**I SEMESTER Bachelor of Engineering**

**Three week long mandatory non- credit Induction Program**

For the UG students entering the institution, right at the start.

Normal classes start only after the Induction program is completed.

**Preamble:**

- Engineering institutions are set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society.
- However, often, the incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents.
- As a result, most students fail to link up with the goals of their own institution.
- Students, who enter an institution, will have come with diverse thoughts, backgrounds and preparations.
- It is important to help them adjust to the new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large and nature, and inculcate in them the ethos of the institution with a sense of larger purpose.
- The graduating student must have knowledge and skills in the area of his study.
- Character needs to be nurtured as an essential quality by which he/she would understand and full his/her responsibility as an engineer, a citizen and a human being.
- Besides the above, several meta-skills and underlying values are needed.

Therefore, a Program is needed to

- Help the newly joined students feel comfortable,
- Sensitize them towards exploring their academic interests and activities,
- Train them to work for excellence,
- Build relations between teachers and students,
- Impart a broader view of life,
- Build character,
- Develop awareness and sensitivity to human values,
- Create feeling of equality, compassion and oneness,
- Develop attention to society and nature.

An induction program for the UG students entering the institution, right at the start, serves the purpose.

- The program also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others).

- It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.
- The Induction Program can also be used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

**Activities of the induction program**

- Induction program includes Physical Activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to Local Area, Familiarization to Department / Branch and Innovations, etc.
- For more details refer to "A Guide to Induction Program", Page – 31, Model Curriculum for Undergraduate Degree Courses in Engineering and Technology, January 2018, Volume I.

| I SEMESTER B.E (PHYSICS GROUP) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Course and Course Code | | Course Title | Teaching Department | Paper Setting Board | Teaching Hours /Week | | Examination | | | | | Credits |
| | | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | | L | T | P | | | | | |
| 1 | BC | 18MA11 | Calculus and Linear Algebra | Mathematics | Science | 3 | 2 | -- | 3 | 50 | 50 | 100 | 4 |
| 2 | BC | 18PH12 | Engineering Physics | Physics | Science | 3 | 2 | -- | 3 | 50 | 50 | 100 | 4 |
| 3 | ES | 18EE13 | Basic Electrical Engineering | E and E Engineering | E and E Engineering | 2 | 2 | -- | 3 | 50 | 50 | 100 | 3 |
| 4 | ES | 18CV14 | Civil Engineering and Mechanics | Civil Engineering | Civil Engineering | 2 | 2 | -- | 3 | 50 | 50 | 100 | 3 |
| 5 | ES | 18MEL15 | Computer Aided Engineering Drawing | ME | Mechanical Engineering | 2 | -- | 2 | 3 | 50 | 50 | 100 | 3 |
| 6 | BC | 18PHL16 | Engineering Physics Laboratory | Physics | Science | -- | -- | 2 | 3 | 50 | 50 | 100 | 1 |
| 7 | ES | 18EEL17 | Basic Electrical Engineering Laboratory | E and E Engineering | E and E Engineering | -- | -- | 2 | 3 | 50 | 50 | 100 | 1 |
| 8 | HS | 18HS11/ 18HS12 | English / Kannada | Humanities | Humanities | 1 | -- | 2 | 2 | 50 | 50 | 100 | 1 |
| 9 | HS | 18HS13 | Career Development Skills | Humanities | Humanities | 2 | -- | -- | 2 | 50 | -- | 50 | -- |
| | | | | | **TOTAL** | **15** | **8** | **8** | **25** | **450** | **400** | **850** | **20** |

| I SEMESTER B.E (CHEMISTRY GROUP) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Course and Course Code | | Course Title | Teaching Department | Paper Setting Board | Teaching Hours /Week | | Examination | | | | | |
| | | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | Credits |
| | | | | | | L | T | P | | | | | |
| 1 | BC | 18MA11 | Calculus and Linear Algebra | Mathematics | Science | 3 | 2 | -- | 3 | 50 | 50 | 100 | 4 |
| 2 | BC | 18CH12 | Engineering Chemistry | Chemistry | Science | 3 | 2 | -- | 3 | 50 | 50 | 100 | 4 |
| 3 | ES | 18CS13 | C Programming for Problem Solving | CSE | CSE | 2 | 2 | -- | 3 | 50 | 50 | 100 | 3 |
| 4 | ES | 18EC14 | Basic Electronics | EC/E and I/ TE | E and C | 2 | 2 | -- | 3 | 50 | 50 | 100 | 3 |
| 5 | ES | 18ME15 | Elements of Mechanical Engineering | ME | Mechanical Engineering | 2 | 2 | -- | 3 | 50 | 50 | 100 | 3 |
| 6 | BC | 18CHEL16 | Engineering Chemistry Laboratory | Chemistry | Science | -- | -- | 2 | 3 | 50 | 50 | 100 | 1 |
| 7 | ES | 18CSL17 | Computer Programming Laboratory | CSE | CSE | -- | -- | 2 | 3 | 50 | 50 | 100 | 1 |
| 8 | HS | 18HS11/ 18HS12 | English / Kannada | Humanities | Humanities | 1 | -- | 2 | 2 | 50 | 50 | 100 | 1 |
| 9 | HS | 18HS13 | Career Development Skills | Humanities | Humanities | 2 | -- | -- | 2 | 50 | -- | 50 | -- |
| **TOTAL** | | | | | | **15** | **10** | **06** | **23** | **450** | **400** | **850** | **20** |

| II SEMESTER B.E (PHYSICS GROUP) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Course and Course Code | | Course Title | Teaching Department | Paper Setting Board | Teaching Hours /Week | | Examination | | | | | Credits |
| | | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | | L | T | P | | | | | |
| 1 | BC | 18MA21 | Differential Equations and Complex Variables | Mathematics | Science | 3 | 2 | -- | 3 | 50 | 50 | 100 | 4 |
| 2 | BC | 18PH22 | Engineering Physics | Physics | Science | 3 | 2 | -- | 3 | 50 | 50 | 100 | 4 |
| 3 | ES | 18EE23 | Basic Electrical Engineering | E and E | E and E | 2 | 2 | | 3 | 50 | 50 | 100 | 3 |
| 4 | ES | 18CV24 | Civil Engineering and Mechanics | Civil | Civil | 2 | 2 | -- | 3 | 50 | 50 | 100 | 3 |
| 5 | ES | 18MEL25 | Computer Aided Engineering Drawing | Mechanical | Mechanical | 2 | | 2 | 3 | 50 | 50 | 100 | 3 |
| 6 | BC | 18PHL26 | Engineering Physics Laboratory | Physics | Science | -- | -- | 2 | 3 | 50 | 50 | 100 | 1 |
| 7 | ES | 18EEL27 | Basic Electrical Engineering Laboratory | E and E | E and E | -- | -- | 2 | 3 | 50 | 50 | 100 | 1 |
| 8 | HS | 18HS21/ 18HS22 | English / Kannada | Humanities | Humanities | 1 | -- | 2 | 2 | 50 | 50 | 100 | 1 |
| 9 | HS | 18HS23 | Soft Skills | Humanities | Humanities | 2 | -- | -- | 2 | 50 | -- | 50 | -- |
| | | | | | **TOTAL** | **15** | **8** | **8** | **25** | **450** | **400** | **850** | **20** |

| **Note: BC: Science Course, ES: Engineering Science, Hu: Humanity and Social Science.** | |
|---|---|
| **Definition of Credit:** | 1 hour Lecture (L) per week per semester =1 Credit<br>2 hour Tutorial (T) per week per semester =1 Credit<br>2 hour Practical/Laboratory/Drawing (P) per week per semester =1 Credit. |

| II SEMESTER B.E (CHEMISTRY GROUP) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Course and Course Code | | Course Title | Teaching Department | Paper Setting Board | Teaching Hours /Week | | Examination | | | | | Credits |
| | | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | | L | T | P | | | | | |
| 1 | BC | 18MA21 | Differential Equations and Complex Variables | Mathematics | Science | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 2 | BC | 18CH22 | Engineering Chemistry | Chemistry | Science | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 3 | ES | 18CS23 | Programming for Problem Solving | CS | CS | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 4 | ES | 18ELN24 | Basic Electronics | EC/EI/ TE | E and C | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 5 | ES | 18ME25 | Elements of Mechanical Engineering | Mechanical | Mechanical | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 6 | BC | 18CHL26 | Engineering Chemistry Laboratory | Chemistry | Science | -- | -- | 2 | 03 | 50 | 50 | 100 | 1 |
| 7 | ES | 18CSL27 | Computer Programming Laboratory | CS | CS | -- | -- | 2 | 03 | 50 | 50 | 100 | 1 |
| 8 | HU | 18HS21/ 18HS22 | English / Kannada | Humanities | Humanities | 1 | -- | 2 | 2 | 50 | 50 | 100 | 1 |
| 9 | HS | 18HS23 | Soft Skills | Humanities | Humanities | 2 | -- | -- | 2 | 50 | -- | 50 | -- |
| | | | | | **TOTAL** | **15** | **10** | **6** | **25** | **450** | **400** | **850** | **20** |

| **Note: BS: Science Course, ES: Engineering Science, Hu: Humanity and Social Science.** | |
|---|---|
| **Definition of Credit:** | 1 hour Lecture (L) / week / semester =1 Credit ; 2 hour Tutorial (T) per week per semester =1 Credit ; 2 hour Practical/Laboratory/Drawing (P) per week per semester =1 Credit. |

**ADMISSION YEAR : 2020-21 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIRST / SECOND**

| **COURSE TITLE : ELEMENTS OF MECHANICAL ENGINEERING** | | |
|---|---|---|
| **Sub Code: 18ME15 / 25** | **No of Credits : L-T-P-SS 2:2:0:0 =3** | **No. of contact hours/week : 04** |
| **Exam Duration : 3 hours** | **Exam Marks : 100 CIE: 50** | **Total No. of hours : 52** |
| **Pre-requisites** | **Physics, Chemistry** | |

**COURSE OBJECTIVES:**

1. Knowledge on importance of steam and its properties.
2. Overview on water, steam and gas turbines. Internal combustion engine's performance.
3. Permanent metal joining processes and their applications.
4. Understanding of manufacturing process, turning machine with emphasis on importance on metal cutting and power transmission.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **ENERGY, STEAM AND TURBINES** (CLASS ROOM TEACHING) | **10** |
| | **Energy – conventional and non-conventional energy sources and their comparison**<br>**Steam -**Steam formation at a constant pressure; properties of steam, simple numerical problems to understand the use of steam tables, Introduction to Boilers<br>**Turbines -** Introduction, construction and working of reaction & impulse steam turbines, construction & working of open & closed cycle gas turbines, construction and working of Pelton wheel, Kaplan and Francis water turbines. Principles of pumps and valves. **(OFFLINE MODE)** | |
| **UNIT-2** | **I C ENGINES, REFRIGERATION AND AIR CONDITIONING**<br>(BLENDED TEACHING) | **16** |
| | **Internal combustion engines -** Introduction, classification of I.C engines, parts of an I.C engine, I.C engine terminology, introduction to2-stroke petrol engines, construction and working principles of 4-stroke petrol & diesel engines, simple numerical problems (four stroke) on indicated power, brake power, mechanical efficiency, indicated and brake thermal efficiency (demonstration of working of I.C engines), introduction to MPFI engines.<br>**Refrigeration and Air conditioning -** Introduction, definition of refrigeration, concepts of refrigeration, parts of a refrigerator, refrigeration terminology, types of refrigeration systems, comparison between VAR and VCR, commonly used refrigerants and their properties. Principles & working of room air conditioner, central air conditioning. | |
| **UNIT-3** | **METAL JOINING AND MANUFACTURING PROCESSES**<br>(BLENDED TEACHING) | **10** |

| | | |
|---|---|---|
| | **Soldering -** working principle and applications; types of solder; sketch and description of soldering iron method.<br>**Brazing -** Working principle and methods of brazing; Comparison of soldering and brazing.<br>**Welding -**introduction and applications of welding; classification; sketch and description of electric arc welding. Sketch and description of oxy-acetylene gas welding; comparison of welding, soldering and brazing processes.<br>**Manufacturing Processes -** Principles of casting, forging and powder metallurgy. | |
| **UNIT-4** | **LATHE AND POWER TRANSMISSION** (ONLINE TEACHING) | **16** |
| | **Lathe -** Working principle, specification of center lathe, sketch and description of operations performed – turning, facing, knurling, thread cutting, drilling, taper turning and boring; demonstration of operations in machine shop.<br>**Power transmission -** Introduction; Belt drives – types of belts, types of belt drive; terminology - velocity ratio, creep and slip, simple numerical problems.<br>**Gear drives -** Introduction, classification; gear trains – introduction; types of gear train; simple numerical problems on gear drives. | |

**TEXT BOOK:**

1. Elements of Mechanical Engineering - K.R. Gopalkrishna, Subhash publishers, Bangalore.

**REFERENCE BOOK:**

1. Elements of Workshop Technology. Vol 1 & 2, S.K.H. Chowdhary, A.K.H. Chowdhary and Nirjhar Roy, 11th edition 2001, Media Promoters and Publishers, Mumbai.
2. Hand books of Mechanical Engineering

**COURSE OUTCOMES: On completion of the course, student should be able to:**

**CO1:** To know the basics, working of various power generation devices like steam, gas and hydraulic turbines.

**CO2:** To study about the various IC engines, and power absorbing devices such as refrigerators and air conditioning.

**CO3:** To know the principle, application of various metal joining and manufacturing processes.

**CO4:** Describe the working principles and applications of turning machine and power transmission methods for various applications.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 3 |
| **CO2** | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 3 |
| **CO3** | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 3 |
| **CO4** | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**SCHEME OF EXAMINATION (SEE)**

1. **COMPULSORY** objective multiple choice questions for 20 marks (Q.1) covering all the FOUR units. It should contain 20 questions of 1 mark each.
2. Two FULL questions from Unit-1 with choice (Q2 **OR** Q.3).
3. Two FULL questions from Unit-2 with choice (Q.4 **OR** Q.5).
4. Two FULL questions from Unit-3 with choice (Q.6 **OR** Q.7)
5. Two FULL questions from Unit-4 with choice (Q.8 **OR** Q.9).
6. Each FULL question carries 20 marks.
7. Answers are to be supported with schematic diagrams/sketches wherever necessary.
8. Each full question shall contain maximum of 3 subdivisions (Q2-Q9).

