specification, Work holding devices, Machining time in shaping.

Broaching – Push and pull type – Continuous and rotary broaching – Machining time in Broaching.

Milling machines – Classifications, Up and down milling, Indexing in milling machine– Simple, compound, and differential indexing, Operations – Plain, face, end, and other milling operations. Cutting conditions and Machining time in milling.

Gear Generation – Gear geometry -Principle of gear hobbing – Spur and helical gear cutting problems – Advantages and limitations – Principle of gear shaping – spur gear cutting problems – Advantages and limitations.

| | | |
|----------------|--|----------|
| UNIT IV | GRINDING AND OTHER ABRASIVE PROCESSES | 9 |
|----------------|--|----------|

Finishing processes: Grinding - Cylindrical grinding – center type and centerless type, surface grinding, Machining time in grinding, grinding wheel specification, Selection of grinding wheel, Polishing and Buffing, Honing & Lapping, Super Finishing.

UNIT V NON - TRADITIONAL MACHINING PROCESSES**6**

Introduction, Classification, Abrasive Jet Machining, Waterjet Machining, Ultrasonic Machining, Electrical Discharge Machining, Wire Cut EDM, Chemical Machining, Electro Chemical machining, Electro chemical grinding, Laser Beam Machining, Electron beam machining, Plasma Arc Machining - Working Principles, Equipment used and Applications.

TOTAL: 45 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, Students will be able to: | | |
| CO1 | Identify the types of chips for a given material, estimate the cutting force, power, energy, tool life and temperature during machining, and will justify the tool angles for a given single point cutting tool. | 3 |
| CO2 | Determine the operational sequence for a given a part diagram to machine on lathe and determine its machining cost. | 3 |
| CO3 | Interpret the given part diagram and select appropriate machine tools to machine the product. | 3 |
| CO4 | Select an appropriate finishing process for a given application. | 4 |
| CO5 | Select an appropriate non – traditional machining process based on their principles and limitations. | 4 |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

TEXTBOOKS:

1. P N Rao, “Manufacturing Technology: Metal Cutting and Machine Tools”, Mc-Graw Hill, Volume 2, 4th Edition, 2018.
2. Serope Kalpakjian & Steven R. Schmid, “Manufacturing Engineering and Technology”, Pearson India Education Services Pvt. Ltd, 7th edition, 2018.

REFERENCES:

1. Mikell P. Groover, “Fundamentals of Modern Manufacturing-Materials, Processes and Systems” Wiley Publications, 7th edition, 2020.
2. HMT, Production technology, Mc-Graw Hill, 2017.
3. Paul De Garmo, J.T. Black, and Ronald. A. Kohser, “Material and Processes in Manufacturing”, Wiley Publications, 12th edition, 2017.
4. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters,2010.
5. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", CRC Press, 2005.

E-RESOURCES:

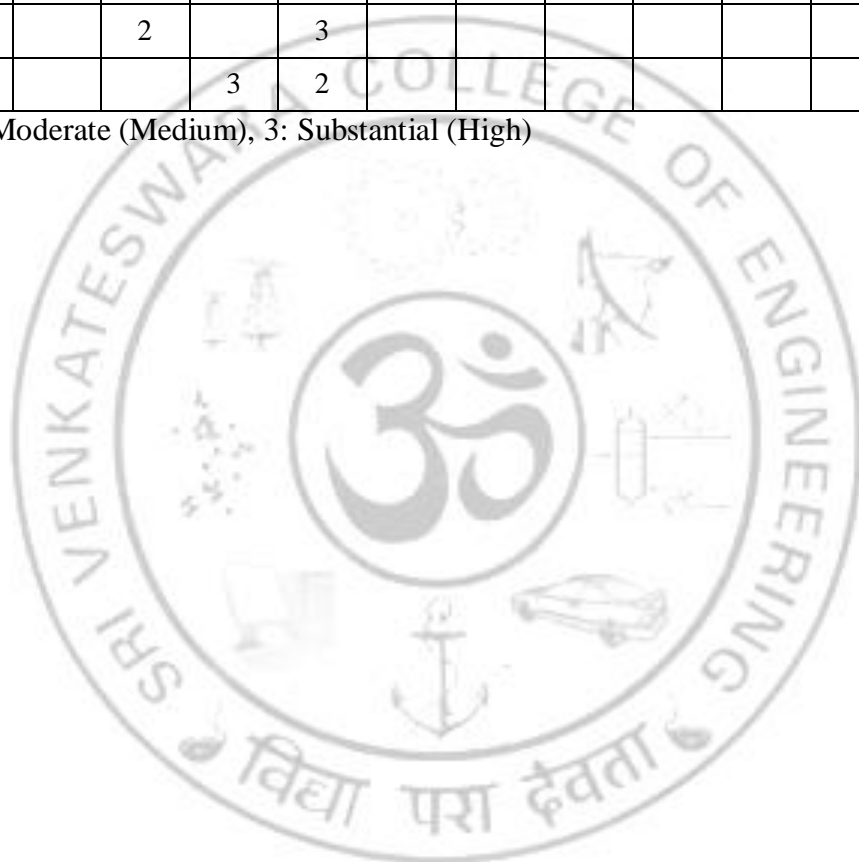
1. <https://archive.nptel.ac.in/courses/112/105/112105219/>
2. <https://archive.nptel.ac.in/courses/112/105/112105233/>
3. <https://nptel.ac.in/courses/112105127>
4. <https://nptel.ac.in/courses/112104290>

5. <https://www.digimat.in/nptel/courses/video/112105211/L11.html>
6. <https://archive.nptel.ac.in/courses/112/103/112103248/>
7. <http://home.iitk.ac.in/~vkjain/Lecture2-Metalcutting.pdf>
8. <http://home.iitk.ac.in/~nsinha/Non-traditional-machining.pdf>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| 1. | 3 | 2 | | 3 | | | 2 | | | | | | | 3 | | |
| 2. | 3 | 2 | 3 | 3 | | 3 | | | | | 1 | | | 3 | | |
| 3. | 3 | 2 | 3 | 3 | | 3 | | | | | 1 | | | 3 | | |
| 4. | 3 | | | 2 | | 3 | | | | | | | | 3 | | |
| 5. | 3 | | | | 3 | 2 | | | | | | | | 3 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)



| | | | |
|---|---|---|---|
| L | T | P | C |
| 2 | 0 | 2 | 3 |

COURSE OBJECTIVES:

1. To understand the metallurgy of casting.
2. To know the basic metallurgy of the weld joints and heat-affected zone of a metal or alloy.
3. To gain knowledge on powder metallurgy.
4. To acquire knowledge on microstructure of various metals.

UNIT I CASTING METALLURGY**12**

Introduction to physical and mechanical metallurgy. Introduction to casting processes. Phenomenon of solidification. Microstructure – grains, grain boundaries, dendrites, ASTM grain size, defects like porosity, blowholes, inhomogeneous segregation, and shrinkage. Effects of cooling rate on microstructure of castings. Effects of Microstructure on mechanical properties. Preheat and post heat treatment of castings.

UNIT II WELDING METALLURGY**12**

Welding processes - Transformations in weldments, residual stresses, distortions and defects in arc welding, gas welding, resistance welding, friction stir welding, TIG & MIG welding processes. Significance of phase diagrams for metals and alloys. Weldability issues in ferrous and non-ferrous materials. Introduction to heat affected zones and properties. Concept of solidification in welding. Preheat and post-weld heat treatments.

UNIT III POWDER METALLURGY**12**

Introduction - Powder Fabrication - Different powder fabrication techniques. Powder Characterization. Compressibility and green strength. Powder preparation & powder packing. Phenomenology of Powder Compaction; Influence of Material and Powder Characteristics. Sintering. Micro and macro structure of powder metallurgy products. Applications of powder metallurgy. Case studies on powder-metallurgy products.

UNIT IV MICROSTRUCTURE STUDIES ON FERROUS MATERIALS**12**

Study of metallurgical microscope and scanning electron microscope, Preparation of specimen for microstructural studies, Investigation of microstructure of - Plain carbon steels, heat-treated mild steel and Stainless steel, Welded Joints and Heat affected zone and Cast Steel

UNIT V MICROSTRUCTURE STUDIES ON NON-FERROUS MATERIALS**12**

Investigation of microstructure of Wrought Aluminum, Magnesium alloys and Copper alloys, Super alloys. Grain size & flake size measurement of alloys using image processing technique. Investigation of microstructure of powder sintered components and aluminum castings.

TOTAL: 60 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, Students will be able to: | | |
| CO1 | Interpret the grain size and morphology of different metal castings and relate the | 3 |

| | | |
|------------|---|---|
| | heat treatment and microstructures. | |
| CO2 | Demonstrate the effects of welding on the properties of ferrous and non-ferrous alloys. | 3 |
| CO3 | Outline the characterization of powder metallurgy materials. | 4 |
| CO4 | Analyze the microstructure of steels and effect of heat treatment on microstructure. | 4 |
| CO5 | Analyze the microstructure of aluminum, Magnesium, copper alloys and castings using metallurgical microscope. | 4 |

TEXTBOOKS:

1. John Campbell, "Complete Casting Handbook: Metal Casting Processes, Metallurgy, Techniques and Design", Butterworth-Heinemann; 2nd edition, 2015
2. Sindo Kou, "Welding Metallurgy", A John Wiley & Sons, 2nd edition, 2002.
3. Anish Upadhyaya & Gopal Shankar Upadhyaya, "Powder Metallurgy: Science, Technology, and Materials", Universities Press; 1st edition, 2011.

REFERENCES:

1. R. Balasubramaniam, "Callister's Materials Science and Engineering, 2nd edition, 2014.
2. George E. Dieter, "Mechanical Metallurgy", McGraw Hill Education; 3rd edition, 2017.
3. John K. C. "Metal Casting and Joining", PHI Learning Pvt. Ltd, 1st edition, 2015.
4. Dr. M. Mohandass, "Material Testing and Metallurgy Laboratory Manual", SVCE, 2018.

E-RESOURCES:

1. https://www.iitg.ac.in/engfac/ganu/public_html/Powdermetallurgy.pdf
2. https://archive.nptel.ac.in/content/syllabus_pdf/113106098.pdf
3. Dr. K. Ramesh, "Strength of Materials Laboratory Manual" IITM, 2003.

| COURSE ARTICULATION MATRIX | | | | | | | | | | | | | | | |
|----------------------------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | | | 1 | | 1 | | | | | | | | 2 | |
| 2 | 3 | | | | | 1 | | | | | | | | 2 | |
| 3 | 3 | | | 1 | | 1 | | | | | | | | 2 | |
| 4 | 2 | 3 | 3 | 3 | 3 | | | | 3 | 2 | 2 | | | 2 | |
| 5 | 2 | 3 | 3 | 3 | 3 | | | | 3 | 2 | 2 | | | 2 | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| Sl. No. | Description of Equipment/Software | Qty |
|---------|-----------------------------------|-----|
| 1. | Metallurgical Microscopes | 1 |
| 2. | Muffle Furnace (1000° C) | 1 |
| 3. | Image processing software | 1 |
| 4. | Jomney End-quench apparatus | 1 |



| | | | |
|----------|----------|----------|------------|
| L | T | P | C |
| 0 | 0 | 3 | 1.5 |

COURSE OBJECTIVES:

1. To impart the practical knowledge in conducting machining operations on various machine tools
2. To impart skills to interpret a product drawing and identify the appropriate machine tools for the manufacture and assembly of the product

LIST OF EXPERIMENTS

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical Gear Cutting in milling machine
4. Gear generation in hobbing machine
5. Gear generation in gear shaping machine
6. Cylindrical grinding
7. Tool angle grinding with tool and Cutter Grinder
8. Measurement of cutting forces in Turning Process
9. Round to square using shaper
10. Round to hexagon using milling
11. Drilling and tapping in a radial drilling machine (Practice with and without drill jig)
12. Machining and assembly of components for the given product diagram using various machine tools
13. Machining of components for clearance/interference fits

| CO No | COURSE OUTCOMES | RBT Level |
|---|--|------------------|
| At the end of the course, learners will be able to: | | |
| CO1 | Perform machining operations in shaper and milling machine tools to generate planar surfaces. | 3 |
| CO2 | Manufacture the single point cutting tool for the given tool signature using tool and cutter grinding | 3 |
| CO3 | Calculate various force components in lathe machine tool by varying cutting parameters and interpret their influence on the force components during orthogonal cutting | 3 |
| CO4 | Select appropriate gear manufacturing methods for gear machining | 3 |
| CO5 | Interpret the given product drawing and chose various machine tools in sequence for the manufacture of various components and assemble the final product for the required fit. | 3 |

REFERENCES: (min 3, max 5)

1. Serop Kalpakjian & Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson India Education Services Pvt. Ltd, 7th edition, 2018
2. HMT, Production technology, Mc-Graw Hill, 2017
3. P N Rao, "Manufacturing Technology: Metal Cutting and Machine Tools", Mc-Graw Hill, Volume 2, 4th Edition, 2018
4. Hajra Choudhury, "Elements of Workshop Technology", Vol.II: Machine tools., Media Promoters &

E-RESOURCES: (including NPTEL course)