**ADMISSION YEAR : 2020-21 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIRST / SECOND**

| **COURSE TITLE : COMPUTER AIDED ENGINEERING DRAWING** | | |
|---|---|---|
| **Sub Code: 18MEL15 / 25** | **No of Credits : L-T-P-SS 0:2:2:0 =3** | **No. of contact hours/week : 04** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Mathematics - Geometry** | **Total No. of hours: 52** |

**COURSE OBJECTIVES:**

1. To make the student to understand the importance of drawing in all walks of life.
2. To give basics of different views of an object and practice principal planes projections
3. To make him understand different orientations of lines, planes and solids.
4. Give the concept of Isometric view of simple objects.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **INTRODUCTION TO ENGINEERING DRAWING (**CLASSROOM TEACHING) | **08** |
| | **BASICS:** History of engineering drawing, Introduction to drawing instruments and their uses, understanding and drawing reducing, enlarging and same scales, different drawing sheet sizes, Different type of lines used in engineering drawing, Introduction to Lettering, Construction of Regular Polygons and Dimensioning.<br>**ORTHOGRAPHIC PROJECTIONS OF POINTS:** Introduction to Orthographic projections, Principal views and Principal Planes [VP, HP, LPP & RPP], Four Quadrants and system of projection, Orthographic projections of points, Location of point in first quadrant. | |
| **UNIT-2** | **ORTHOGRAPHIC PROJECTION OF STRAIGHT LINE [FIRST ANGLE] (**CLASSROOM TEACHING) | **08** |
| | Definition of a Straight line, Projection of line, Position of line with respect to HP, VP & PP: i) Parallel to both planes, ii) Parallel to one plane and perpendicular to the other, iii) Parallel to one plane and inclined to other, iv) Inclined to both planes. True length and Apparent Length, True Inclination and Apparent Inclination, End projector distance. | |
| **UNIT-3** | **ORTHOGRAPHIC PROJECTIONS OF PLANE SURFACES [FIRST ANGLE]** (BLENDED TEACHING) | **08** |
| | Definition of plane surfaces, Placing a plane surface, Projections of plane surface: Triangle, Square, Rectangle, Rhombus, Pentagon, Hexagon, and Circle. Planes in different positions by change of position only. | |
| **UNIT-4** | **PROJECTIONS OF SOLIDS** (BLENDED TEACHING) | **20** |
| | Definition of solid, Classification of solids (Polyhedron and solids of revolution).<br>Projection of triangular, square, rectangular and hexagonal prisms and pyramids, tetrahedron, projection of cone and cylinder in different positions. | |
| **UNIT-5** | **ISOMETRIC PROJECTION** (ONLINE TEACHING) | **08** |
| | Introduction, Isometric scales, Isometric projections of Regular Polygons, Isometric Projection of prisms, pyramids, cylinders, cones, sphere, hemisphere, tetrahedron, hexahedron/cube and combination of **any two full** solids or combination of **one full** and **one frustum** of one solids. Demonstration of basic machine parts | |

**COURSE OUTCOMES: On completion of the course, student should be able to;**

1. Draw views of points, lines and planes in any orientation.
2. Draw views of simple solids resting in different positions.

3. Visualize the building / machine yet to be built / manufactured.

**TEXT BOOKS:**

1. Engineering Graphics – K.R. Gopalakrishna, 32nd Edition, 2005
2. Engineering Drawing – N.D. Bhatt and V.M. Panchal, 48th Edition, 2005

**REFERENCE BOOKS:**

1. Computer Aided Engineering Drawing – S. Trymbaka Murthy, 3rd Revised Ed, 2006.
2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production – J. Luzadder Warren, M. Duff John, 2005
3. A Primer on Computer Aided Engineering Drawing – 2006.

**COURSE OUTCOMES:** On completion of the course, student should be able to:
**CO1:** To make the student to understand the importance of drawing in all walks of life.
**CO2:** To give basics of different views of an object and practice principal planes projections and to make him understand different orientations of lines,
**CO3:** Will be able to orient the planes in different directions
**CO4:** Will be able to project solids in different orientations.
**CO5:** Give the concept of Isometric view of simple objects.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO** |
| **CO1** | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 2 | 0 | 2 |
| **CO2** | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 2 | 0 | 2 |
| **CO3** | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 2 | 0 | 2 |
| **CO4** | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 2 | 0 | 2 |
| **CO5** | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 2 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**CONTINUOUS INTERNAL EVALUATION (CIE):**

1. Solve class work problems manually using pencil, scale and other geometry instruments on A4 drawing sheets and submit them to the staff-in-charge, and only after the students are allowed to do in computer drafting.
2. All the solutions must be valued on the spot by examining the manual sketches, computer display and hard copies.
3. All the sketches including the computer print outs must be submitted in a bound form for Continuous Internal Evaluation and they must be preserved for one year by the concerned Department.
4. Break-up of marks for CIE:

| | | |
|---|---|---|
| ➢ Manual Sketching | - | 25 Marks |
| ➢ Computer Drafting | - | 15 Marks |
| ➢ Test | - | 10 Marks |
| **Total** | **-** | **50 Marks** |

| SCHEME OF EXAMINATION FOR SEE: | | |
|---|---|---|
| **Q. No.** | **CHAPTERS** | **Marks** |
| Q1 (a) | Orthographic projection of points | **05** |
| (b) | Orthographic projection of Lines | **10** |
| Q2 | Projection of Planes | **15** |
| Q3& Q4 | Projection of solids **[2 question's with Choice]** | **20** |
| Q5 & Q6 | Isometric projection **[2 question's with Choice]** | **15** |
| **TOTAL** | | **50** |

1. Note: Six Full Questions are to be set.
2. Three full Questions are to be answered with a choice as Q1 or Q2; Q3 or Q4 and Q5 or Q6.
3. Both manual sketching and computer printout are necessary for all questions.
4. 40% of marks is for manual sketching and 60% is for computer print outs.

**Dr. Ambedkar Institute of Technology, Bengaluru-560 056**
**SCHEME OF TEACHING AND EXAMINATION from Academic Year 2020-21**
**B.E Name of the programme**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**

**III SEMESTER**

| Sl .No | Course and Course Code | | Course Title | Teaching Department | Teaching Hours / Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 01 | BC | 18MA31 | Transforms & Boundary Value Problems | Mathematics | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 02 | PC | 18ME31 | Material Science | Mechanical | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 03 | PC | 18ME32 | Mechanics of Materials | Mechanical | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 04 | PC | 18ME33 | Manufacturing Processes - I | Mechanical | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 05 | PC | 18ME34 | Basic Thermodynamics | Mechanical | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 06 | PC | 18MEL35 | Computer Aided Machine Drawing | Mechanical | 2 | 0 | 2 | 03 | 50 | 50 | 100 | 3 |
| 07 | PC | 18MEL36 | Manufacturing Processes Laboratory - I | Mechanical | -- | | 2 | 03 | 50 | 50 | 100 | 1 |
| 08 | PC | 18MEL37 | Material Testing Laboratory | Mechanical | -- | | 2 | 03 | 50 | 50 | 100 | 1 |
| 09 | PC | 18MEL38 | Fitting and Forging Workshop | Mechanical | -- | -- | 2 | 03 | 50 | 50 | 100 | 1 |
| 10 | HS | 18HS31/32 | Constitution of India Professional Ethics and Human Rights / Environmental Studies | Humanities | 1 | -- | 0 | 02 | 50 | 50 | 100 | 1 |
| 11 | NC MC | 18HS33 | Soft Skills (MC) | Humanities | 2 | -- | -- | 03 | 50 | - | 50 | PP/ NP |
| **TOTAL** | | | | | **19** | **06** | **08** | **32** | **550** | **500** | **1050** | **24** |

| Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | HS | 18HS34 | Placement Training | Humanities | 02 | -- | -- | 03 | 50 | - | 50 | PP/NP |
| 13 | MC | 18MAD31 | Advance Mathematics-I | Mathematics | 02 | 01 | -- | 03 | 50 | | 50 | PP/NP |

**Note:** HODs are informed to accommodate one more laboratory in addition to the above courses if needed, without altering the total number of credits (TOTAL: 24).

(a) **The mandatory non – credit courses** Advance Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of BE programs shall compulsorily be registered during respective semesters to complete all the formalities of the course and appear for SEE examination.

(b) **The mandatory non – credit courses** Advance Mathematics I and II, prescribed to lateral entrant Diploma holders admitted to III semester of BE programs, are to be completed to secure eligibility to VII semester. However, they are not considered for vertical progression from II year to III year of the programme but considered as head of passing along with credit courses of the programme to eligibility to VII semester.

**Note: BC: Science Course, PC: Professional Core. Hu: Humanities, NCMC: Non-Credit Mandatory Course.**

**Dr. Ambedkar Institute of Technology, Bengaluru-560 056**
**SCHEME OF TEACHING AND EXAMINATION from Academic Year 2020-21**
**B.E Name of the programme**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**

**IV SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 01 | BC | 18MA41 | Numerical Methods & Applied Statistics | Mathematics | 2 | 2 | | 03 | 50 | 50 | 100 | 3 |
| 02 | PC | 18ME41 | Mechanical Measurements | Mechanical | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 03 | PC | 18ME42 | Fluid Mechanics | Mechanical | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 04 | PC | 18ME43 | Manufacturing Processes - II | Mechanical | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 05 | PC | 18ME44 | Applied Thermodynamics | Mechanical | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 06 | PC | 18ME45 | Kinematics of Machines | Mechanical | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 07 | PC | 18MEL46 | Manufacturing Processes Laboratory - II | Mechanical | -- | -- | 2 | 03 | 50 | 50 | 100 | 1 |
| 08 | PC | 18MEL47 | Mechanical Measurements Laboratory | Mechanical | -- | -- | 2 | 03 | 50 | 50 | 100 | 1 |
| 09 | HS | 18HS41/42 | Constitution of India Professional Ethics and Human Rights / Environmental Studies | Hum/Civil | 1 | -- | -- | 02 | 50 | 50 | 100 | 1 |
| 10 | NC MC | 18HS43 | Employability Skills (MC) | Humanities | 2 | -- | -- | 03 | 50 | - | 50 | PP/ NP |
| | | | | **TOTAL** | **20** | **08** | **04** | **29** | **500** | **450** | **950** | **24** |

**Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | HS | 18HS44 | Placement Training | Humanities | 02 | -- | -- | 03 | 50 | - | 50 | PP/ NP |
| 12 | MC | 18MAD41 | Advance Mathematics-II | Mathematics | 02 | 01 | -- | 03 | 50 | | 50 | PP/ NP |

**Note:** HODs are informed to accommodate one more laboratory in addition to the above courses if needed, without altering the total number of credits (TOTAL: 24).

(a) The mandatory non – credit courses Advance Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of BE programs shall compulsorily be registered during respective semesters to complete all the formalities of the course and appear for SEE examination.

(b) **The mandatory non – credit courses** Advance Mathematics I and II, prescribed to lateral entrant Diploma holders admitted to III semester of BE programs, are to be completed to secure eligibility to VII semester. However, they are not considered for vertical progression from II year to III year of the programme but considered as head of passing along with credit courses of the programme to eligibility to VII semester.

**Note: BC: Science Course, PC: Professional Core. Hu: Humanities, MC: Mandatory Course.**
**ENV: Environmental Studies, CIP: Constitution of India Professional Ethics and Human Rights**

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE: MATERIAL SCIENCE** | | |
|---|---|---|
| **Sub Code:18ME31** | **No of Credits =3**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks : 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Engineering Physics & Chemistry** | |

**COURSE OBJECTIVES:**

1. Know the fundamental science and engineering principles relevant to engineering materials.
2. Understand the intricacies involved in characterization, processing and design of materials.
3. Have the necessary theoretical and experimental skills for a pursuit in professional career.
4. Possess an intrinsic knowledge of the significance of different materials, the value of continued learning and environmental / social issues surrounding materials.
5. The student should be able to understand all basic principles involved in the application of materials for different engineering sectors.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT 1** | **CRYSTAL STRUCTURES, MECHANICAL BEHAVIOUR AND PLASTIC DEFORMATION** (CLASSROOM TEACHING) | **08** |
| | Introduction to types of crystal structures, imperfection in solids, diffusion, stress-strain diagram showing ductile and brittle behaviour of materials, linear and nonlinear elastic behaviour and properties, mechanical properties in plastic region, yield strength, offset yield strength, ductility, malleability, ultimate tensile strength, toughness. Plastic deformation of single crystal by slip and twinning, strain hardening and strain aging, simple problems on stress and strain. | |
| **UNIT 2** | **FRACTURE, CREEP AND FATIGUE** (CLASSROOM TEACHING) | **07** |
| | Types of fracture, Griffith criteria for brittle fracture, distinguishing features of brittle and ductile fracture. Three stages of creep deformation and creep properties. Types of fatigue loading with examples, mechanism of fatigue, fatigue properties, fatigue testing and SN diagram. | |
| **UNIT 3** | **SOLIDIFICATION AND PHASE DIAGRAMS** (CLASSROOM TEACHING) | **08** |
| | Mechanism of solidification, homogenous and heterogeneous nucleation, crystal growth, cast metal structures. Solid solutions Hume Rothary rule, substitutional and interstitial solid solutions, intermediate phases and Gibbs phase rule. Types of phase diagrams, construction of equilibrium diagrams involving complete and partial solubility, lever rule, and simple problems on phase diagrams. Iron carbon equilibrium diagram, description of phases. | |
| **UNIT 4** | **HEAT TREATMENT AND FERROUS ALLOYS** (BLENDED TEACHING) | **08** |
| | TTT curves, continuous cooling curves (CCT), Annealing and its types, normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening. Steel and its classification, properties, composition and applications of Grey cast iron, malleable iron. | |
| **UNIT 5** | **NON-FERROUS ALLOYS AND COMPOSITE MATERIALS** | **08** |

| | | |
|---|---|---|
| | (ONLINE TEACHING) | |
| | Copper alloys-brasses and bronzes; Aluminum alloys-Al-Cu, Al-Si, Al-Zn alloys; **Composite materials:** classification, properties, characteristics, and applications of PMCs, MMCs, CMCs and Carbon-Carbon Composites.<br>**Biomaterials:** Introduction, Materials used as biomaterials, advantages, disadvantages and applications. | |

**TEXT BOOKS:**


1. Foundations of Materials Science and Engineering, Smith, 3rd Edition McGraw Hill, 2009
2. Materials Science, Shackleford and M. K. Muralidhara, Pearson Publication –2007.
3. Material Science, by Callister, Reprint 2008, Wiley India (P) LTD.
4. Material Science by V. Raghavan, Fifth Edition, PHI (P) LTD.
5. Introduction to physical metallurgy by Avner S H, 2nd Ed., MHP, 1985
6. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.


**REFERENCE BOOKS:**


1. Elements of Materials Science and Engineering, H. Van Vlack
2. Engineering Materials Science, W.C. Richards, PHI, 1965.
3. Physical Metallurgy; Lakhtin, Mir Publications.
4. Material Science and Engineering (SI Units), R.K. Rajput
5. Smart Materials and Structures, M V Gandhi and B S Thompson Chapmen &Hall
6. Material science and Metallurgy by K R Phaneesh, Sudha Publications-2005


**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Differentiate crystal structures, imperfections, diffusion in solids, elastic and plastic properties of metal materials.

**CO2:** Analyze the various types of fracture, stages of creep and fatigue failure.

**CO3:** Describe mechanism of solidification, cast metal structure and rules for formation of solid solution.

**CO4:** Develop a capability to read a binary phase diagram and predict the properties that can be obtained by heat treatment and to know the characteristics and application of ferrous metals.