1. <https://archive.nptel.ac.in/courses/112/105/112105219/>
2. <https://archive.nptel.ac.in/courses/112/107/112107219/>
3. <https://archive.nptel.ac.in/courses/112/105/112105233/>
4. <https://archive.nptel.ac.in/courses/112/106/112106179/>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| 1. | 3 | | | | | | | | | | | | | | 3 | |
| 2. | 3 | | | | | | | | | | | | | | 3 | |
| 3. | 3 | 3 | | 3 | | | | | 3 | | | | | | 3 | |
| 4. | 3 | 3 | | | | | | | | | | | | | 3 | |
| 5. | 3 | 3 | 3 | 3 | | | | | 3 | | | | | | 3 | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Horizontal Milling Machine 2 No
2. Vertical Milling Machine 1 No
3. Cylindrical Grinding Machine 1 No
4. Lathe Tool Dynamometer
5. Gear hobbing machine 1 No
6. Tool and cutter grinder 1
7. Gear shaper 1 no
8. Cylindrical grinding machine 1 no
9. Universal milling machine 1 no
10. Lathe machine 5 Nos

| | | | |
|----------|----------|----------|------------|
| L | T | P | C |
| 0 | 0 | 3 | 1.5 |

COURSE OBJECTIVES:

- To supplement the theoretical knowledge gained in Mechanics of Solids and Material Characterization
- with practical testing for determining the strength of materials under externally applied different forms of load.
 - To enable the students to evaluate the strengths, hardness, and stiffness of the metallic materials.

LIST OF EXPERIMENTS

Tension test on a mild steel rod

Double shear test on Mild steel and Aluminum rods

Torsion test on mild steel rod

Impact test on mild steel specimen (Charpy & Izod)

Hardness test on metals – Vickers Micro-hardness, Brinell and Rockwell Hardness Number

Deflection test on beams (Simply supported and Cantilever)

Compression test on helical springs

Comparison of Mechanical properties of steel using impact test.

i. Unhardened specimen

ii. Quenched Specimen

iii. Quenched and tempered specimen

Comparison of Mechanical properties of steel using hardness test.

i. Unhardened specimen

ii. Quenched Specimen

iii. Quenched and tempered specimen

Hardenability test of steel using Jomney end quench method.

TOTAL: 45 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|--|--|------------------|
| At the end of the course, Students will be able to | | |
| CO1 | Determine the various mechanical properties like hardness, strength (yield, ultimate, fracture), impact using Rockwell & Brinell hardness tester, universal testing machine and impact testing machine respectively. | 3 |
| CO2 | Evaluate the Young's modulus of steel & aluminum beams using simply supported and cantilever methods. | 3 |
| CO3 | Evaluate the stiffness and spring index of alloy spring steel using compression test. | 3 |
| CO4 | Analyze the medium carbon steel hardenability using Jomney end-quench testing. | 4 |

REFERENCES:

- Strength of materials laboratory manual.
- IS1786-2008, specification for cold worked steel high strength deformed bars for concrete reinforcement, 2008.

E-RESOURCES:

1. <https://sm-nitk.vlabs.ac.in/List%20of%20experiments.html>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | | | | 3 | | | | 3 | | | | 3 | | |
| 2 | 3 | | | | 3 | | | | 3 | | | | 3 | | |
| 3 | 3 | | | | 3 | | | | 3 | | | | 3 | | |
| 4 | 3 | | | | 3 | | | | 3 | | | | 3 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| S. No. | Description of Equipment | Qty |
|--------|--|-----|
| 1. | Universal Tensile Testing Machine with Double Shear attachment (40 Ton Capacity) | 1 |
| 2. | Torsion Testing Machine (60 Nm capacity) | 1 |
| 3. | Impact Testing Machine (300 Nm capacity) | 1 |
| 4. | Brinell Hardness Testing Machine | 1 |
| 5. | Rockwell Hardness Testing Machine | 1 |
| 6. | Spring Testing Machine for Tensile and Compressive loads (2500 N) | 1 |
| 7. | Muffle Furnace (800°C) | 1 |
| 8. | Vickers Micro Hardness Tester | 1 |
| 9. | Deflection (Beam) testing setup – Simply Supported & Cantilever | 1 |
| 10. | Jomni End Quench Test Setup | 1 |

IV SEMESTER

ME22401

FLUID MECHANICS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

COURSE OBJECTIVES:

1. To make students to understand the Fluid properties.
2. To make students to calculate the flow.
3. To make students to calculate the interaction of compressible flow and incompressible flow.
4. To make students to do dimensional and model analysis.

UNIT I FLUID PROPERTIES AND STATICS

9

Introduction to Fluid Properties and Statics: Fluids and continuum, Physical properties of fluids, Newton's law of viscosity. Ideal and real fluids, Newtonian and non - Newtonian fluids. Other transport properties of fluids. Pressure Measurements, Manometry. Fluid Statics-Pressure-density-height relationship. Hydrostatic forces on a plane and a curved surface. Buoyancy, Flotation and Stability.

UNIT II FLUID KINEMATICS

9

Types of Motion and deformation for a fluid element. Velocity field – Eulerian and Lagrangian flow description, Classification of fluid flow streamline, path line and streak lines, Acceleration field. Introduction to stream function. Velocity potential and potential function. Divergence and Curl, Vorticity, Control Volume and System representations, Reynolds transport theorem.

UNIT III FUNDAMENTALS OF FLUID DYNAMICS

9

Elementary Fluid dynamics – Euler and Bernoulli's Equations and their applications; Restrictions on the use of Euler and Bernoulli's Equations. Differential and Finite control volume approach for the fluid flow.

Inviscid and incompressible flow- Some basic planes and potential flows and their superposition. Viscous flow – Simple viscous and incompressible flows. Flow over immersed bodies-Prandtl/Blasius Equation – Prandtl/Blasius Boundary Layer solutions. Flow in pipes – Major and Minor losses – Darcy Weisbach Equation – Moody diagram - Flow in series and parallel pipes and pipe networks. Hydraulic and Energy gradient lines.

UNIT IV FUNDAMENTALS OF COMPRESSIBLE FLOW

9

Ideal Gas relationship-Mach Number and Speed of sound – Isentropic flow of an Ideal Gas – Effect of Variation in flow cross section – Converging and diverging duct flow- Constant area duct flow.

Non-Isentropic flow – Fanno and Rayleigh flows. Flow with shock – Normal shocks. (Only qualitative treatment)

UNIT V SIMILITUDE, DIMENSIONAL ANALYSIS AND MODELING

9

Dimensional Analysis – Buckingham Pi theorem – Common dimensionless groups in fluid mechanics. Correlation of experimental data. Modelling and similitude – Theory of models and Model scales. Practical aspects of Using Models.

TOTAL: 45 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|---|---|-----------|
| At the end of the course, Students will be able to: | | |
| CO1 | Calculate the various properties of the fluids using fundamental relationships and calculate the hydrostatic forces on the submerged objects. | 3 |
| CO2 | Calculate and draw the velocity and acceleration field vectors by knowing the potential and/or stream functions and apply the Reynolds Transport theorem. | 3 |
| CO3 | Calculate the forces acting on the various surfaces and pressure drop in the flow. | 3 |
| CO4 | Calculate the flow parameters in a compressible fluid flow. | 3 |
| CO5 | Perform Dimensional analysis and model analysis. | 3 |

TEXTBOOKS:

- Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Alric P. Rothmayer Fundamentals of fluid mechanics - John Wiley & Sons, Inc. 7th Edition – 2013.
- Modi P.N., and Seth S.M., “Hydraulics and Fluid Mechanics Including Hydraulic Machines (In SI Units) – 21st Edition - 2017

REFERENCES:

- Frank m. White Henry Xue – Fluid Mechanics – McGraw-Hill Education 9th edition 2022
- John Anderson, Fundamentals of Aerodynamics- McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121 6th Edition 2017
- Victor Streeter, E. Benjamin Wylie, K.W. Bedford - Fluid Mechanics – Indian edition 2017
- Philip J. Pritchard Fox and McDonald’s Introduction To Fluid Mechanics – John Wiley & Sons, Inc. 8th Edition - 2011
- Yunus A. Cengel, John M. Cimbala - Fluid Mechanics - 4th Edition - 2017

E-RESOURCES:

- <https://nptel.ac.in/courses/112104118>
- <https://nptel.ac.in/courses/105103192>
- E Resource: <https://archive.nptel.ac.in/courses/112/105/112105171/>
- <https://nptel.ac.in/courses/112105269>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| 1. | 3 | 3 | 3 | 2 | | | | | | | | | | | | 2 |
| 2. | 3 | 3 | 3 | 2 | | | | | | | | | | | | 2 |
| 3. | 3 | 3 | 3 | 2 | | | | | | | | | | | | 2 |
| 4. | 3 | 3 | 3 | 2 | | | | | | | | | | | | 2 |
| 5. | 3 | 3 | 3 | 2 | | | | | | | | | | | | 2 |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| | | | |
|----------|----------|----------|----------|
| L | T | P | C |
| 2 | 1 | 0 | 3 |

COURSE OBJECTIVES:

1. To study the basic components of mechanisms, analyzing the mechanisms with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
2. To acquire knowledge about basic approach to solve forward Kinematics of one DOF planar robot.
3. To design the cam profile for specified output motions and to study the gear parameters.
4. To learn the effects of friction and its influence in machine elements.

UNIT I KINEMATICS OF MECHANISMS**9**

Mechanisms – Terminology and definitions –Mobility and range of movement - Kutzbach and Grubler's criterion, Grashof's criterion. Kinematics inversions of four bar and slide crank chain –Description of some common mechanisms – Quick return mechanisms, Straight line generators – Spherical and Spatial Mechanisms - Network formula – Gross motion concept - Compliant Mechanisms -Equivalent mechanisms.

UNIT II KINEMATICS SYNTHESIS AND ANALYSIS**9**

Synthesis - Number Synthesis, Dimensional synthesis of mechanism; motion, path and function generation, precision point approach, Chebyshev spacing, Position Analysis. Vector loop equations for four bar and slider crank mechanisms

Analysis of simple mechanisms - Single slider crank mechanism and four bar mechanism – Graphical Methods for displacement, velocity, and acceleration - velocity and acceleration polygons.

Instantaneous Centre of Velocity, Coriolis Component of acceleration in Shaping machine mechanism.

UNIT III ROBOT KINEMATICS**9**

Introduction to Robotics – Terminologies – Classifications. Overview – Links & Joints - Degrees of Freedoms - Coordinate Systems - Position and Orientation of Objects - Roll, Pitch and Yaw Angles - Need for forward and Inverse Kinematics Equation – Parameters in Design and Control – Methods of forward and inverse kinematics for one degree of freedom of a Planar Robot.

UNIT IV GEAR, GEAR TRAINS AND CAMS**9**

Gears – law of toothed gearing – Involute gearing – Gear tooth action- interference and undercutting – minimum number of teeth, contact ratio. Gear trains – Epicyclic gear trains –Speed ratio.

Classification of followers and cams, Terminology, and definitions – Displacement diagrams –Uniform velocity and simple harmonic motions, Graphical approach.

UNIT V FRICTION IN MACHINE ELEMENTS**9**

Surface contacts – Types of friction – Friction drives – Friction in screw threads – Friction in clutches – Friction aspects in brakes.

TOTAL: 45 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|--|--|------------------|
| At the end of the course, Students will be able to | | |
| CO1 | Classify the mechanisms involved in various applications. | 2 |
| CO2 | Select, configure, and synthesize linkages into complete mechanisms. | 3 |

| | | |
|------------|---|---|
| CO3 | Apply the concept of kinematics for robot motion control. | 3 |
| CO4 | Calculate the relevant kinematic parameters of cam and gear mechanisms. | 3 |
| CO5 | Apply the concepts of friction in real time applications. | 3 |

TEXTBOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2017
2. Ramamurthi. V, “Mechanics of Machines”, Narosa Publishing House, 3rd Edition, 2019
3. Mikell P. Groover, "Industrial Robotics", McGraw Hill, 2nd Edition, 2018
4. John J. Craig, “Introduction to Robotics”, 4th Edition, Pearson 2017

REFERENCES:

1. K. J, Waldron and G. L Kinzel, Sunil K. Agrawal, Kinematics, Dynamics and Design of Machinery, 3rd Edition, Wiley Student Edition, 2016.
2. Rao.J.S. and Dukkupati.R.V. “Mechanism and Machine Theory”, New Age International Pvt. Ltd., 2nd Edition, 2014
3. Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 5th Edition, 2019.
4. R. L. Norton, Kinematics and Dynamics of Machinery, Tata Mcgraw Hill, 2017.
5. Lynch, Kevin M., and Frank C. Park. Modern Robotics: Mechanics, Planning, and Control 1st Edition, Cambridge University Press, 2017.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_me21
2. https://onlinecourses.nptel.ac.in/noc22_me108
3. <https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-me08>
4. <http://www.roboanalyzer.com>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----------|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1. | 3 | 2 | 2 | | 2 | | | 1 | | | | 1 | 3 | | |
| 2. | 3 | 2 | 2 | | 2 | | | 1 | | | | 1 | 3 | | |
| 3. | 3 | 2 | 2 | | 2 | | | 1 | | | | 1 | 3 | | |
| 4. | 3 | 2 | 2 | | 2 | | | 1 | | | | 1 | 3 | | |
| 5. | 3 | 2 | 2 | | 2 | | | 1 | | | | 1 | 3 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

COURSE OBJECTIVES:

1. To integrate the concepts, laws, and methodologies from the first course in thermodynamics into analysis of cyclic processes.
2. To understand the working principles of advanced IC Engines and evaluate its performances.
3. To apply the thermodynamic concepts into various thermal applications like Steam nozzles, Steam turbines, Compressors, Refrigeration and Air conditioning systems.