**CO5:** Know the different characteristics of nonferrous metals and their applicability for different applications and also know the physical and mechanical properties of composite materials also introduced to biomaterials.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 1 | 1 | 1 | 2 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 3 |
| **CO2** | 2 | 1 | 1 | 2 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 3 |
| **CO3** | 2 | 1 | 1 | 2 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 3 |
| **CO4** | 2 | 2 | 1 | 2 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 3 |
| **CO5** | 2 | 1 | 1 | 2 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE : MECHANICS OF MATERIALS** | | |
|---|---|---|
| **Sub Code: 18ME32** | **No of Credits =4**<br>**L-T-P-SS::3:2:0:0** | **No. of contact hours/week : 3L+2T**<br>**Total Number of contact hours : 65** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Basic engineering mathematics** | |

**COURSE OBJECTIVES:**

1. Understand mechanics of deformable bodies and apply them in analysis and design.
2. Analyze a body subjected to two dimensional and three dimensional stress systems.
3. Examine the stresses in thin and thick cylinders subjected to loads.
4. Evaluate the slope and deflection in beams subjected to different loading conditions.
5. Assess the stability of columns and struts.
6. Interpret the torsional behavior of structural members.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **SIMPLE STRESS AND STRAIN** (ONLINE TEACHING) | **9L+4T** |
| | Introduction, Stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation – Ductile & Brittle, materials. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self-weight, Principle of super position. Stress in Composite Section**:** Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars). Compound Stresses**:** Introduction, Plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress. | |
| **UNIT-2** | **BENDING MOMENT AND SHEAR FORCE IN BEAMS** (BLENDED TEACHING) | **9L+4T** |
| | Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams. Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress, radius of curvature, relationship between bending moment and radius of curvature. | |
| **UNIT-3** | **DEFLECTION OF BEAMS** (CLASSROOM TEACHING) | **9L+4T** |
| | Moment carrying capacity of standard sections. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections. (Composite / notched beams not included).<br>Introduction, differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method,<br>Energy Methods: Work, strain energy, Strain energy in bar/beams due to various loads. | |
| **UNIT-4** | **TORSION OF CIRCULAR SHAFTS & ELASTIC STABILITY OF COLUMNS** (CLASSROOM TEACHING) | **9L+4T** |
| | Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts columns**:** Euler's theory for axially loaded elastic long columns. | |

| | | |
|---|---|---|
| | Derivation of Euler's load for various end conditions, limitations, Rankine's formula. | |
| **UNIT-5** | **CYLINDERS, PLATES AND SHELLS** (CLASSROOM TEACHING) | **9L+4T** |
| | Stresses in thin cylinders due to internal pressure, circumferential stresses & longitudinal stresses. Deformation in thin cylinders, stresses due to internal pressure of thick cylinders, Lame's theory and numerical problem.<br>Plates and Shells Classification, Bending of long rectangular plate to a cylindrical surface, Differential equation – Bending of plates with different boundary conditions – Long plates on elastic foundation, Pure Bending**,** Moment and curvature relations – problems of simply supported plates – strain energy in pure bending.<br>General description of various types, Membrane Theory of Thin Shells (Stress Analysis**),** Cylindrical shells – spherical shells – shells of double curvature, viz., cooling tower, Hyperboloid, Paraboloid and elliptic paraboloid, Membrane deformation of shells: Symmetrically loaded cylindrical shell – symmetrically loaded spherical shell. | |

**TEXT BOOKS:**

1.**"Strength of Materials",** S.S. Rattan, Tata McGraw Hill, 2009

2.**"Strength of Materials", S. Ramamrutham**

**REFERENCE BOOKS:**

1. **"Mechanics of materials",** James. M. Gere, Thomson, Fifth edition 2004.
2. **"Mechanics of materials",** in S.I. Units, Ferdinand Beer & Russell Johnstan, TMH.
3. **"Strength of Materials",** S.S.Bhavikatti, Vikas pub. House -1 Pvt. Ltd., 2nd Ed., 2006.
4. **"Engineering Mechanics of Solids**", Egor.P. Popov, Pearson Edu. India, 2nd, Edison, 1998.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Evaluate fundamental concepts of stresses, strains applied to members under loadings and material properties.

**CO2:** Understand the SFD and BMD for different types of loads and support conditions and relate bending stress, bending moment, radius of curvature.

**CO3:** Analyze Shear stresses in beams of different cross sections analyze the deflection in beams and Estimate the strain energy in mechanical elements.

**CO4:** Characterize torsional equation, power transmission in shafts and analyze buckling and bending phenomenon in columns, struts and beams

**CO5:** Analyze and design thin, thick cylinders and plates, shells.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE: MANUFACTURING PROCESSES - I** | | |
|---|---|---|
| **Sub Code: 18ME33** | **No of Credits =3**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Elements of Mechanical Engineering** | |

**COURSE OBJECTIVES:**

1. This course will introduce the student to the various constituent of molding sand.
2. The course is to study various molding machines and casting process.
3. This course is to study various melting furnaces and welding process.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **MOULDING MATERIALS, PROCESSES & MACHINES** (CLASS ROOM TEACHING) | **08** |
| | **Introduction:** Concept of manufacturing process, its importance. Classification of manufacturing processes and list different material handling methods. Introduction to casting process & steps involved. Components varieties, of produced by casting processes. Advantages & limitations of casting processes.<br>**Patterns**: Definition, functions, materials used for pattern, various pattern allowances and their importance. Classification of patterns, BIS color coding of patterns.<br>**Binder:** Definition, Types of binder used in molding sand. Additives: need, types of additives used and their properties.<br>**Sand molding:** Sand, Types of base sand, requirement of base sand, molding sand mixture, ingredients for different sand mixtures.<br>**Moulding machines:** Jolt type, Squeeze type, Jolt & Squeeze type and sand slinger.<br>**Molding processes:** Method used for sand molding such as green sand, dry sand and skin dried moulds, sweep mold, CO2 mold, shell mold, flask less moulds, investment mould.<br>**Cores:** Definition, need, types, method of making cores, binders used, core sand moulding,<br>Concept of gating and risering. | |
| **UNIT-2** | **CASTING PROCESSES & MELTING FURNACES** (ONLINE TEACHING) | **08** |
| | **Casting processes**: Gravity die-casting, pressure die casting, centrifugal casting, and continuous casting processes.<br>**Casting defects**: Causes, features and remedies.<br>**Melting furnaces:** Classification of furnaces, Constructional features & working principle of coke fired, oil fired and gas fired pit furnace, resistance furnace, coreless induction furnace, electric arc furnace, Cupola furnace and process parameters. | |
| **UNIT-3** | **WELDING PROCESSES** (ONLINE TEACHING) | **07** |
| | **Welding processes:** Introduction, definition, principles, classification, application, advantages & limitations of welding. Arc welding: Principle, metal arc welding (MAW), flux shielded metal arc welding (FSMAW), inert gas welding (TIG & MIG). Briefing about latest welding processes.<br>Resistance welding: Principles, seam welding, butt welding, spot welding and projection welding, friction welding, explosive welding, thermit welding. | |
| **UNIT-4** | **METALLURGICAL ASPECTS OF WELDING & INSPECTION METHODS** (BLENDED TEACHING) | **08** |

| | | |
|---|---|---|
| | **Metallurgical aspects:** Structure of welds, formation of different zones during welding. Heat affected zone (HAZ), parameters affecting HAZ. Effect of carbon content on structure and properties of steel.<br>**Inspection methods:** Methods used for inspection of casting and welding. Visual, magnetic particle, fluorescent particle, ultrasonic, radiography, eddy current, holography methods of inspection. | |
| **UNIT-5** | **MECHANICAL WORKING OF METALS** (ONLINE TEACHING) | **08** |
| | Introduction to metal forming processes & classification of metal forming processes. Hot working & cold working of metals. Forging: Smith forging, drop forging & press forging. Forging Equipment, Defects in forging.<br>**Rolling:** Rolling process, Angle of bite, Types of rolling mills, Variables of rolling process, Rolling defects.<br>**Drawing & Extrusion:** Drawing of wires, rods & pipes, Variables of drawing process. Difference between drawing & extrusion. Various types of extrusion processes.<br>**Sheet Metal Operations:** Blanking, piercing, and punching. | |

**TEXT BOOKS**:


1. **"Manufacturing Process-I & II",** Dr. K. Radhakrishna, Sapna Book House, 5th Revised Edition 2009.
2. **"Manufacturing & Technology**: Foundry Forming and Welding", P.N. Rao 2nd Ed, TMH, 2003.
3. **Manufacturing Science**, Amitabha Ghoshand Mallik, affiliated East West Press, 2003.
4. **Metal Casting: Principles and Practice**, T.V. Ramana Rao,Published by New Age International (P) Limited (2010)
5. **Principles of Metal Casting,** MahiSahoo **,** Sam Sahu **, McGraw Hill Education (India) Private Limited; Third edition (26 September 2014)**


**REFERENCE BOOKS**:


1. **"Manufacturing Technology**", Serope Kalpakjain, Steuen.R. Sechmid, Pearson Education Asia, 5th Ed. 2006.
2. **"Process and Materials of Manufacturing**", Roy A Lindberg, 4thEd. Pearson Edu. 2006.
3. **Principles of Metal Casting- Second Edition**, Heine, Richard W.; CarlR. Loper, Jr. & Philip C. Rosenthal, Published by McGraw-Hill, New York (1967)
4. **Mechanical Metallurgy Paperback,** George E. Dieter **TMH.**
5. **Metal Forming: Mechanics and Metallurgy**, Hosford,WF and Caddell,R.M, Published by Prentice Hall (1993)


**COURSE OUTCOMES:** On completion of the course, student should be able to;

**CO1:** Explain different manufacturing process, patterns, cores, moulding sand constituents, moulding process and machines.

**CO2:** Discuss different casting processes, defects and melting furnaces.

**CO3:** Understand the principle of metal arc, TIG, MIG, resistance, explosive and thermit welding processes.

**CO4:** Describe metallurgical aspect of welding, inspection of casting and welded components.

**CO5:** Understand the concepts of mechanical working of metals, forging, rolling, drawing, extrusion and sheet metal operations.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 1 | 0 | 1 | 2 | 0 | 1 | 3 | 1 | 1 | 0 | 1 | 3 |
| **CO2** | 1 | 0 | 1 | 2 | 0 | 1 | 3 | 1 | 1 | 0 | 1 | 3 |
| **CO3** | 1 | 0 | 1 | 2 | 0 | 1 | 3 | 1 | 1 | 0 | 1 | 3 |
| **CO4** | 1 | 0 | 1 | 2 | 0 | 1 | 3 | 1 | 1 | 0 | 1 | 3 |
| **CO5** | 1 | 0 | 1 | 2 | 0 | 1 | 3 | 1 | 1 | 0 | 1 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE : BASIC THERMODYNAMICS** | | |
|---|---|---|
| **Sub Code: 18ME34** | **No of Credits : L-T-P-SS 3:2:0:0= 4** | **No. of Contact hours/week : 3L+2T Total Number of contact hours : 65** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Engineering chemistry, physics, mathematics** | |

**COURSE OBJECTIVES:**

1. To understand the fundamental concepts of thermodynamic system, process and cycle.
2. To explain work and heat transfer with illustrations and examples.
3. To interpret first and second law of thermodynamics in the context of closed and open system.
4. To understand the concept of entropy and the principle of increase of entropy.
5. To solve problems related to thermodynamic system applying the various thermodynamic relations to pure substances and gases.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **FUNDAMENTAL CONCEPTS** (BLENDED TEACHING) | **9L+4T** |
| | Macroscopic and microscopic viewpoint, thermodynamic system and control volume, thermodynamic property, process and cycle, homogeneous and heterogeneous system, thermodynamic equilibrium, quasi-static process, pure substance, concept of continuum, thermostatics, units and dimensions; zeroth law of thermodynamics, temperature scales, different types of thermometers. Work transfer, pdV work – path function and point function, pdV work in various quasi-static processes, indicator diagram, other types of work transfer, free expansion with zero work transfer, net work done by a system, heat transfer, heat transfer as a path function, specific heat and latent heat, comparison of heat and work transfer; Numerical problems. | |
| **UNIT-2** | **FIRST LAW OF THERMODYNAMICS** (CLASSROOM TEACHING) | **9L+4T** |
| | First law of a closed system undergoing a cycle (Joule's experiment) and undergoing a change of state, energy as a property of a system, forms of stored energy, specific heat at constatn volume and constant pressure, enthalpy, energy of an isolated system, PMM 1, limitations of the first law; application of first law to flow processes – control volume, steady flow process, mass and energy balance in a simple steady flow process, examples of steady flow processes -turbines, pumps, nozzles and diffusers; Numerical problems. | |
| **UNIT-3** | **SECOND LAW OF THERMODYNAMICS AND ENTROPY** (CLASSROOM TEACHING) | **9L+4T** |
| | Qualitative difference between heat and work, cyclic heat engine, energy reservoirs, kelvin-planck and clausius statement of second law of thermodynamics, PMM 2, refrigerator and heat pump, equivalence of kelvin-planck and clausius statements, reversibility and irreversibility, causes and conditions of irreversibility, carnot cycle, reversed heat engine, carnot's theorem and its corollary, absolute thermodynamic temperature scale, efficiency of the reversible heat engine, equality of ideal gas and Kelvin temperatures, types of irreversibility, numericals.<br>Entropy - Introduction, clausius theorem, The property of entropy, T-S plot, clausius inequality, entropy change in an irreversible process, entropy principle and its applications. Numerical problems. | |

| | | |
|---|---|---|
| **UNIT-4** | **AVAILABILITY AND PROPERTIES OF PURE SUBSTANCE** (CLASSROOM TEACHING) | **9L+4T** |
| | Availability, Irreversibility and General Thermodynamic relations. Introduction, Availability (Exergy), Unavailable energy, Relation between increase in unavailable energy and increase in entropy. Maximum work, maximum useful work for a system and control volume, irreversibility; Pure substances: p-V diagram and p-T diagram, p-v-T surface, T-s and h-s diagram for a pure substance, quality of pure substance, steam tables – saturation state, liquid-vapour mixture, compressed liquid, charts of thermodynamic properties, measurement of steam quality – throttling calorimeter, separating and throttling carlorimeter; Numerical problems. | |
| **UNIT-5** | **IDEAL AND REAL GASES** (ONLINE TEACHING) | **9L+4T** |
| | Ideal gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases, Air- Water mixtures and related properties. Real gases – Introduction, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Beattie-Bridgeman equation, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gases; Numerical problems. | |

**TEXT BOOKS**

1.**Engineering Thermodynamics**, P.K. Nag, Tata McGraw Hill Education (India) Publications, 5th Edition, 2013.

2.**Thermodynamics:An Engineering Approach**, Yunus A. Cenegal and Michael A. Boles, McGraw-Hill Publications (SIE), 8th Edition, 2015.

3. **A Text Book of Engineering Thermodynamics**, R.K. Rajput, Laxmi Publishers, 3rd Edition, 2010.

**REFERENCE BOOKS**

**1. Applications of Thermodynamics,** V. Kadambi, T R Seetharam and K B Subramanya Kumar, Wiley India Private Limited, 1st Edition, 2019

**2. Fundamentals of Thermodynamics**, Claus Borgnakke and Richard E. Sonntag, Wiley Student Edition, 7th Edition, 2009.

**3. Fundamentals of Engineering thermodynamics by** H . N. Shapiro & M J Moran.

**e-LEARNING RESOURCES**

**Videos and Lecture Notes:** http:// www.nptel.ac.in

**DATA HAND BOOK**

**Thermodynamics Data Book**, B T Nijaguna and B S Samaga, Sudha Publishers, 2016.

**COURSE OUTCOME (CO)**

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

**CO1:** *Explain* the concept of thermodynamic system and its interaction with surroundings; *differentiate* work and heat transfer in various quasistatic thermodynamics processes; and *solve* related numerical problems (RBTL 1, 2, 3)

**CO2:** *Interpret* the first law of thermodynamics applied to a thermodynamic system and a flow process; and *solve* related numerical problems (RBTL 1, 2, 3).

**CO3:** *Understand* the Kelvin-Planck and Clausius statements of second law of thermodynamics; *understand* the concept of entropy principle and its applications to thermodynamic processes; *summarize* thermodynamic relations; and *solve* related numerical problems (RBTL 1, 2, 3).

**CO4:** *Understand* the concept of availability and irreversibility; *understand* various thermodynamic property diagrams for a pure substance; *use* the steam tables; (RBTL 1, 2, 3)
**CO5:** D*iscuss* ideal and real gases; and *solve* related numerical problems (RBTL 1, 2, 3)
(RBTL: Revised Bloom's Taxonomy Levels; 1 – Remembering, 2 – Understanding, 3 – Applying, 4 - Analyzing, 5 - Evaluating, 6 - Creating)

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO2** | 3 | 3 | 2 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO3** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO4** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO5** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE : COMPUTER AIDED MACHINE DRAWING** | | |
|---|---|---|
| **Sub Code: 18MEL35** | **No of Credits =3**<br>**L-T-P-SS::2:0:2:0** | **No. of lecture hours/week : 04** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Computer Aided Engineering Drawing, Solid edge software** | |

**COURSE OBJECTIVES:**

1. To understand the sectional views and developments of various solid shapes.
2. Simple machine parts orthographic views with and without sections to be under-stood.
3. Different types of thread forms to be studied.
4. Permanent and temporary fasteners study
5. Assembly drawings in 2D of several joints.

| # | **CONTENTS** | **Hrs.** |
|---|---|---|
| **UNIT-1** | **SECTIONS OF SOLIDS AND ORTHOGRAPHIC PROJECTIONS** (ONLINE TEACHING) | **12** |
| | Introduction to geometrical dimensions & tolerances<br>**Sections of solids:** Prisms, pyramids, cones, cylinders cut by a single section plane perpendicular to vertical plane and inclined to horizontal plane<br>**Orthographic projections:** Orthographic views of simple machine parts with and without sections | |
| **UNIT-2** | **THREAD FORMS, FASTENERS, KEYS AND RIVETED JOINTS** (BLENDED TEACHING) | **12** |
| | **Thread Forms:** Thread forms: thread terminology, sectional views of threads. ISO Metric (internal & external) BSW (internal & external) square and Acme. Sellers thread, American Standard thread.<br>**Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut, flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.<br>**Keys & Joints**: Parallel key, taper key, feather key, gib head key and woodruff key. Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.<br>**Riveted joints:** Single and double riveted lap joints, butt joints with single/double cover straps (chain and zigzag, using snap head rivets). | |
| **UNIT-3** | **ASSEMBLY DRAWINGS** (ONLINE TEACHING) | **28** |
| | Connecting Rod, Plummer block (Pedestal bearing), Tail Stock, Screw jack (Bottle type), Machine vice | |

**TEXT BOOKS:**

**1. Computer Aided Machine Drawing 2007,** Published by VTU, Belgaum

**REFERENCE BOOKS:**

**1. Machine Drawing'**, K.R. Gopala Krishna, Subhash Publication.
**2. Machine Drawing',** N. D. Bhat& V. M. Panchal
**3. Computer Aided Machine Drawing'** Trymbaka Murthy, CBS Publishers, New Delhi 2007

**COURSE OUTCOMES:**

On completion of the course, student should be able to;

**CO1:** Understand Section of solid and orthographic projections of machine elements.
**CO2:** Identifying several thread forms and pinpointing their usage.
**CO3:** Realize fasteners and their importance with specific decision to select the right type of fastener for the right job.
**CO4:** Understand the part or assembly drawings as per the conventions.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO3** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

## CONTINUOUS INTERNAL EVALUATION (CIE)

1. CIE has a maximum of 50 marks
2. All the drawings should be drawn in the class using Solid edge software. Sheet sizes should be A4. All sheets must be submitted at the end of the class by taking printouts.
3. CIE Marks is finalized by conducting a test at the end of $10^{th}$ week of the semester
4. CIE Marks (50) = Evaluation of Record (Sketch-15 and Printout-15) + Test (20)

| QUESTION PAPER PATTERN (SEE) | | | | | | | TOTAL MARKS |
|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | |
| UNIT | 1 | | 2 | | 3 | | |
| MARKS | 10 | | 10 | | 30 | | **50** |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | |
| 2. Student shall answer totally three full questions selecting one full question from each unit. | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE : MANUFACTURING PROCESSES LABORATORY - I** | | |
|---|---|---|
| **Sub Code: 18MEL36** | **No of Credits: L-T-P-SS :: 00:00:02:00 = 01** | **No. of practical hours/week: 02** |
| **Exam Duration : 03 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Elements of Mechanical Engineering, Manufacturing Processes I** | |

**COURSE OBJECTIVES:**

1) This course will give the student knowledge of testing sand used in foundries.
2) It also focuses on preparation of sand molds with and without patterns and also to cast a component

| # | CONTENTS | Hrs |
|---|---|---|
| **PART - A** | **SAND TESTING** | **10** |
| | Preparation of sand specimen and its testing using<br>**(a) Universal Sand Testing Machine –** Compression, Shear & Tensile test<br>**(b) Permeability Meter -** Permeability test<br>**(c) Sieve Shaker -** Sieve analysis to find Grain Fineness number of base sand<br>**(d) Clay Stirrer -C**lay content determination in base sand<br>**(e) Hot Air Oven -** Core & Mold hardness tests | |
| **PART - B** | **FOUNDRY** | **16** |
| | Use of foundry tools:<br>Preparation of molds with and without patterns.<br>Preparation of a casting (Aluminum or cast iron-Demonstration only) | |

**REFERENCE BOOKS:**

**1. "Manufacturing & Technology** Foundry Forming and Welding", P.N. Rao 2 Ed.Tata Mc Graw Hill, 2003.
**2. Manufacturing Science, Amitabh Ghosh and Mallik,** affiliated East West Press,2003.
**3. Metal Casting: Principles and Practice**, T.V. Ramana Rao, Published by New Age
**4. Principles of Metal Casting,** Mahi Sahoo, Sam Sahu McGraw Hill Education (India) Private Limited; Third edition (26 September 2014).

**COURSE OUTCOMES:** On completion of the course, student should be able to:
**CO1:** Preparation of standard sand specimens and conduct of various tests on it.
**CO2:** To read working drawings, understand operational symbols and prepare moulds as per dimensions.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| **CO2** | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**CONTINUOUS INTERNAL EVALUATION (CIE)**

1.CIE has a maximum of 50 marks.

2.CIE Marks is finalized by conducting a test at the end of 12th week of the semester.

3.CIE Marks (50) = Evaluation of Record (30) + Test (20)

**SCHEME OF CONTINUOUS INTERNAL EVALUATION (CIE)**

| **RECORD WRITING** | |
|---|---|
| **PART-A** | |
| Sand Testing tools, instruments and AFS standards | 05 MARKS |
| Experiments in sand testing | 10 MARKS |
| **PART-B** | |
| Foundry tools and operations | 05 MARKS |
| Foundry models | 10 MARKS |
| **TOTAL – 1** | **30 MARKS** |
| **CIE at the end of 12th week of the semester** | |
| One sand testing experiment from PART A | 15 MARKS |
| One foundry Model from PART B | 25 MARKS |
| Viva – Voce | 10 MARKS |
| | 50 MARKS |
| **TOTAL – 2** = 50/2.5 | **20 MARKS** |
| **GRAND TOTAL (TOTAL-1+TOTAL-2)** | **50 MARKS** |

| **SCHEME OF SEMESTER END EXAMINATION (SEE)** | |
|---|---|
| One sand testing experiment from PART A | 15 MARKS |
| One foundry Model from PART B | 25 MARKS |
| Viva – Voce | 10 MARKS |
| **TOTAL** | **50 MARKS** |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE : MATERIAL TESTING LABORATORY** | | |
|---|---|---|
| **Sub Code: 18MEL37** | **No of Credits =1**<br>**L-T-P-SS::0:0:2:0** | **No. of practical hours/week : 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Material science and metallurgy** | |

**COURSE OBJECTIVES:**

1) To focus on the standards to be followed for mechanical properties estimation
2) To understand the need for the methods of mechanical properties testing
3) To know the salient steps in preparing test specimens for microstructure study
4) To introduce concept of non-destructive testing.

| # | CONTENTS | Hrs |
|---|---|---|
| **PART A** | **TESTING OF MATERIALS AS PER ASTM STANDARDS** | **16** |
| | Explain ASTM and BIS standards.<br>Tensile, shear and compression tests of metallic and non-metallic specimens using Universal Testing Machine, Torsion Test, Bending Test on metallic and nonmetallic specimens, Fatigue Test | |
| **PART B** | **FRACTURE, HARDNESS TESTING AND NDT** | **10** |
| | Izod and Charpy Tests, Brinell, Rockwell and Vickers's Hardness test. Demonstration on Identification of microstructures. To study the defects of Cast and Welded specimens using Non-destructive test experiments like, (a) Magnetic crack detection (b) Dye penetration testing equipment. | |

**REFERENCE BOOKS:**

1."Mechanical Metallurgy"**, George E Dieter, Mc Graw Hill Publications, 1986.**
2."Strength of Materials", **S.S. Rathan, Tata McGraw Hill Publications, Second Edition**
3. ASTM Standard Hand Books.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Acquire experimentation skills in the field of material testing.
**CO2:** Develop theoretical understanding of the mechanical properties of materials by performing experiments.
**CO3:** Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
**CO4:** Apply the knowledge of testing methods in related areas.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **CO2** | 1 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 |
| **CO3** | 0 | 2 | 1 | 3 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 |
| **CO4** | 0 | 1 | 2 | 3 | 2 | 1 | 0 | 0 | 1 | 2 | 1 | 0 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**CONTINUOUS INTERNAL EVALUATION (CIE)**

1. CIE has a maximum of 50 marks i.e., Evaluation of Record (30) + Test (20)
2. CIE Marks is finalized by conducting ONE test at the end of $10^{th}$ week of the semester.

| **SCHEME OF EXAMINATION (SEE)** | |
|---|---|
| ONE question from Part A | 25 MARKS |
| ONE question from Part B | 15 MARKS |
| Viva – Voce | 10 MARKS |
| TOTAL | 50 MARKS |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : THIRD**

| **COURSE TITLE : FITTING & FORGING WORKSHOP** | | |
|---|---|---|
| **Sub Code: 18MEL38** | **No of Credits L-T-P-SS :: 0:0:2:0 = 01** | **No. of practical hours/week: 02** |
| **Exam Duration :03 hours** | **CIE Marks: 50** | **Examination Marks : 50** |
| **Pre-requisites** | **Elements of Mechanical Engineering, Manufacturing Processes** | |

**COURSE OBJECTIVES:**

1. To give an introduction to fitting tools and their operations to make models
2. To forge a model involving various forging operations

| # | CONTENTS | Hours |
|---|---|---|
| **PART A** | **FITTING** | **10** |
| | Demonstration of fitting tools, operations and model making | |
| **PART B** | **FORGING** | **16** |
| | Forging Models preparation<br>• Calculation of length of the raw material required to do the model.<br>• Preparing minimum three forged models involving<br>Upsetting,<br>Drawing and<br>Bending operations | |

**REFERENCE BOOKS:**

**1. Workshop Technology Vol.1 & Vol.2, Hajra Chowdhary**

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Fitting tools, operations and model making

**CO2:** Analyze and utilize tools in forging operation to make a model with care as per the set dimensions.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**CONTINUOUS INTERNAL EVALUATION (CIE)**

1. CIE has a maximum of 50 marks.
2. CIE Marks is finalized by conducting a test at the end of $12^{th}$ week of the semester.
3. CIE Marks (50) = Evaluation of Record (30) + Test (20)

| **SCHEME OF CONTINUOUS INTERNAL EVALUATION (CIE)** | |
|---|---|
| **RECORD WRITING** | |
| **PART-A** | |
| Fitting tools, operations and model making | 15 MARKS |
| **PART-B** | |
| Forging tools, operations and model making | 15 MARKS |
| **TOTAL – 1** | **30 MARKS** |
| **CIE at the end of 12$^{th}$ week of the semester** | |
| One fitting model | 20 MARKS |
| One forging model | 20 MARKS |
| Viva – Voce | 10 MARKS |
| | 50 MARKS |
| **TOTAL – 2** = 50/2.5 | **20 MARKS** |
| **GRAND TOTAL (TOTAL-1+TOTAL-2)** | **50 MARKS** |

| **SCHEME OF SEMESTER END EXAMINATION (SEE)** | |
|---|---|
| FITTING | 20 MARKS |
| FORGING | 20 MARKS |
| Viva – Voce | 10 MARKS |
| **TOTAL** | **50 MARKS** |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : FOURTH**

| **COURSE TITLE : MECHANICAL MEASUREMENTS** | | |
|---|---|---|
| **Sub Code: 18ME41** | **No of Credits =3**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Engineering physics, Basic electrical engineering** | |

**COURSE OBJECTIVES:**

1. Explain the concepts of measurement and gauging instruments.
2. To provide knowledge on various metrological equipment's available to measure the dimension of the components.
3. To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
4. Explain and apply the principles in manufacturing industries.

| # | **CONTENTS** | **Hrs.** |
|---|---|---|
| **UNIT-1** | **STANDARDS OF MEASUREMENT, LIMITS, FITS AND TOLERANCE** (CLASSROOM TEACHING) | **08** |
| | **Standards of measurement:** Definition and Objectives of metrology, standards of length- international prototype meter, imperial standard yard, wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), slip gauges, wringing phenomena, Indian standards (M-81, M-12), numerical problems on building of slip gauges.<br>**Limits, fits and tolerance:** definition, need for limit systems, definition of fits, types of fits and their designation (IS919-1963), hole basis system, shaft basis system. definition of tolerance, principle of interchangeability and selective assembly ,concept of limits of size and tolerance specification in assembly, and tolerances, compound tolerances, accumulation of tolerances, geometrical tolerance, positional-tolerances. | |
| **UNIT-2** | **GAUGES AND LINEAR MEASUREMENTS** (ONLINE TEACHING) | **07** |
| | **Gauges:** Design of limit gauges by Taylor's principle, types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials wear allowance on gauges.<br>**Linear Measurements:** introduction to comparators, characteristics, classification of comparators, mechanical comparators-Johnson Mikrokator, sigma comparators, dial indicator, optical comparators- Mechanical-optical comparators, Zeiss ultra-optimeter, electric and electronic comparators- LVDT, pneumatic comparators, Velocity and back pressure type, solex comparator. | |
| **UNIT-3** | **ANGULAR MEASUREMENTS AND INTERFEROMETRY** (CLASSROOM TEACHING) | **07** |
| | **Angular measurements:** Bevel protractor, sine principle and use of sine bars, sine center, use of angle gauges (numerical on building of angles), and clinometers. Surface roughness-Straightness, flatness, perpendicularity, parallelism, roundness and cylindrical.<br>**Interferometry**: Interferometer, autocollimator. Optical flats. Terminology of screw threads, profile projector- measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, tool maker's microscope, gear tooth terminology, use of gear tooth | |

| | | |
|---|---|---|
| | vernier caliper and micrometer. | |
| **UNIT-4** | **MEASUREMENT AND MEASUREMENT SYSTEMS** (CLASSROOM TEACHING) | **09** |
| | **Measurement:** Definition, significance, accuracy, Resolution precision, calibration, threshold, sensitivity, hysterisis, repeatability, linearity, Errors, classification of errors.<br>**Generalized measurement systems:** Transducers - transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages. Intermediate modifying devices - Mechanical systems, electronic amplifiers and telemetry. Terminating devices- cathode ray oscilloscope, oscillographs, X-Y plotters. | |
| **UNIT-5** | **FORCE, TORQUE, PRESSURE, TEMPERATURE AND STRAIN MEASUREMENT** (ONLINE TEACHING) | **08** |
| | **Force measurement –** Introduction, direct methods, indirect methods and Proving ring<br>**Torque measurements-** Introduction, mechanical dynamometers, hydraulic dynamometers and electrical dynamometers.<br>**Pressure measurements:** introduction**,** definition of pressure terms, methods of measuring pressure- pressure measurement with elastic transducers, Bridgeman gauge, McLeod gauge.<br>**Temperature measurements:** Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer.<br>**Strain measurements**, Wheatstone resistance bridge arrangement for strain measurement, gauge factor, mechanical strain gauge, Resistance strain gauge, Electrical strain gauge | |

**TEXT BOOKS:**


1. **Mechanical Measurements,** Beckwith Marangoni and Lienhard, Pearson Education, 6th Edition, 2006. (For Measurements Only)
2. **Engineering Metrology,** R.K. Jain, Khanna Publishers, 1994. (For Metrology Only)


**REFERENCE BOOKS:**


1. **Engineering Metrology,** I.C. Gupta, Dhanpat Rai Publications, Delhi.
2. **Mechanical Measurements,** R.K. Jain
3. **Industrial Instrumentation,** Alsutko, Jerry. D. Faulk, Thompson Asia Pvt. Ltd.2002.
4. **Measurement Systems Applications and Design,** Ernest O. Doblin, McGraw Hill