UNIT I FUNDAMENTALS OF IC ENGINES AND GAS POWER CYCLES 9

Working principles of IC engines. Classifications-Components and their functions. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Otto, Diesel, Dual, Brayton cycles - Calculation of mean effective pressure and air standard efficiency, Comparison of cycles.

UNIT II INTERNAL COMBUSTION ENGINES SYSTEM AND PERFORMANCE 9

Simple Carburetor, MPFI, Diesel pump and injector system, CRDI. Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculations -Fuel consumption, Brake power, Indicated power, Friction power, Thermal efficiencies, and Heat Balance sheet.

UNIT III STEAM NOZZLES AND TURBINES 9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, super saturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations- Governors.

UNIT IV AIR COMPRESSORS 9

Classification and working principle of reciprocating compressors - compression work with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and intercooling - work done. Working Principle of different types of rotary compressors (descriptive only).

UNIT V REFRIGERATION AND AIR CONDITIONING 9

Refrigeration -Vapour compression refrigeration cycle - Effect of super heating and subcooling - Performance calculations - working principle of Vapour absorption system, Ammonia-Water, Lithium bromide-water systems (descriptive only). Air conditioning system - Processes, Types and Working Principles -Concept of RSHF, GSHF, ESHF- Cooling load estimation (descriptive only). Refrigerants - desirable properties, refrigerants used in modern Refrigerators and Air conditioners.

TOTAL: 45 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|--|---|-----------|
| At the end of the course, Students will be able to | | |
| CO1 | Compare the various system & components of IC engine and to analyze their performance of air standard cycles. | 4 |
| CO2 | Understand the various system used in IC engine and to analyze their performance. | 4 |
| CO3 | Distinguish the different types of nozzles and turbine, and to analyze their performance. | 4 |
| CO4 | Distinguish the different types of air compressor and to analyze their performance. | 4 |
| CO5 | Analyze the performance of different air conditioning and Refrigeration system. | 4 |

TEXTBOOKS:

1. Kothandaraman. C.P., Domkundwar. S, Domkundwar. A.V., "A course in Thermal Engineering", Fifth Edition, Dhanpat Rai & Sons, 2002
2. Rajput. R.K., "Thermal Engineering", Laxmi Publications, Tenth Edition, 2017.

REFERENCES:

1. Arora. C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers, (Third Edition) 2013.
2. Ganesan.V, "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.
3. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
4. Rudramoorthy. R., "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.
5. Sarkar. B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2007

E-RESOURCES:

1. <https://nptel.ac.in/courses/112106133>
2. <https://nptel.ac.in/courses/112103262>
3. <https://www.youtube.com/watch?v=ZBfmj4PRoRA>
4. <https://archive.nptel.ac.in/courses/112/105/112105129/>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| 1 | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 2 | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 3 | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 4 | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| 5 | 3 | 3 | 3 | 3 | | | | | | | | | | | | 3 |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

OBJECTIVES:

1. To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize the biodiversity of India and its conservation.
2. To impart knowledge on the causes, effects and control or prevention measures of environmental pollution.
3. To study and understand the various types of renewable sources of energy and their applications.
4. To familiarize the concept of sustainable development goals, economic and social aspects of sustainability, recognize and analyze climate changes, and environmental management challenges.
5. To inculcate and embrace sustainability practices, develop a broader understanding of green materials and energy cycles, and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– food chains, food webs and ecological pyramids, ecological succession. Biodiversity- types- genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: fragmentation and habitat loss, poaching of wildlife, human-wildlife conflicts – endangered and endemic species of India –conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition, causes, effects and preventive measures of air, water and soil pollution. Marine and thermal pollution - causes, effects and control measures. Light and noise pollution - effect on flora and fauna. Nuclear pollution- Sources, effects and control measures. Disposal of radioactive wastes (Nuclear hazards). Pollution case studies. Role of an individual in the prevention of pollution. Solid, hazardous and E-waste management. Occupational health and safety management system (OHSASMS). Environmental protection, Environmental protection acts, categorization of species according to IUCN.

UNIT III RENEWABLE SOURCES OF ENERGY 9

Energy resources: Growing energy needs, Nonrenewable resources – types, uses. Energy management and conservation - New energy sources, Need of new sources - geo suitability of establishing renewable energy sources, different types new energy sources. Applications of hydrogen energy, ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. Role of an individual in conservation of energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 9

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols, Sustainable Development Goals-targets, indicators and intervention areas - Principles of green chemistry, Climate change- Global, Regional and local environmental issues and possible solutions-case studies - Role of non-governmental organization, Concept of carbon credit, carbon footprint - Environmental management in industry - A case study

UNIT V SUSTAINABILITY PRACTICES**9**

Zero waste and R concept, circular economy, ISO 18000 series, material life cycle assessment, environmental impact assessment. Wasteland reclamation, Sustainable habitat: green buildings, green materials, energy efficiency and energy audit, sustainable transports. Energy cycles, carbon cycle, emission and sequestration, Green engineering: sustainable urbanization- socio-economical and technological change. Rainwater harvesting, watershed management, environmental ethics: Issues and possible solutions.

TOTAL: 45

| CO No | COURSE OUTCOMES: | RBT LEVEL |
|--|--|-----------|
| After completion of this course, the students will be able to | | |
| CO 1 | Recognize the fundamental role of ecosystems and suggest an appropriate method for the conservation of biodiversity. | 3 |
| CO 2 | Describe the different types of pollution, their effects and strategies to control pollution. | 3 |
| CO 3 | Identify the various renewable energy resources and use the appropriate one thereby conserving non-renewable resources for future generation. | 3 |
| CO 4 | Explain the various goals of sustainable development applicable to suitable technological advancement and societal development. | 2 |
| CO 5 | Summarize the various sustainability practices, green materials, energy cycles, and the role of green engineering in sustainable urbanization. | 2 |

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 7th Edition, New Age International Publishers, 2022.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Pearson. 2011.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, CL Engineering, 2015.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