**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Describe different standards and the importance of standardization.
**CO2:** Recognize measurements necessity, various dimensional measurements.
**CO3:** Design measurement system for a given parameter
**CO4:** List the different kinds of sensors, transducers, and recorders.
**CO5:** Assess measurement system with its limitations.

| MAPPING OF COs WITH Pos | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 2 |
| **CO2** | 3 | 3 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 2 |
| **CO3** | 3 | 3 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 2 |
| **CO4** | 3 | 3 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 2 |
| **CO5** | 3 | 3 | 3 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : FOURTH**

| **COURSE TITLE : FLUID MECHANICS** | | |
|---|---|---|
| **Sub Code: 18ME42** | **No of Credits : L-T-P-SS 3:2:0:0 =4** | **No. of contact hours/week : 3L+2T Total Number of contact hours : 65** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Physics, Mathematics** | |

**COURSE OBJECTIVES:**

1. Explain various properties related to fluid mechanics.
2. Determine hydrostatic force and centre of pressure on plane and curved surfaces, locate met centre and Meta centric height of floating bodies.
3. Summarize different types of pressure measurement devices.
4. Apply laws of conservation of momentum, mass and energy to fluid flow systems and explain the measurement of fluid flow parameters.
5. Interpret compressibility of gases in terms of Mach number.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **PROPERTIES OF FLUID** (BLENDED TEACHING) | **9L+4T** |
| | Introduction, classification of fluids, properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure, cavitation phenomenon. Numerical problems.<br>**Fluid statics:** Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Numerical problems. | |
| **UNIT-2** | **SUBMERGED BODIES AND BUOYANCY** (CLASSROOM TEACHING) | **9L+4T** |
| | **Submerged bodies:** Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid. Related numerical problems.<br>**Buoyancy:** Buoyancy, center of buoyancy, metacentre and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of metacentric height experimentally and theoretically. Numerical problems. | |
| **UNIT-3** | **FLUID KINEMATICS AND DYNAMICS** (CLASSROOM TEACHING) | **9L+4T** |
| | **Fluidkinematics:** Types of fluid flow, continuity equation in 2Dand 3D (Cartesian Co-ordinates only), velocity and acceleration, Numerical problems.<br>**Fluid dynamics:** Introduction, Equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation. Numerical problems. | |
| **UNIT-4** | **FLUID FLOW MEASUREMENTS AND FLOW THROUGH PIPES** (CLASSROOM TEACHING) | **9L+4T** |
| | **Fluid flow measurements:** Applications of Bernoulli's equation, venturimeter, orifice meter, pitot-tube, vertical orifice, V-notch and rectangular notches, Numerical problems. Navier-stoke's Equation.<br>**Flow through pipes:** Introduction, major and minor losses through pipes. Darcy's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL. Numerical problems.<br>**Laminar flow and viscous effects:** Reynold's number, critical Reynold's number, laminar flow through circular pipe-Hagen Poiseille's equation, laminar flow between parallel and stationary plates. Numerical problems. | |
| **UNIT-5** | **FLOW PAST IMMERSED BODIES AND COMPRESSIBLE FLOW** | **9L+4T** |

| | | |
|---|---|---|
| | (ONLINE TEACHING) | |
| | **Flow past immersed bodies:** Introduction, drag, lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness. Numerical problems.<br>**Compressible flow:** introduction – stagnation properties relationship, velocity of sound in a fluid, mach number, mach cone, propagation of pressure waves in a compressible fluid. Numerical problems.<br>**Introduction to Computational Fluid Dynamics (CFD):** Necessity, limitations, philosophy behind CFD, applications; Commercial softwares available for CFD analysis. | |

**TEXT BOOKS**

1. **A Textbook of Fluid Mechanics and Hydraulic Machines (SI Units)**, Dr. R.K. Bansal, Laxmi Publications (P) Limited, Revised 9th Edition,, 2010.

2. **Fluid Mechanics: Fundamentals and Applications (SI Units),**Yunus A. Cengel, JohnM.Cimbala. McGraw-Hill Publications (SIE), 3rd Edition, 2014.

**REFERENCE BOOKS**

1. **Hydraulics and Fluid Mechanics including Hydraulic Machines**, Dr. P.N. Modi and S.M. Seth, Rajsons Publications Private Limited, Standard Book House, 2009.
2. **Fluid Mechanics**, Frank M. White, McGraw-Hill Publications (SIE), 7th Edition, 2011.
3. **A Text Book of Fluid Mechanics,** R K Rajput, S Chand Publishers , 1998.

**e-LEARNING RESOURCES**

1. **Fluid Mechanics: Mechanical Engineering Handbook,** Kreith,F, Berger, S.A, et. al., Ed. Frank Kreith, Boca Raton: CRC Press LLC, 1999.
2. **Videos and Lecture Notes:** http://www.nptel.ac.in

**MASSIVE OPEN ONLINE COURSES (MOOCs):**

Students are encouraged to visit http:// www.nptel.ac.in (http:// www.swayam.gov.in) and register for the following MOOCs:
Fluid Mechanics (8 Week Course; July-Oct)

**COURSE OUTCOME (CO):** After completion of the course, students will be able to:

**CO1:** *Understand* how a fluid is classified and *define* various properties of a fluid; *understand* Pascal's law and *explain* various types of manometers; and *solve* related numerical problems (RBTL 1, 2, 3)

**CO2:** *Explain* the total pressure and centre of pressure acting on submerged surfaces; *understand* the concept of buoyancy, metacentre and metacentric height of floating and submerged bodies; and *solve* related numerical problems (RBTL 1, 2, 3)

**CO3:** *Describe* the types of fluid flow and *understand* the continuity, Euler and Bernoulli's equation; *solve* numerical problems related to fluid kinematics and dynamics (RBTL 1, 2, 3)

**CO4:** *Explain* different types of flow measuring devices; *understand* the minor and major losses; *discuss* Darcy and Chezy equations; *describe* Reynolds number and *understand* the derivation of flow through circular pipe, laminar flow between parallel and stationary plates; and *solve* related numerical problems (RBTL 1, 2, 3)

**CO5:** *Understand* the terms related to fluid flow past an immersed body; *explain* boundary layer, displacement, momentum and energy thickness; *understand* the relationship of stagnation properties applicable to compressible flow; *explain* Mach number and Mach cone;

and *solve* related numerical problems (RBTL 1, 2, 3).
(RBTL: Revised Bloom's Taxonomy Level 1 – Remembering, 2 – Understanding, 3 – Applying, 4 - Analyzing, 5 - Evaluating, 6 - Creating)

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO2** | 3 | 3 | 2 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO3** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO4** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO5** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3. Each full question shall have maximum of 3 sub-divisions. | | | | | | | | | | |

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**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : FOURTH**

| **COURSE TITLE : MANUFACTURING PROCESSES - II** | | |
|---|---|---|
| **Sub Code: 18ME43** | **No of Credits =3**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | | **Exam Marks : 100** |

**COURSE OBJECTIVES:**

1. To expose the students to production techniques including their typical use and capabilities.
2. To teach the students mechanical aspects of manufacturing processes, such as cutting force, tool life.
3. To provide students a technical understanding of common traditional processes and non-traditional processes to aid in appropriate process selection for the material and required tolerances.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **THEORY OF METAL CUTTIN**G (CLASSROOM TEACHING) | **08** |
| | Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation, Types of Chips. Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems on Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation. | |
| **UNIT-2** | **CUTTING TOOL MATERIALS** (ONLINE TEACHING) | **08** |
| | Desired properties and types of cutting tool materials – HSS, carbides, coated carbides, ceramics. Cutting fluids. Desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool and work piece and chip. Measurement of tool tip temperature. | |
| **UNIT-3** | **LATHES, SHAPING, PLANING AND SLOTTING MACHINE**S (CLASSROOM TEACHING) | **07** |
| | **LATHES, SHAPING, PLANING AND SLOTTING MACHINE**S Classification, constructional features, Different operations, work holding and tool holding devices on lathes, turret and capstan lathe, shaping machine, planing machine and slotting machines. Simple problems on machining time calculations. | |
| **UNIT-4** | **DRILLING, MILLING, HOBBING, GRINDING AND BROACHING MACHINE**S (BLENDED TEACHING) | **09** |
| | **DRILLING AND MILLING MACHINE**S: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, drill materials, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations. Indexing: Simple, compound, differential and angular indexing calculations. Hobbing - Principle of working, related operations and its applications, Simple problems on simple and compound indexing.<br>**GRINDING MACHINE -** Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding machines (Centerless, cylindrical and surface grinding). Selection of grinding wheel, Grinding process parameters. Dressing and truing of grinding wheels.<br>**BROACHING MACHINE -** Principle of broaching. Details of a broach. Types of broaching machines-constructional details, applications, advantages and limitations. (CLASSROOM TEACHING) | |

| UNIT-5 | **FINISHING PROCESSES** (BLENDED TEACHING) | **07** |
|---|---|---|
| | **LAPPING AND HONING OPERATIONS** – Principles, arrangement of set up and application.<br>**SUPER FINISHING PROCESS**: Polishing, buffing operation and application.<br>**NON-TRADITIONAL MACHINING PROCESSES**<br>Classification, Mechanism of material removal, Principle of working, process parameters, process capabilities, application, advantages and limitations of ECM, EDM, WEDM and USM. | |

**TEXT BOOK**S:

1. **Workshop Technology,** Hajra Choudhry, Vol-II, Media Promoters & Pub. Pvt. Ltd. 2004
2. **Production Technology,** R.K.Jain, Khanna Publications, 2003.
3. **Production Technology,** HMT, Tata McGraw Hill, 2001.
4. Manufacturing Technology - Vol. 2, P N Rao, TMH Education; 3rd edition (1 May 2013)
5. Production Technology, P.C. Sharma, S Chand (1 December 2006)

**REFERENCE BOOK**S:

1. **Manufacturing Science**, Amitabha Ghosh and Mallik, affiliated East West Press, 2003.
2. **Fundamentals of Metal Machining and Machine Tools,** G.Boothroyd, McGraw Hill, 2000.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Understand different types of tools, chips, tool wear, tool failure criteria, forces acting during metal cutting and metal cutting theories.

**CO2:** Classify different cutting tools, their properties and applications.
Understand and analyze the effect of temperature, strain rate in metal working, heat affected zones and learn different tool materials.

**CO3:** have in depth knowledge on working of lathe, shaping, planning and slotting machines, different machining operations performed, tool and work holding devices and heat generated during metal cutting.

**CO4:** have in depth knowledge on working of drilling, milling, hobbling grinding and broaching machines, different machining operations performed on them and their applications.

**CO5:** Differentiate and understand different finishing operations, non-traditional machining processes based on the mechanism of material removal, working principle and analyze the process parameters.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 2 |
| **CO2** | 3 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 2 |
| **CO3** | 3 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 2 |
| **CO4** | 3 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 2 |
| **CO5** | 3 | 1 | 0 | 2 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : FOURTH**

| **COURSE TITLE : APPLIED THERMODYNAMICS** | | |
|---|---|---|
| **Sub Code: 18ME44** | **No of Credits : L-T-P-SS 3:2:0:0 =4** | **No. of contact hours/week : 3L+2T Total Number of contact hours : 65** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Fluid mechanics, Engineering thermodynamics** | |

**COURSE OBJECTIVES**

1. To relate the fundamentals of thermodynamics to the real time applications.
2. To describe the various thermodynamic power cycles which use air and vapour as the working fluid
3. To apply the fundamental concepts to derive various thermodynamic variables for solving numerical problems
4. To understand and determine the performance parameters of various thermodynamic systems.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **AIR STANDARD POWER CYCLES** (BLENDED TEACHING) | **9L+4T** |
| | Introduction; Description, work and heat transfers of various thermodynamic processes, p-v and T-s diagrams, Air standard cycles - derivation of efficiency and mean effective pressure of Carnot, Otto, Diesel, dual combustion and Stirling cycles; IC Engines – Combustion of SI and CI engines, Detonation and factors affecting detonation; Testing and performance of IC engines: basic measurements – engine speed, fuel consumption, air consumption, exhaust Smoke, IP, BP, FP measurements, heat balance sheet, Alternate Fuels, Numerical problems. | |
| **UNIT-2** | **GAS TURBINE CYCLES AND JET PROPULSION** (CLASSROOM TEACHING) | **9L+4T** |
| | Introduction; Analysis of simple gas turbine cycle (Brayton cycle); Methods to improve the performance of gas turbine plant – efficiency of regenerative gas turbine cycle; Reheat gas turbine cycle; Gas turbine cycle with intercooling; Gas turbine cycle with reheat, regeneration and intercooling, Numerical problems; Jet Propulsion **–** Introduction to jet propulsion**, G**as turbine cycles for jet propulsions, Working of ram jet engine, Pulse jet engine, Turbo jet engine, Turboprop engine, comparisons of various propulsive devices, Numerical problems. | |
| **UNIT-3** | **VAPOUR POWER CYCLES** (CLASSROOM TEACHING) | **9L+4T** |
| | Introduction; Performance parameters; Carnot vapor power cycle; Rankine cycle; actual vapour power cycle; Comparison of Rankine and Carnot cycles; Mean temperature of heat addition; Steam nozzles - Flow of steam through nozzles, Shape of nozzles, effect of friction, Critical pressure ratio, Supersaturated flow; Methods of improving the thermal efficiency of vapor power plant; Reheat cycle; Ideal and practical regenerative cycle; Reheat-regenerative cycle; feed water heaters; Numerical problems. | |
| **UNIT-4** | **RECIPROCATING AIR COMPRESSORS** (CLASSROOM TEACHING) | **9L+4T** |
| | Introduction; Working principle, p-v diagram and derivation of work input of a single stage reciprocating compressor; Adiabatic, isothermal and mechanical efficiencies; Effect of clearance and derivation of volumetric efficiency, Numerical problems; Multistage compressor; Intercooling, Saving in work, Optimum intermediate pressure, Minimum work for compression; Numerical problems. | |
| **UNIT-5** | **REFRIGERATION CYCLES AND PSYCHROMETRY** (ONLINE TEACHING) | **9L+4T** |

| | | |
|---|---|---|
| | Introduction; Units of refrigeration, COP; Reversed Carnot cycle; Vapour compression refrigeration cycle; Deviation of actual cycle from ideal cycle; Effect of change in operating conditions on the performance of vapour compression cycle, Numerical problems; Refrigerants – Selection, Properties of refrigerant; Vapour absorption refrigeration system, Steam jet refrigeration system; Gas cycle refrigeration-Bell Coleman cycle; Numerical problems; Psychrometry: Definitions of terms related to psychrometry – WBT, DBT, DPT, specific humidity, relative humidity, enthalpy, psychrometric chart, psychrometric processes, summer and winter air conditioning, numerical problems. | |

**TEXT BOOKS**

1. **Basic and Applied Thermodynamics,** P.K. Nag, Tata McGraw-Hill Publications, 2nd Edition, 2010.
2. **Applications of Thermodynamics,** V. Kadambi, T R Seetharam and K B Subramanya Kumar, Wiley India Private Limited, 1st Edition, 2019.
3. **Thermodynamics: An Engineering Approach**, Yunus A Cengel and Michael A Boles, McGraw Hill Education (India) Pvt. Limited, 8th Edition, 2016

**REFERENCE BOOKS**

1. **A Course in Thermal Engineering,** A. Domkundwar, C.P. Kothandaraman, S. Domkundwar, DanpatRai and Co (P) Limited, 2013.
2. **Gas Turbines,** V Ganeshan,Tata McGraw-Hill Publications, 2nd Edition, 2003.
3. **Gas Turbines and Jet Rocket Propulsion**, V.M. Domkundwar, DhanpatRai & Co. (P) Limited, 2nd Edition, 2013.

**e-LEARNING RESOURCES**

**For Videos, Lecture Notes, Visit** http:// www.nptel.ac.in

**MASSIVE OPEN ONLINE COURSES (MOOCs):**

Students are encouraged to visit http:// www.nptel.ac.in (http:// www.swayam.gov.in) and register for the following MOOCs:

1. Concepts of Thermodynamics (12 Week Course; Jan-April/July-Oct)
2. IC Engines and Gas Turbines (12 Week Course; Jan-April)
3. Applied Thermodynamics for Engineers (12 Week Course; July-Oct)

**DATA HAND BOOKS AND CHARTS**

1. **Thermodynamics Data Hand Book (SI Units),** B T Nijaguna and B S Samaga, Sudha Publications, 2016.
2. **Refrigeration Tables and Charts: SI Units,** C.P. Kothandaraman**,** 4th Edition, New Age International Publishers, 2015.

**COURSE OUTCOME (CO)**

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

**CO1:** *Explain* various thermodynamic processes and air standard power cycles with p-v and T-s diagrams; *derive* expressions of efficiency and mean effective pressure of power cycles; *understand* the measurement of various parameters to *assess* the performance of internal combustion engines (RBTL 1, 2, 3).

**CO2:** *Describe* the various gas turbine cycles and jet propulsion devices with neat sketches; *solve* related numerical problems (RBTL 1, 2, 3).

**CO3:** *Understand* and *compare* the Carnot and Rankine vapour power cycles with T-s diagrams; *derive* expressions for efficiency and *solve* related numerical problems (RBTL 1, 2, 3).
**CO4:** *Describe* the working principle of reciprocating air compressor; *derive* the expressions for its performance and *solve* related numerical problems (RBTL 1, 2, 3).
**CO5:** *Explain* the vapour compression and gas cycle refrigeration systems with T-s diagrams; *derive* expressions for coefficient of performance and *solve* related numerical problems; *Describe* the various psychrometric processes plotted on a psychrometric chart; *understand* the summer and winter air conditioning systems and *solve* related numerical problems (RBTL 1, 2, 3).
(RBTL: Revised Bloom's Taxonomy Level 1 – Remembering, 2 – Understanding, 3 – Applying, 4 - Analyzing, 5 - Evaluating, 6 - Creating)

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 2 | 2 | 0 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 2 | 0 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 0 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 2 | 0 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 0 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3. Each full question shall have a maximum of 3 sub-divisions. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : FOURTH**

| **COURSE TITLE : KINEMATICS OF MACHINES** | | |
|---|---|---|
| **Sub Code: 18ME45** | **No of Credits =4**<br>**L-T-P-SS::3:2:0:0** | **No. of Contact hours/week : 3L+2T**<br>**Total Number of Contact hours : 65** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Basic engineering mathematics** | |

**COURSE OBJECTIVES:**

1) Explain the types of relative motion.
2) Differentiate between Machine, Mechanism, and Structure.
3) Draw the velocity and acceleration diagram of various linkages.
4) Determine the gear parameters and check for interference.
5) Calculate the fixing torque in gear trains.
6) Design the Cam profile for the desired follower motion.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **INTRODUCTION** (BLENDED TEACHING) | **9L+4T** |
| | Definitions Link or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, mechanism, structure, mobility of mechanism, inversion, machine.<br>**Kinematic chains and inversions -** Inversions of four bar chain; single slider crank chain and double slider crank chain practical applications.<br>**Mechanisms -** Quick return motion mechanisms-drag link mechanism, Whitworth mechanism and crank and slotted lever mechanism.<br>Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism,. All wheel drive mechanism, power steering, Antilock Braking System. | |
| **UNIT-2** | **VELOCITY AND ACCELERATION ANALYSIS OF MECHANISMS (GRAPHICAL METHODS)** (CLASS ROOM TEACHING) | **9L+4T** |
| | Velocity and acceleration analysis of four bar mechanism, slider crank mechanism and simple mechanisms by vector polygons: relative velocity and acceleration of particles .in a common link, relative velocity and accelerations of coincident particles on separate links-Coriolis component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing, Numericals. | |
| **UNIT-3** | **VELOCITY ANALYSIS BY INSTANTANEOUS CENTER METHOD**<br>(CLASS ROOM TEACHING) | **9L+4T** |
| | Definition, Kennedy's Theorem, determination of linear and angular velocity using instantaneous center method, Numericals.<br>**KLEIN'S CONSTRUCTION**:<br>Analysis of velocity and acceleration of single slider crank mechanism, Numericals. | |
| **UNIT-4** | **GEARS & GEAR TRAINS** (ONLINE TEACHING) | **9L+4T** |
| | **GEARS:** Spur gears and its terminology, law of gearing, characteristics of involute action, path of contact, arc of contact, contact ratio of spur, helical, bevel and worm gears, interference in involute gears. Methods of avoiding interference, backlash, comparison of involute and cycloidal teeth, numericals.<br>**GEAR TRAINS:** Simple gear trains, Compound gear trains for large speed reduction, epicyclic gear trains, reverted gear trains Algebraic and tabular methods of finding | |

| | | |
|---|---|---|
| | velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains, numericals. | |
| **UNIT-5** | **CAMS** (CLASS ROOM TEACHING) | **9L+4T** |
| | Types of cam and follower. Displacement, velocity and, acceleration time curves for cam profiles, disc cam with reciprocating follower having knife-edge, roller and flat-face follower, disc cam with oscillating roller follower. Follower motions including SHM, uniform velocity, uniform acceleration and retardation and cycloidal motion, Problems. | |

**TEXT BOOKS:**

1. **"Theory of Machines",** Thomas Bevan
2. **"Theory of Machines",** Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009.
3. **"Theory of Machines",** Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006

**REFERENCE BOOKS:**

1. **"Theory of Machines & Mechanisms**", J.J. Uicker, G.R. Pennock, J.E. Shigley. OXFORD 3rd Ed. 2009.
2. **Mechanism and Machine theory**, Ambekar, PHI, 2007

Graphical Solutions may be obtained either on the Graph Sheets or on the Answer Book itself.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Identify the types of Kinematic motion in machines used in everyday life.

**CO2:** calculate the velocity and acceleration of linkages using graphical, analytical, and vector approaches.

**CO3:** Analyse the four bar and slider crank mechanism through instantaneous centre method

**CO4:** Estimate the gear tooth parameters, train value for different types of gear trains.

**CO5:** Design the cam profile for the desired follower motion for applications such as IC engine valves, machine tools.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 0 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 0 | 2 |
| **CO3** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 0 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 0 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : FOURTH**

| **COURSE TITLE : MANUFACTURING PROCESSES LABORATORY - II** | | |
|---|---|---|
| **Sub Code:18MEL46** | **No of Credits L-T-P-SS :: 0:0:2:0 = 01** | **No. of practical hours/week: 02** |
| **Exam Duration : 03 hours** | **CIE Marks: 50** | **Examination Marks : 50** |
| **Pre-requisites** | **Elements of Mechanical Engineering, Manufacturing Processes II** | |

**COURSE OBJECTIVES:**

1.To teach the students to produce simple work pieces using a lathe
2. To let students cut teeth on a gear blank using a milling machine

| # | CONTENTS | Hours |
|---|---|---|
| **PART A** | **LATHE**<br>02 models preparation on Turning Machine involving;<br>• Facing - preliminary operation<br>• Plain turning - preliminary operation<br>• Step turning<br>• Taper turning<br>• Knurling<br>• Thread cutting<br>• Drilling<br>• Boring<br>• Internal-Thread-cutting<br>• Eccentric-turning | **16** |
| **PART B** | **MILLING MACHINE**<br>Milling Machine - Milling machine tools and operations demonstration Cutting of Gear Teeth – 01 model | **10** |

**REFERENCE BOOKS:**


1. **Production Technology,** R.K.Jain, Khanna Publications, 2003.
2. **Production Technology,** HMT, Tata McGraw Hill, 2001.
3. Manufacturing Technology - Vol. 2, P N Rao,TMH; Third edition (1 May 2013)
4. **Production Technology,** R.K.Jain, Khanna Publications, 2003.
5. Production Technology, P.C. Sharma, S Chand (1 December 2006)


**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Identify the universal machine tool and prepare models using lathe.
**CO2:** Able to calculate the number of teeth that can be cut on a given blank and cut gear teeth using a milling machine.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 3 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**CONTINUOUS INTERNAL EVALUATION (CIE)**

1. CIE has a maximum of 50 marks.
2. CIE Marks is finalized by conducting a test at the end of 12th week of the semester.
3. CIE Marks (50) = Evaluation of Record (30) + Test (20)

| **SCHEME OF CONTINUOUS INTERNAL EVALUATION (CIE)** | |
|---|---|
| **RECORD WRITING** | |
| **PART-A** | |
| Lathe tools, operations and model | 20 MARKS |
| **PART-B** | |
| Tools, Operations and model on a milling machine | 10 MARKS |
| **TOTAL – 1** | **30 MARKS** |
| **CIE at the end of 12th week of the semester** | |
| ONE lathe Model from PART A | 30 MARKS |
| ONE model from PART B | 10 MARKS |
| Viva – Voce | 10 MARKS |
| | 50 MARKS |
| **TOTAL – 2** = 50/2.5 | **20 MARKS** |
| **GRAND TOTAL (TOTAL-1+TOTAL-2)** | **50 MARKS** |

| **SCHEME OF SEMESTER END EXAMINATION (SEE)** | |
|---|---|
| One **Lathe Model** from PART A | 30 MARKS |
| ONE **model** from PART B | 10 MARKS |
| Viva – Voce | 10 MARKS |
| **TOTAL** | **50 MARKS** |

**ADMISSION YEAR : 2019-20 ACADEMIC YEAR: 2020-21**
**SEMESTER : FOURTH**

| **COURSE TITLE : MECHANICAL MEASUREMENTS LABORATORY** | | |
|---|---|---|
| **Sub Code: 18MEL47** | **No of Credits =1**<br>**L-T-P-SS::0:0:2:0** | **No. of practical hours/week: 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | | |

**COURSE OBJECTIVES:**

1. Calibration of vital tools including micrometer in measurements laboratory
2. Calculate modulus of elasticity of a ductile specimen
3. Measurement of parameters like; Angle, Alignment, Cutting tool forces, Screw thread, Surface roughness and Gear tooth profile

| | **Contents** | **Hrs** |
|---|---|---|
| **PART A** | **MEASUREMENTS** | **12** |
| | Calibration of Pressure Gauge, Thermocouple, LVDT, Load cell, Micrometer using slip gauges; Determination of modulus of elasticity of a ductile specimen using strain gauges | |
| **PART B** | **METROLOGY** | **14** |
| | Measurement using Optical Projector and Optical Flats, Measurement of angle using Sine bar & bevel protractor, Surface roughness using Mechanical Comparator, gear tooth profile using gear tooth Vernier | |

**REFERENCE BOOKS:**


1. **Mechanical Measurements,** Beckwith Marangoni and Lienhard, Pearson Education, 6th Edition, 2006. (For Measurements Part Only)
2. **Engineering Metrology,** R.K. Jain, Khanna Publishers, 1994
3. **Mechanical Measurements and Metrology,** Dr. T. Chandrasekhar, Subhash Publishers, III Edition, 2009.


**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Calibrate various measuring instruments such as Pressure Gauge, Thermocouple, LVDT, Load cell and determination of modulus of elasticity.

**CO2:** Use Optical Projector, Optical Flats, measurement of angle using Sine bar & bevel protractor, Surface roughness using Mechanical Comparator, gear tooth profile using gear tooth Vernier

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 1 | 1 | 0 | 2 | 2 | 2 | 3 | 3 | 0 | 2 |
| **CO2** | 3 | 3 | 1 | 1 | 0 | 2 | 2 | 2 | 3 | 3 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**CONTINUOUS INTERNAL EVALUATION (CIE)**

1.CIE Marks is finalized by conducting a test at the end of 10th week of the semester.
2.CIE Marks (50) = Evaluation of Record (30) + Test (20)

| **SCHEME OF EXAMINATION (SEE)** | |
|---|---|
| One experiment from PART A | 15 MARKS |
| One experiment from PART B | 25 MARKS |
| Viva – Voce | 10 MARKS |
| TOTAL | 50 MARKS |

**Dr. Ambedkar Institute of Technology, Bengaluru-560 056**
**SCHEME OF TEACHING AND EXAMINATION from Academic Year 2020-21**
**B.E Name of the programme**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**

**V SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | HS | 18HS51/52 | Management & Entrepreneurship / Intellectual Property Rights | Hu | 3 | - | -- | 03 | 50 | 50 | 100 | 3 |
| 2 | PC | 18ME51 | Design of Machine Elements - I | ME | 4 | 0 | -- | 03 | 50 | 50 | 100 | 4 |
| 3 | PC | 18ME52 | Dynamics of Machines | ME | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 4 | PC | 18ME53 | Turbomachines | ME | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 5 | PC | 18ME54 | Computer Aided Design and Manufacturing | ME | 4 | 0 | -- | 03 | 50 | 50 | 100 | 4 |
| 6 | PE | 18ME55X | Professional Elective -1 | ME | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 7 | PE | 18XXE01 | Open Elective -A | | 3 | -- | -- | 03 | 50 | 50 | 100 | 3 |
| 8 | PC | 18MEL56 | Computer Aided Manufacturing Laboratory | ME | -- | -- | 2 | 03 | 50 | 50 | 100 | 1 |
| 9 | PC | 18MEL57 | Fuel Testing and Internal Combustion Engines Laboratory | ME | -- | 0 | 2 | 03 | 50 | 50 | 100 | 1 |
| **TOTAL** | | | | | **22** | **2** | **4** | **27** | **450** | **450** | **900** | **25** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | HS | 18HS55 | Placement Training | Hu | 02 | -- | -- | 03 | 50 | - | 50 | PP/ NP |
| **Note: Hu: Humanities, PC: Professional Core, MC: Mandatory Course** | | | | | | | | | | | | |

| **Course code** | **Professional Electives - 1** | **OPEN ELECTIVE –A** |
|---|---|---|
| 18ME551 | Engineering Economics | Students can select any one of the open electives (Please refer to consolidated list of Dr AIT for open electives) offered by any Department.<br>Selection of an open elective is not allowed provided,<br>• The candidate has studied the same course during the previous semesters of the programme.<br>• The syllabus content of open elective is similar to that of Departmental core courses or professional electives.<br>• A similar course, under any category, is prescribed in the higher semesters of the programme.<br>Registration to electives shall be documented under the guidance of Programme Coordinator / Mentor. |
| 18ME552 | Composite Materials and Manufacturing | |
| 18ME553 | Automobile Engineering | |
| 18ME554 | Mechatronics and Microprocessor | |
| 18ME555 | Principles of Metal Forming | |
| 18ME556 | Experimental Stress Analysis | |
| | **OPEN ELECTIVE – A** | |
| 18XXE01 | | |
| | | |
| | | |

**Dr. Ambedkar Institute of Technology, Bengaluru-560 056**
**SCHEME OF TEACHING AND EXAMINATION from Academic Year 2020-21**
**B.E Name of the programme**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**

**VI SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | HS | 18HS61/62 | Management & Entrepreneurship / Intellectual Property Rights | Hu | 3 | -- | -- | 03 | 50 | 50 | 100 | 3 |
| 2 | PC | 18ME61 | Design of Machine Elements - II | ME | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 3 | PC | 18ME62 | Heat Transfer | ME | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 4 | PC | 18ME63 | Mechanical Vibrations | ME | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 5 | PE | 18ME64X | Professional Elective -2 | ME | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 6 | OE | 18XXE02 | Open Elective -B | | 3 | -- | -- | 03 | 50 | 50 | 100 | 3 |
| 7 | PC | 18MEL65 | Fluid Mechanics and Machines Laboratory | ME | -- | -- | 2 | 03 | 50 | 50 | 100 | 1 |
| 8 | PC | 18MEL66 | Heat Transfer Laboratory | ME | -- | 0 | 2 | 03 | 50 | 50 | 100 | 1 |
| 9 | MP | 18MEP67 | Mini-project | ME | | | | 03 | 50 | 50 | 100 | 2 |
| 10 | INT | 18XXI69 | Industry Internship | (To be carried out during the intervening vacations of VI / VII semesters) | | | | -- | | | | |
| **TOTAL** | | | | | **17** | **6** | **4** | **27** | **450** | **450** | **900** | **24** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | HS | 18HS66 | Placement Training | Hu | 02 | -- | -- | 03 | 50 | - | 50 | PP/NP |