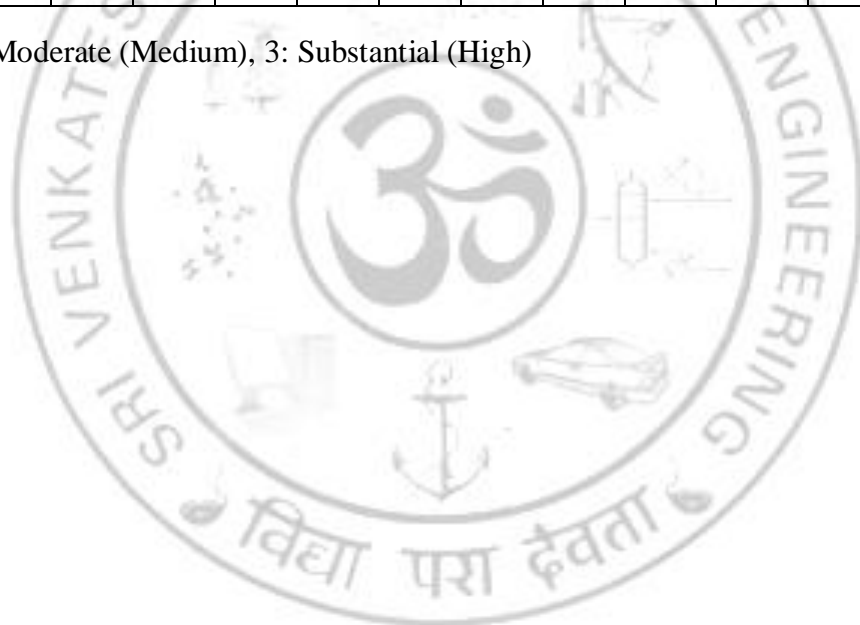
REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38

2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 3rdedition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 3rd edition, 2021.

| COs | POs | | | | | | | | | | | | PSOs | | |
|------------|----------|---|----------|---|---|----------|----------|----------|---|----------|----|----------|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | | | | | 3 | 3 | 2 | | 2 | | 1 | | | |
| CO2 | 3 | | | | | 3 | 3 | 2 | | 2 | | 2 | | | |
| CO3 | 3 | | 1 | | | 3 | 3 | 1 | | 2 | | 1 | | | |
| CO4 | 3 | | | | | 3 | 3 | 3 | | 2 | | 2 | | | |
| CO5 | 3 | | | | | 3 | 3 | 3 | | 2 | | 2 | | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)



MN22408

**HYDRAULICS AND PNEUMATICS FOR
AUTOMATION:
THEORY AND PRACTICES**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

COURSE OBJECTIVES:

1. To appreciate the fundamental principles of Fluid Power System
2. To gain knowledge on the construction and working principle of various components used in hydraulic and pneumatic systems.
3. To design hydraulic and pneumatic circuits for different machine tool applications.
4. To apply the principles of fluid power circuits for various industrial applications.

UNIT I INTRODUCTION TO FLUID POWER AND PUMPS

12

Introduction to Fluid power - Advantages and Applications. Types of fluid power system - Hydraulics and Pneumatics. Hydraulic fluids, Pascal's Law, Darcy's equation. Valves and fittings. Losses in pipes and fittings - K factor.

Pumping Theory – Pump Classification- Construction, Working, Advantages, Disadvantages, Selection criterion of Linear & Rotary pumps.

UNIT II HYDRAULIC AND PNEUMATIC SYSTEM COMPONENTS

12

Hydraulic Actuators - Cylinders & Motors – Types and construction, Cylinder cushioning and mounting. Control Components - Directional control, Flow control and Pressure control valves - Types, Construction, Operation and Applications. Fluid Power ANSI Symbol. Maintenance of hydraulic components.

Properties of Pneumatic gases and air. Compressors- Types and Working principle. Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Maintenance of pneumatic components.

UNIT III ELECTRICAL, ELECTRONICS AND OTHER ACCESSORIES

12

Accessories - Pressure Switches, Electrical switches, Limit switches, Relays. PLC, Microcontroller. Types of Accumulators – applications - Pressure Intensifier.

Air-over oil system, Hydrostatic transmission, Electro-hydraulic and Mechanical Hydraulic servo systems. Low-cost automation using fluid power systems.

UNIT IV DESIGN OF HYDRAULIC CIRCUITS

12

Design of hydraulic circuit to perform punching, drilling, and pressing operations using basic hydraulic kit, Design of cascade hydraulic circuit to perform automatic forging operation using PLC electrohydraulic kit , Design and simulation of various hydraulic circuits using Automation Studio software

UNIT V DESIGN OF PNEUMATIC CIRCUITS

12

Design of pneumatic circuit to perform bending, blanking, and shaping operations using basic pneumatic kit, Design of cascade pneumatic circuit to perform automatic punching operation using PLC electro pneumatic kit, Design and simulation of various pneumatic circuits using Automation Studio software.

TOTAL: 60 PERIODS

| CO No | COURSE OUTCOMES | RBT Level |
|--|--|-----------|
| At the end of the course, Students will be able to | | |
| CO1 | Select Hydraulic fluids and pumps for various operating conditions. | 3 |
| CO2 | Select the hydraulic and pneumatic components for different industrial applications and learn the maintenance of fluid power components. | 4 |
| CO3 | Select the electrical and electronic control devices for designing the hydraulic and pneumatic circuits. | 3 |
| CO4 | Design the hydraulics circuits for different industrial applications. | 3 |
| CO5 | Design the pneumatic circuits for different industrial applications. | 3 |

TEXTBOOKS:

1. Anthony Esposito, Fluid Power with Applications, Pearson Education, 7th edition, 2013.
2. James L. Johnson, Introduction to Fluid Power, Cengage Learning, Inc, 2002.

REFERENCES:

1. Majumdar, S.R., Oil Hydraulics Systems-Principles and Maintenance, Tata McGraw-Hill, 2007.
2. Majumdar, S.R., Pneumatic Systems-Principles and Maintenance, Tata McGraw-Hill, 2007.
3. Dudelyt, A Pease and John J. Pippenger, Basic Fluid Power, Prentice Hall, 1987.
4. Srinivasan. R., Hydraulic and Pneumatic Controls, 3rd Edition, Vijay Nicole Imprints, 2019.

E-RESOURCES:

1. <https://amatrol.com/products-training-assessment-solutions/ebooks/>
2. <https://archive.nptel.ac.in/courses/112/106/112106300/>
3. <https://www.my-mooc.com/en/mooc/fluidpower/>

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | | | | | | | | 2 | | | 2 | 2 | | |
| 2 | | | 2 | | 2 | 2 | | | | | | | 2 | | |
| 3 | 2 | | 2 | | 2 | | | | 2 | | | 2 | 2 | 2 | |
| 4 | 3 | | 3 | | 3 | | | | 3 | | | | 3 | 3 | |
| 5 | 3 | | 3 | | 3 | | | | 3 | | | | 3 | 3 | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. **Basic pneumatic trainer kit**
2. **Electro pneumatic trainer kit**
3. **Electro pneumatic PLC trainer kit**
4. **Basic hydraulic trainer kit**
5. **Electrohydraulic PLC trainer kit**
6. **Automation Studio Software – 5 licenses**
7. **Fluid SIM software – 5 licenses**



| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 2 |

COURSE OBJECTIVES

1. To understand the concept of design thinking and define the problems effectively.
2. To develop skills in ideation, prototyping, and user feedback.
3. To develop skills in testing, finalizing designs, and overcoming resistance.
4. To apply design thinking in business/startup, validate solutions, and develop team project skills while considering ethical and social needs.