**Note: PC: Professional core, PE: Professional Elective, OE: Open Elective, MP: Mini-project, INT: Internship.**

**Internship:** All the students admitted to III year of BE/B. Tech have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. A University examination will be conducted during VIII semester and prescribed credit are added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent University examination after satisfy the internship requirements.

| Course code | Professional Electives - 2 | OPEN ELECTIVE –B |
|---|---|---|
| 18ME641 | Inspection And Quality Control | Students can select any one of the open electives (Please refer to consolidated list of Dr AIT for open electives) offered by any Department.<br>Selection of an open elective is not allowed provided,<br>• The candidate has studied the same course during the previous semesters of the programme.<br>• The syllabus content of open elective is similar to that of Departmental core courses or professional electives.<br>• A similar course, under any category, is prescribed in the higher semesters of the programme.<br>Registration to electives shall be documented under the guidance of Programme Coordinator / Mentor. |
| 18ME642 | Advanced Welding Processes | |
| 18ME643 | Internal Combustion Engines | |
| 18ME644 | Production And Operations Management | |
| 18ME645 | Finite Element Methods | |
| 18ME646 | Fluid Power Control Systems | |
| | **OPEN ELECTIVE – B** | |
| 18XXE02 | | |
| | | |
| | | |
| | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : DESIGN OF MACHINE ELEMENTS – I** | | |
|---|---|---|
| **Sub Code: 18ME51** | **No of Credits =04**<br>**L-T-P-SS::4:0:0:0** | **No. of lecture hours/week : 04**<br>**Total Number of Lecture hours : 52** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Mechanics of Materials, Material science and metallurgy** | |

**COURSE OBJECTIVES:**

1. To study basic principles of machine design
2. To acquaint with the concepts of strength design related to various components.
3. To familiarize usage of design data books & various codes of practice.
4. To make conversant with preparation of working design drawings

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **INTRODUCTION TO MACHINE DESIGN** (ONLINE TEACHING) | **10** |
| | Introduction to machine design, Classification, Phase/steps in Machine design process. Design Considerations, Design Method and mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects. Manufacturing Considerations in Design: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Codes and standards, Stress-strain diagrams, Stress analysis, Definitions: normal, shear, biaxial and tri axial stresses, Stress tensor, Principal and Shear Stresses and their directions. | |
| **UNIT-2** | **DESIGN FOR STATIC STRENGTH & STRESS CONCENTRATION** (BLENDED TEACHING) | **10** |
| | **DESIGN FOR STATIC STRENGTH:** Static loads and factor of safety, Theories of failure: Maximum normal and shear stress theories, Maximum strain theory, Strain and Distortion energy theories. Failure of brittle and ductile materials.<br>**STRESS CONCENTRATION:** Definition, Reason for occurrence, Methods to reduce, Stress concentration factor, charts and static loads, compound stress concentration factors, Design of stress concentrated members under various loads and Numerical problems. | |
| **UNIT-3** | **DESIGN FOR FATIGUE STRENGTH & IMPACT STRENGTH** (CLASSROOM TEACHING) | **10** |
| | **DESIGN FOR FATIGUE STRENGTH**: Introduction- S-N Diagram, Low and High cycle fatigues, Endurance limit, fatigue failure prevention. Modifying factors: Load, size, surface, causes for SEF and effects of SEF, Fluctuating stresses, Soderberg and Goodman, Gurber relation, stresses due to combined loading, cumulative fatigue damage. Problems on design of members for finite & infinite life subjected to individual & combined loading. Cumulative damage in fatigue.<br>**IMPACT STRENGTH:** Introduction, Impact stresses due to axial, bending and torsional loads, effect of inertia. Numerical problems**.** | |
| **UNIT-4** | **DESIGN OF SHAFTS, KEYS & COUPLINGS** (CLASSROOM TEACHING) | **10** |
| | **DESIGN OF SHAFTS**: Types, Design of solid & hollow shaft on strength and rigidity basis with steady loading subjected to pure torsion with steady loading, Design of shafts carrying pulleys & gears (Combined loading). ASME codes for power transmission shafting, shafts under fluctuating loads and combined loads and Numerical problems. | |

| | | |
|---|---|---|
| | **KEYS:** Types of Keys and their selection based on shafting condition, key ways, splines **SHAFT COUPLINGS**: Introduction, classification, advantages, and applications of Couplings: design of Rigid and flexible couplings, Flange coupling, Bush and Pin type coupling and Oldham's coupling and Numerical problems. | |
| **UNIT-5** | **RIVETED, WELDED AND BOLTED JOINTS** (BLENDED TEACHING) | **12** |
| | **RIVETED JOINTS**: Types, rivet materials, Modes of failures of riveted joints, Strength Equations – efficiency of riveted joints, Joint Efficiency, Boiler Joints, Lozenge Joints, Riveted Brackets, Eccentrically riveted joints and Numerical problems.<br>**WELDED JOINTS:** Types, Strength of butt and fillet welds, eccentrically loaded welded joints and Numerical problems.<br>**BOLTED JOINTS:** Design of bolts with pre-stresses – Design of joints under eccentric loading | |

**TEXT BOOKS:**

1. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2009.
2. Design of Machine Elements**,** V.B. Bhandari, TMH, New Delhi, 2nd Ed. 2007.

**DESIGN DATA HANDBOOK:**

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, Shri Shashi Prakashan, Belgaum.

**REFERENCE BOOKS:**

1. **Machine Design,** Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, TMH, New Delhi, Special Indian Edition, 2008.
4. Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.
5. Fundamentals of Machine Elements - Hawrock, Jacobson Mcgraw Hill
6. Machine Design - Patel, Pandya, Sikh, Vol. - I & II, C.
7. Fundamentals of Machine Elements B.J. Hamrock, and S.R. Schmid TMH.
8. The Mechanical Design Process. D.G. Ullman, TMH, New Delhi, 2008.

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

**CO1:** Demonstrate understanding of various design considerations

**CO2:** Apply basic principles of machine design

**CO3:** Design machine elements on the basis of strength concept

**CO4:** Use design data books and various standard codes of practices and acquire skill in preparing production drawings pertaining to various designs.

**CO5:** Successfully design machine components for suitable applications.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 3 | 3 |
| **CO2** | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 3 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3. Design Data Hand Book is permitted | | | | | | | | | | |

**ADMISSION YEAR : 2018-19** **ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : DYNAMICS OF MACHINES** | | |
|---|---|---|
| **Sub Code: 18ME52** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **KOM** | |

**COURSE OBJECTIVES:**

1. Draw and analyze free body diagram for multiple forces applied on static members of four bar chain and slider mechanism.
2. Design the size of the flywheel for the excess energy storage and retrieval.
3. The terms slip and creep in belt drives.
4. Determine the value of balancing mass for the system.
5. Define sensitivity, isochronous, hunting, controlling force with respect to governors.
6. Analyses the effect of gyro on automobile, ship, Aeroplanes.

| **UNITS** | **CONTENTS** | **Hrs** |
|---|---|---|
| **UNIT-1** | **STATIC FORCE ANALYSIS** (CLASS ROOM TEACHING) | **08** |
| | Introduction, Static equilibrium, Equilibrium of two and three force members. Members with two forces and torque, Free body diagrams, Static force analysis of simple mechanisms. Principle of virtual work, Numericals. | |
| **UNIT-2** | **DYNAMIC FORCE ANALYSIS** (CLASS ROOM TEACHING) | **07** |
| | Dynamic force analysis, motion and Inertia: Alembert's principle, Inertia force and inertia torque, Inertia forces on a four bar mechanism, Numericals. | |
| **UNIT-3** | **FRICTION & BELT DRIVES** (BLENDED TEACHING) | **08** |
| | **Friction:** Definitions: Types of friction: laws of solid friction, coefficient friction.<br>**Belt dives:** Initial tension in the belt, ratio of belt tensions, Effect of Centrifugal tension, power transmitted by Belt thickness and width calculations, V-Belts ,Rope Drives (circular belts ) Numericals. | |
| **UNIT-4** | **BALANCING OF ROTATING and RECIPROCATING MASSES** (BLENDED TEACHING) | **08** |
| | **Balancing Of Rotating Masses:** Static and dynamic balancing. Balancing of single rotating mass in same plane and in different planes. Balancing of several rotating masses in same plane and in different planes, Numericals.<br>**Balancing Of Reciprocating Masses:** Inertia effect of crank and connecting rod, single cylinder engine, balancing in multi cylinder-inline engine (primary & secondary forces), V-type engine; Numericals. | |
| **UNIT-5** | **GOVERNORS & GYROSCOPES** (BLENDED TEACHING) | **08** |
| | **Governors:** Types of governors; force analysis of Porter and Hartnell governors - Controlling force, stability, sensitiveness, isochronism, effort and power, Numericals.<br>**Gyroscopes:** Vectorial representation of angular motion, gyroscopic couple. Effect of gyroscopic couple on the movement of plane disc, aero plane, stability of two wheeler and four wheeler taking a turn, Numericals. | |

**TEXT BOOKS:**

**1. Theory of Machines**, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2009.

**2. Theory of Machines**, Sadhu Singh, Pearson Education. 2nd edition. 2007.

**REFERENCE BOOKS:**

**1. Theory of Machines & Mechanisms,** J.J. Uicker, G.R. Pennock, J.E. Shigley. Oxford 3rd edition. 2009

**2. Mechanism and Machine Theory**, A.G. Ambekar PHI, 2007.

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

**CO1**: Illustrate basic concept of static forces of equilibrium in a mechanism.

**CO2:** Illustrate basic concept of dynamic forces of equilibrium in a mechanism and design a flywheel

**CO3:** Characterize the operation of bearings and belt drives and design them for power transmission.

**CO4:** Analyze and understand concept of static and dynamic balancing of rotating and reciprocating masses in engine.

**CO5:** Analyze and understand working Principles of different types of governors and Gyroscopic effects on the mechanical systems

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19** **ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : TURBOMACHINES** | | |
|---|---|---|
| **Sub Code: 18ME53** | **No of Credits : L-T-P-SS 2:2:0:0 =3** | **No. of lecture hours/week : 04 Total Number of Lecture hours : 52** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Basic thermodynamics, Fluid mechanics** | |

**COURSE OBJECTIVES :**

1. To outline the working principle of turbo machines with examples and classify turbomachines and describe the energy transfer mechanism of turbo machines.
2. To understand the thermodynamics of flow and apply dimensional analysis and similarity laws for conducting model tests.
3. To explain the functioning of radial flow and axial flow turbo machines such as centrifugal pumps, compressors, steam, gas and hydraulic turbines
4. To demonstrate the effect of important variables affecting the output of turbo machines.
5. To analyze a given problem, apply the fundamental knowledge to solve the problems.
6. To estimate and evaluate unknown parameters and predict the performance of turbo machines.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **INTRODUCTION AND DIMENSIONAL ANALYSIS** (BLENDED TEACHING) | **10L+2T** |
| | **Introduction**: Definition of a turbo machine; parts of a turbo machine; comparison with positive displacement machine; classification of Turbomachines.<br>**Thermodynamics of fluid flow:** Application of first and second law of thermodynamics to turbo machines; Efficiencies of turbo machines; Static and Stagnation states; Overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes; Reheat factor for expansion process; Simple numerical problems on stage efficiency and polytropic efficiency.<br>**Dimensional Analysis:** Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham □ theorem, dimensionless numbers, and similitude, types of similitude, dimensional analysis and similarity studies. Numerical problems. | |
| **UNIT-2** | **GENERAL ANALYSIS OF RADIAL AND AXIAL FLOW TURBOMACHINES** (CLASSROOM TEACHING) | **8L+2T** |
| | **Energy transfer in a turbo machine** - Euler turbine equation; alternate form of Euler turbine equation (components of energy transfer); degree of reaction, utilization factor and relationship between them.<br>**General analysis of radial flow turbo machines (turbines and pumps)** - Effect of blade discharge angle on their performance; Theoretical head-capacity relationship; Numerical problems.<br>**General analysis of axial flow turbines** – utilization factor, degree of reaction, relationship between utilization factor and blade speed ratio; Maximum utilization factor and optimum blade speed ratio for impulse and reaction axial flow turbines; General analysis of axial flow compressors and pumps – general expression for energy transfer and degree of reaction; Numerical problems. | |
| **UNIT-3** | **STEAM TURBINES** (CLASSROOM TEACHING) | **8L+2T** |
| | Introduction; Different efficiencies; Analysis of single stage impulse (De Laval) turbine; Impulse staging and need for compounding; Analysis of velocity compounded impulse | |

| | | |
|---|---|---|
| | (Curtis) turbine; Analysis of Impulse-reaction (Rateau) turbine; Reheat factor for multi stage turbine; Numerical problems. | |
| **UNIT-4** | **HYDRAULIC TURBINES** (CLASSROOM TEACHING) | **8L+2T** |
| | Introduction; Classification; Different heads and efficiencies; Pelton turbine-velocity triangles; Francis turbine-velocity triangles, runner shapes for different blade speeds; function of a draft tube, types of draft tube; Kaplan and Propeller turbines – velocity triangles and analysis; Related numerical problems; Specific speed and its significance; Unit quantities and their uses; Characteristic curves of hydraulic turbines; Numerical Problems. | |
| **UNIT-5** | **CENTRIFUGAL PUMPS AND COMPRESSORS** (ONLINE TEACHING) | **8L+2T** |
| | Centrifugal pumps –Introduction, Main parts of a centrifugal pump; Work done; Definitions of heads and efficiencies; minimum speed for starting; Multistage centrifugal pump; Specific speed; Priming; Characteristic curves; Cavitation; Thoma's cavitation factor; Maximum suction lift; Net positive suction head; Related numerical problems: Centrifugal compressors-Introduction; Work done; Overall pressure ratio developed; Pressure ratio in terms of $\phi_s$, $\phi_p$, $\phi_w$; Compressibility and pre-whirl; Diffuser design; Surging; Numerical problems. | |

**TEXT BOOKS**


**1. A Textbook of Turbo Machines**, Dr M S Govindegowda and Dr A M Nagaraja, 8th Edition, M M Publishers, 2014

**2. Turbo Machines**, Dr. N. Krishnamurthy, Sunstar Publisher, 2nd Edition, 2015.

**3. A Textbook of Fluid Mechanics and Hydraulic Machines (SI Units)**, Dr. R.K. Bansal, Laxmi Publications (P) Limited, Revised 9th Edition, 2010.


**REFERENCE BOOKS**


**1. An introduction to energy conversion, Vol. III – Turbomachinery**, V. Kadambi and Manohar Prasad, 2nd Edition, New Age International Publishers (P) Limited, 2011.