UNIT I DESIGN THINKING PROCESS AND TOOLS 12

A brief insight to design thinking and innovation - people centered design & evoking the right problem - Purpose of design thinking - design thinking framework, design thinking process, design thinking tools, Empathy - Uncovering and investigating community concerns - Define: Examine and Reflect on the problem.

UNIT II CONCEPT GENERATION AND BUILDING 11

Design team-Team formation, Conceptualization: Visual thinking, Sketching/Drawing, new concept thinking, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies. Patents and Intellectual Property.

UNIT III TEST, REFINE AND PITCH IDEAS 12

Importance of testing, Testing the design with people - Retest and Redefine Results - Creating a pitch for the design.

UNIT IV VALUE PROPOSITION DESIGN 10

Business Vs Startup - Briefing the problem - Problem Validation and user discovery - Briefing the Challenges.

TOTAL: 45 PERIODS**Guidelines**

- Two assignments, two seminars and two Formative assignment tests are mandatory.
- All the students enrolled for this course must do design project work based on design thinking strategies.
- The team should submit a project report as documents at the end of the semester.
- A maximum of 3 students are permitted in a team.

End semester:

End semester examination will be conducted as VIVA VOCE by presenting the project work carried out by the students.

| CO No | COURSE OUTCOMES | RBT Level |
|---|--|-----------|
| At the end of the course, students will be able to: | | |
| CO1 | Understand design thinking principles and empathize with users to define the problem. | 2 |
| CO2 | Generate and evaluate ideas, develop prototypes, and iterate based on user feedback. | 4 |
| CO3 | Evaluate prototype effectiveness, finalize the design, and develop implementation strategies. | 4 |
| CO4 | Apply design thinking in business/startup, validate solutions, and present/implement final design. | 4 |

TEXTBOOKS:

1. Idris Mootee, Design thinking for strategic innovation, Wiley publications, 2013.
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd, 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011.

REFERENCES:

1. Ulrich & Eppinger, Product Design and Development, 3rd Edition, McGraw Hill, 2004.
Michael Lewrick, Patrick Link, and Larry Leifer, The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems, 2018, John Wiley & Sons.
2. Tom Kelley, The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm, Currency/Doubleday, 2001.
3. Kevin Otto, Kristin Wood, Product design, Pearson publications, 2001.
4. George Dieter, Linda Schmidt, Engineering Design, McGraw Hill, 2012.

E-Resources:

1. Design & Thinking Documentary, <https://nyu.kanopy.com/video/design-and-thinking>.
2. Christian Bason and Robert D. Austin, The Right Way to Lead Design Thinking.
3. Jon Kolko, Design Synthesis.
4. Dr. Ashwin Mahalingam, Prof. Bala Ramadurai, Design Thinking - A Primer, IIT Madras.
5. Lee-Sean Huang, Innovate with Design Thinking audio course, <https://knowable.fyi/courses/innovate-design-thinking/>
6. https://www.academia.edu/24919250/Understanding_the_behaviour_of_design_thinking_in_complex_environments

COURSE ARTICULATION MATRIX

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | | 3 | 1 | | 1 | | | 2 | 2 | 1 | | 2 | | |
| 2 | 2 | 1 | 2 | 1 | | 1 | | | 2 | 2 | 1 | | 2 | 2 | |
| 3 | 2 | | 3 | 1 | | 1 | | | 2 | 2 | 1 | | 2 | 1 | |
| 4 | 2 | 1 | 3 | 1 | | 2 | | | 3 | 3 | 2 | 1 | 2 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

| L | T | P | C |
|---|---|---|-----|
| 0 | 0 | 3 | 1.5 |

COURSE OBJECTIVES:

1. Create 3D models of parts and assembly, and exploded views of assembly using CAD software
2. To provide knowledge on three-dimensional model of simple mechanism and animation using CAD software.
3. To expose the knowledge to prepare the technical documents for the given components using software.

LIST OF EXPERIMENTS

1. Introduction to modeling software and Study of Drawing Sheet Layout and Drawing Standards. Sketch, Solid modeling- Extrude, Revolve, Sweep.
2. Solid modeling: Variational Sweep, Helical Sweep, Rotational Blend, Blend and Parametric modeling- conversion of STL format.
3. Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.
4. Create a surface model of Aero Foil / Blower upper housing / Bend Pipe with flange.
5. Construct a three-dimensional assembly model of Flange Coupling. **
6. Construct a three-dimensional assembly model of Screw Jack. **
7. Create a three-dimensional assembly model of Universal Coupling. **
8. Create a three-dimensional assembly model of kinematic mechanism and animate its working using modeling software.
9. Introduction to Generative Design for Weight Reduction of a support frame.
10. Generative Design for Weight Reduction of cycle frame.

****Drafting of standard assembly elements into Orthographic, Isometric and Sectional views with Bill of Materials.**

| CO No | COURSE OUTCOMES | RBT Level |
|---|---|-----------|
| At the end of the course, Students will be able to: | | |
| CO1 | Interpret the given 2D drawing and create a 3D part using 3D modeling software. | 4 |
| CO2 | Create a 3D assembly in the assembly module using the 3D parts created in the part modeling module. | 4 |
| CO3 | Generate 2D detail drawing for the given parts & assembly models. | 4 |
| CO4 | Analyze and interpret the kinematic links using 3D modeling software. | 4 |

REFERENCES:

1. Creo Parametric 4.0 Tutorials by Roger Too good, SDC Publications, 2017.
2. Creo Parametric 4.0 for Designers BY Sham Tickoo, BPB Publications, 2018.
3. Machine Drawing by K.R. Gopalakrishnan, 2018
4. Machine Drawing by K. L. Narayana, New Age Publications, 2012

E-RESOURCES:

1. <https://grabcad.com/tutorials/basic-creo-tutorials>
2. https://support.ptc.com/help/creo/creo_pma/r9.0/usascii/index.html#page/part_modeling/part_modeling/partmodeling.html#

3. <https://www.youtube.com/watch?v=bYKbYLfpk6k>
4. <https://www.youtube.com/watch?v=gJLAM54Vf-w>
5. <https://youtu.be/lhq-O5w6STU>

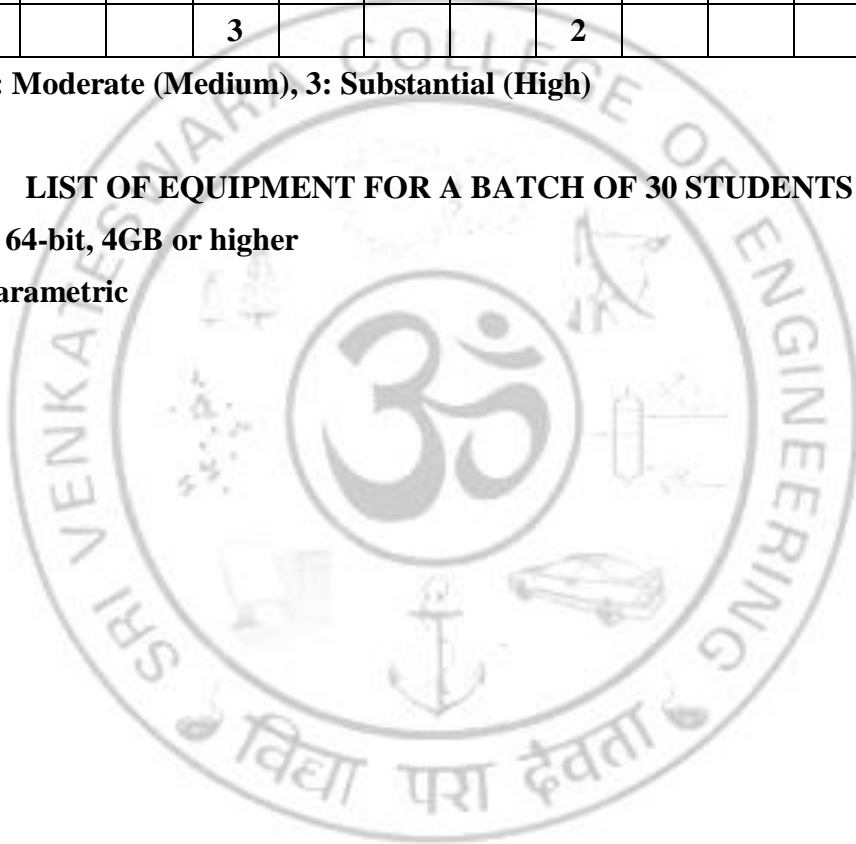
COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | | | | | 3 | | | | 2 | 2 | | | 2 | | |
| 2 | | | | | 3 | | | | 2 | | | | 3 | | |
| 3 | | | | | 3 | | | | 2 | 2 | | | 3 | | |
| 4 | | | | | 3 | | | | 2 | | | | 3 | | |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Windows 10 64-bit, 4GB or higher
2. PTC Creo parametric



ME22412

**FLUID AND THERMAL ENGINEERING
LABORATORY**

| | | | |
|----------|----------|----------|------------|
| L | T | P | C |
| 0 | 0 | 3 | 1.5 |

COURSE OBJECTIVES:

1. To gain hands on experience in flow measurements using different devices.
2. To calculate the frictional loss in pipes.
3. To study the performance characteristics of pumps and turbines.
4. To study the performance characteristics of diesel engine and compressor.
5. To study the properties of fuels/lubricants used in IC Engine.

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Venturi meter and Orifice meter
2. Determination of friction factor for a given set of pipes
3. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submersible pump
4. Conducting experiments and drawing the characteristic curves of reciprocating pump
5. Conducting experiments and drawing the characteristic curves of Gear pump
6. Conducting experiments and drawing the characteristic curves of Pelton wheel
7. Determination of viscosity and flash & fire point of fuels/Lubricants.
8. Port timing and Valve timing diagram of two and four stroke Engine.
9. Performance test on diesel engine
10. Performance test on air compressor
11. Heat Balance test on Diesel Engine
12. Retardation test on Diesel Engine

| CO No | COURSE OUTCOMES | RBT Level |
|---|--|------------------|
| At the end of the course, Students will be able to: | | |
| CO1 | Use the flow measurement equipment. | 3 |
| CO2 | Analyze the performance of various pumps. | 4 |
| CO3 | Analyze the performance of various turbines. | 4 |
| CO4 | Analyze the performance of diesel engine and compressors. | 4 |
| CO5 | Calculate the viscosity, flash & fire point of fuels/Lubricants. | 3 |

REFERENCES:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2019.
2. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Fluid Mechanics and Machinery", 2011
3. Rajput. R.K., "Thermal Engineering", Laxmi Publications, Tenth Edition, 2017
4. Ganesan, V "Internal Combustion Engines", fourth Edition, Tata McGraw-Hill, 201

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1. | 3 | 3 | | | | | | | | | | 2 | | | 3 |
| 2. | 3 | 3 | | | | | | | | | | 2 | | | 3 |
| 3. | 3 | 3 | | | | | | | | | | 2 | | | 3 |
| 4. | 3 | 3 | | | | 1 | | | | | | 2 | | | 3 |
| 5. | 3 | 3 | | | | | | | | | | 2 | | | 3 |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Venturi meter setup and Orifice meter setup
2. Pipe Flow analysis setup
3. Centrifugal pump setup
4. Reciprocating pump setup
5. Gear pump setup
6. Pelton wheel setup
7. Apparatus for Flash and Fire Point and viscometer
8. 4-stroke Diesel Engine with hydraulic loading
9. Four Stroke Diesel Engine with Mechanical Loading
10. Steam Boiler setup
11. Air compressor
12. Cut Section model of two stroke and Four Stroke Engine

COURSE OBJECTIVES:

- To provide a complete review of Mechanical Engineering topics covered in second, third and Fourth semesters so that a comprehensive understanding is achieved.
- To strengthen the students in fundamentals pertaining to core courses
- To make the students to face job interviews, competitive examinations and to enhance the employment potential

CONTENTS

1. Fundamentals of Engineering drawing
2. Fundamentals of Engineering Mechanics
3. Basics of Geometric Dimensioning and Tolerancing
4. Basics of Metal forming processes
5. Basics of Metal Machining processes
6. Fundamentals of Thermodynamics
7. Fundamentals of Strength of Materials
8. Fundamentals of Thermal Engineering

| CO No | COURSE OUTCOMES | RBT Level |
|---|---|-----------|
| At the end of the course, Students will be able to: | | |
| CO1 | Understand and strengthen the fundamentals in Engineering science courses | 3 |
| CO2 | Understand and strengthen the fundamentals in Professional core courses | 3 |

Evaluation

After revising the fundamentals, a Multiple-Choice questions-based test will be conducted every week in each subject. The grade will be awarded based on the score secured by the students in each subject.

COURSE ARTICULATION MATRIX:

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1. | 3 | | | | | | | | | | | | 3 | 3 | 3 |
| 2. | 3 | | | | | | | | | | | | 3 | 3 | 3 |
| 3. | 3 | | | | | | | | | | | | 3 | 3 | 3 |
| 4. | 3 | | | | | | | | | | | | 3 | 3 | 3 |
| 5. | 3 | | | | | | | | | | | | 3 | 3 | 3 |

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)