**2. Principles of turbomachinery**, D. G. Shepherd, MacMillan Company, 1964.

**4. Turbomachines**, B.U. Pai, Wiley Precise Textbook Series, 2014.


| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3. Each full question shall have a maximum of 3 sub-divisions. | | | | | | | | | | |

**COURSE OUTCOME (CO):** After the completion of the course, students will be able to:
**CO1:** *Explain* the fundamentals of energy transfer in turbo machines with the application of first and second laws of thermodynamics; *Understand* the dimensional analysis and model studies applied to turbomachines; and *solve* related numerical problems (RBTL 1, 2, 3)
**CO2:** *Analyse* the radial flow and axial flow turbines and *solve* related numerical problems (RBTL 1, 2, 3).
**CO3:** *Classify* and *analyse* the various types of steam turbines and *solve* related numerical problems (RBTL 1, 2, 3).
**CO4:** *Classify* and *analyse* the various types of hydraulic turbines and *solve* related numerical problems (RBTL 1, 2, 3).
**CO5:** *Classify* and *analyse* the various types of centrifugal pumps and compressors and *solve* related numerical problems (RBTL 1, 2, 3)
(RBTL: Revised Bloom's Taxonomy Levels; 1 – Remembering, 2 – Understanding, 3 – Applying, 4 - Analyzing, 5 - Evaluating, 6 - Creating)

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO3** | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO5** | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : COMPUTER AIDED DESIGN AND MANUFACTURING** | | |
|---|---|---|
| **Sub Code: 18ME54** | **No of Credits =04**<br>**L-T-P-SS::4:0:0:0** | **No. of lecture hours/week : 04**<br>**Total Number of Lecture hours : 52** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Manufacturing process** | |

**COURSE OBJECTIVES:**

1. Describe the importance of computers role of CAD/CAM in modern design and manufacturing
2. Comprehend and solve the basic mathematical elements of Computer Graphics.
3. Effective learning of NC & CNC technology and create simple CNC programs for machining operations.
4. To impart the use of CAD and CAM in the design and production preparation process.
5. Demonstrate the concept, configurations and features of Robotics along with its applications.

| **Sl. No.** | **CONTENTS** | **Hrs** |
|---|---|---|
| **UNIT-1** | **INTRODUCTION** (ON-LINE TEACHING) | **10** |
| | Role of computers in design and manufacturing influence of computers in manufacturing environment. Product cycle in convention to computerized manufacturing environment. Introduction to CAD. Introduction to CAM. Advantages and disadvantages of CAD and CAM, Types of surface generation and its applications.<br>Hardware for CAD: Design Workstation, Graphics Terminal - Image generation and maintenance techniques (CRT, LCD, LED), Colour generation in graphic. | |
| **UNIT-2** | **GEOMETRIC TRANSFORMATIONS IN COMPUTER GRAPHICS** (BLENDED TEACHING) | **10** |
| | Software configuration of a graphic system. Function of graphics package, Elements of Solid Modeling, wire frame and solid modeling, CAD/CAM integration. Desirable modeling facilities and transformation. Introduction to exchange of modeling data – basic features of IGES, STEP, DXF, DMIS.<br>SOLID MODELLING – Boundary Representation Cubic splines and Bezier curves and its characteristics, simple problems on Hermite Cubic splines and Bezier curves, concept of B-splines and its advantages. | |
| **UNIT-3** | **NC, CNC, DNC TECHNOLOGIES** (ON-LINE TEACHING) | **11** |
| | NC, CNC, DNC, modes. NC element, advantages and limitations of NC, CNC. Functions of computer in DNC. CNC tooling: Turning tool geometry, milling tooling system, tool presetting. ATC, work holding.<br>Operational features of CNC machine; CNC Technology (Machine Spindle, Drives, Feedback devices etc.) | |
| **UNIT-4** | **CNC MACHINING CENTERS** (BLENDED TEACHING) | **11** |
| | Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning.<br>Canned Cycles (Stock Removal, Threading, Grooving, Parting Off, Contour, Drilling, Face Milling, End Milling), Preparing the Process chart | |

| UNIT-5 | **INTRODUCTION TO ROBOTICS** (BLENDED TEACHING) | **10** |
|---|---|---|
| | Introduction, robot configuration, robot motion, programming of robots, end effectors work cell, control and interlock, sensor, robot applications. Kinematic Analysis – Direct and Inverse Kinematic analysis, numerical problems. | |

**REFERENCE BOOKS**


1. **Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM)** by MikellGroover, Pearson Education INC, Fifth Impression, 2008.
2. **CAD/CAM** by P N Rao, Tata McGraw Hill, Sixth Reprint, 2006.
3. **CAD/CAM** by Ibrahim Zied, Tata McGraw Hill, Fourth Reprint, 2008.


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

**CO1:** Understand the possible applications of the CAD/CAM systems in structure analysis, optimize and virtual engineering.

**CO2:** Demonstrate the basic fundamentals that are used to create, manipulate and analyze Geometric models in a computer graphics.

**CO3:** Explain the basic concepts, features of NC, CNC, DNC machines.

**CO4:** Explain the features of machining centres and able to write part programmes for different operations and work parts.

**CO5:** Appraise the functions of Robotic configurations, sensors, end effectors, Programming and able to analyze kinematic and dynamic motion of robot.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO3** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO4** | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO5** | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : ENGINEERING ECONOMICS (PROFESSIONAL ELECTIVE - 1)** | | |
|---|---|---|
| **Sub Code: 18ME551** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Engineering mathematics** | |

**COURSE OBJECTIVES:**

1. Helping decision making
2. Calculation of interest
3. Arriving at break-even point
4. Feasibility study from economic point of view
5. Preparation of budget
6. Understanding financial statements
7. Arriving at the product cost.

| **UNIT** | **CONTENTS** | **Hrs.** |
|---|---|---|
| **UNIT-1** | **INTRODUCTION (**CLASS ROOM TEACHING) | **07** |
| | Elements of engineering economics, engineering decision- makers, engineering and economics, problem solving and decision making, intuition and analysis, tactics and strategy. Engineering economic decision, maze. Law of demand and supply, law of returns, interest and interest factors: interest rate, simple interest, compound interest, cash - flow diagrams, personal loans and EMI payment, exercises and discussion. | |
| **UNIT-2** | **PRESENT-WORTH COMPARISONS: (**CLASS ROOM TEACHING) | **08** |
| | Conditions for present worth comparisons, basic present worth comparisons, present-worth equivalence, net present-worth, assets with unequal lives, infinite lives, future-worth comparison, pay-back comparison, exercises, discussions and problems. | |
| **UNIT-3** | **RATE-OF-RETURN CALCULATIONS AND DEPRECIATION**:<br>**(**CLASS ROOM TEACHING) | **07** |
| | Rate of return, minimum acceptable rate of return, IRR, IRR misconceptions, cost of capital concepts. Causes of depreciation, basic methods of computing depreciation charges, tax concepts, and corporate income tax. | |
| **UNIT-4** | **INTRODUCTION, SCOPE OF FINANCE, FINANCE FUNCTIONS:**<br>**(**CLASS ROOM TEACHING) | **08** |
| | Statements of financial information: introduction, source of financial information, financial statements, balance sheet, profit and loss account, relation between balance sheet and profit and loss account. Simple Numericals.<br>**FINANCIAL RATIO ANALYSIS**: Introduction, nature of ratio analysis, liquidity ratios, leverage ratios, activity ratios, profitability ratios, evaluation of a firm's earning power. Comparative statements analysis. Simple Numericals. | |
| **UNIT-5** | **FINANCIAL AND PROFIT PLANNING** (BLENDED TEACHING) | **09** |
| | Introduction, financial planning, profit planning, objectives of profit planning, essentials of profit planning, budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting. Introduction to bench marking of manufacturing operation.<br>**ESTIMATING AND COSTING:** Components of costs such as direct material costs, direct labor costs, fixed over-heads, factory cost, administrative overheads, first cost, marginal cost, selling price, estimation for simple components. | |

**TEXT BOOKS:**

1. Engineering Economy, Riggs J.L., McGraw Hill, 2002
2. Engineering Economy, Thuesen H.G. PHI, 2002

**REFERENCE BOOKS:**

1. Engineering Economy, Tarachand, 2000.
2. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000
3. Financial Management, Prasanna Chandra, TMH, 2004
4. Financial Management, IM PANDEY, Vikas Publisahing House, 2002

**COURSE OUTCOMES:** At the end of the course the student will be able to:

**CO1:** Take the right financial decision.
**CO2:** Help in calculating the financial factors.
**CO3:** Arrive at feasibility study of the project.
**CO4:** Training the students for preparing the budget.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19** **ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : COMPOSITE MATERIALS & MANUFACTURING (PROFESSIONAL ELECTIVE –1)** | | |
|---|---|---|
| **Sub Code: 18ME552** | **No of Credits =3**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |

**COURSE OBJECTIVES:**

1. This subject introduces different types of composite materials to the students
2. Students are introduced to different properties of composite materials
3. Students get to know the different applications of these materials

| UNIT | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **INTRODUCTION TO COMPOSITES** (BLENDED MODE) | **08** |
| | Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. | |
| **UNIT-2** | **PROCESSING OF POLYMER MATRIX COMPOSITES** (BLENDED MODE) | **08** |
| | Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand lay-up processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GFRP). | |
| **UNIT-3** | **PROCESSING OF METAL MATRIX COMPOSITES** (BLENDED MODE) | **08** |
| | Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting | |
| **UNIT-4** | **PROCESSING OF CERAMIC MATRIX COMPOSITES** (BLENDED MODE) | **08** |
| | Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). | |
| **UNIT-5** | **ADVANCES IN COMPOSITES** (BLENDED MODE) | **07** |
| | Carbon / carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications. | |

**TEXT BOOKS**

1. Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 1st edition, 1994.
2. Chawla K.K., Composite materials, Springer – Verlag, 1987
3. M. Balasubramanian, Composite materials and Processinng, CRC Press, 2014

**REFERENCE BOOKS**

1. Clyne T.W. and Withers P.J., Introduction to Metal Matrix Composites, Cambridge University Press, 1993.
2. Strong A.B., Fundamentals of Composite Manufacturing, SME, 1989.
3. Sharma S.C., Composite materials, Narosa Publications, 2000.
4. Short Term Course on Advances in Composite Materials, Composite Technology Centre, Department of Metallurgy, IIT- Madras, December 2001.
5. Manoj Kumar Buragohain, Composite Structures: Design, Mechanics, Analysis, Manufacturing, and Testing; CRC Press, 2017
6. Srinivasan K; Composite Material: Production Properties Testing; Narosa Publishers; 2009.
7. Autar K Kaw, Mechanics of Composite Materials, CRC, Taylor & Francis Group, 2006.
8. R.K.Everret & R.J. Arsenault Metal matrix composite Academic press.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Appreciate the wonder material i.e., composites
**CO2:** Understand the various processing methods of polymer matrix composites
**CO3:** Enhance awareness on intricate knowledge on metal matrix composites
**CO4:** Familiarize with the basics of ceramic matrix composites processing
**CO5:** Evaluate the role of advanced composites usage in aerospace

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 0 | 3 |
| **CO2** | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 0 | 3 |
| **CO3** | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 0 | 3 |
| **CO4** | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 0 | 3 |
| **CO5** | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 0 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : AUTOMOBILE ENGINEERING (PROFESSIONAL ELECTIVE – 1)** | | |
|---|---|---|
| **Sub Code: 18ME553** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | Elements of Mechanical Engineering, Basic and Applied Thermodynamics and Heat Engines | |

**COURSE OBJECTIVES:**

1. To describe the basic systems and components of Automobiles and to analyze Engines, other power generation modes and its allied mechanisms.
2. To emphasize hybrid-electric and electric powertrains, focusing on experimental characterization.
3. To emphasize on encompasses the analysis, design and synthesis of gears and power transmission systems for improved efficiency.
4. To emphasize on Batteries and energy storage, Charging stations, Requirements for interfacing, Connection of sensors/actuators To emphasize on steering geometry, and suspension systems.
5. The efficient control of the braking systems, automotive emission control systems and emission standards.

| **UNIT** | **CONTENTS** | **Hrs.** |
|---|---|---|
| **UNIT-1** | **ENGINE COMPONENTS, VALVE AND PORT TIME MECHANISMS, AUTOMOTIVE PROPULSION SYSTEMS , ENERGY CONVERSION AND STORAGE** | **08** |
| | Spark Ignition (SI) & compression Ignition (CI) engines, cylinder arrangements and their relative merits, liners, piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams.<br>**Automotive Propulsion Systems:** Internal combustion engines, hybrid-electric and electric powertrains, focusing on experimental characterization.<br>**Energy Conversion and Storage** covers fundamental and applied research for improving the efficiency of conversion, recovery and storage of primary energy for automotive applications, for instance electrochemical energy converters (fuel cells), waste heat recovery systems based upon thermodynamic cycles or solid-state conversion devices, or electrochemical storage technologies (batteries and super capacitors). | |
| **UNIT-2** | **VEHICLE DYNAMICS, SMART MATERIALS, STRUCTURES AND ALTERNATIVE FOSSIL FUEL OPTIONS** | **07** |
| | Encompasses the analysis, design and synthesis of gears and power transmission systems for improved efficiency, reduced noise and vibrations, as well as the study of complex acoustic sources and transmission paths, techniques for passive and active noise control and diagnostics. Other relevant topics include the study of chassis and vehicle dynamics, and driver assistance systems for efficient and safe mobility.<br><br>**Smart Materials, Structures and**<br>Encompasses topics related to the design and control of smart materials and devices that compose sensors, actuators and structures for automotive applications; the | |

| | | |
|---|---|---|
| | analysis of aerodynamic flow control systems for road vehicles for reducing drag forces, and advanced manufacturing, lightweight materials and multi-material joining processes.<br>Alternative fossil fuel options, Electrified automotive transportation for the twenty-first century, Industrial and policy background, Categorizing electrified vehicles by "electrification level", Efficiency improvements in ICEs, | |
| **UNIT-3** | **IGNITION SYSTEMS, ADVANCED AUTOMOTIVE SYSTEMS, PRINCIPLES AND APPLICATIONS OF SENSOR** | **07** |
| | **Ignition Systems:** Battery, magneto, Electronic and automatic ignition systems.<br>**Advanced automotive systems**: hybridization and electrification, Categories of hybridization, Clean petroleum enhancements, Battery Electric Vehicles (BEVs), Electric Motors for Vehicle Applications, Batteries and energy storage, Charging stations, ,<br>**Principles And Applications Of Sensor:** Some general statements, Definition of sensors and actuators, Classification of Sensors and Actuators, Sensing and actuating strategies, Requirements for interfacing, Connection of sensors/actuators | |
| **UNIT-4** | **DRIVE TO WHEELS** | **08** |
| | Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle, different arrangements of fixing the wheels to rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer and neutral steer, numerical problems.<br>**Suspension springs:** Requirements, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system. | |
| **UNIT-5** | **BRAKES AND AUTOMOTIVE EMISSION CONTROL SYSTEMS** | **09** |
| | **Brakes:** Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk & drum brakes, antilock braking systems, purpose and operation of antilock-braking system, ABS hydraulic unit, rear-wheel antilock.<br>**Automotive emission control systems:** Automotive emission controls, controlling crankcase emissions, controlling evaporative emissions, cleaning the exhaust gas, controlling the air-fuel mixture, controlling the combustion recirculation, treating the exhaust gas, air-injection system, air-aspirator system, catalytic converter, emission standards- euro and bharath norms. | |

**TEXT BOOKS**


1. Automobile Engineering, Vol I and II, Kirpal Singh, 2002.
2. Automotive mechanics, William H Crouse & Donald L Anglin, 10$^{th}$Ed.TMH 2007
3. Advanced Automotive Systems, Electrification, and an Overview of Relevant Policy Concerns by Josipa G. Petrunic 11$^{th}$ Ed, 2014


**REFERENCE BOOKS:**


1. Automotive mechanics: Principles and Practices, Joseph Heitner
2. Fundamentals of Automobile Engineering, K.K.Ramalingam, Scitech Pub. Pvt.Ltd.
3. Automobile Engineering, R. B. Gupta, Satya Prakashan, 4$^{th}$ edn. 1984.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Have in depth knowledge on various engine components, cooling, lubrication systems, material choice, cetane and octane numbers.

**CO2:** Understand the driving wheel systems, to know propeller shaft, universal joints, steering mechanism and suspension systems.

**CO3:** Understand the ABS automotive emission control, emission standards and bharath norms.

**CO4:** To understand mixture requirements for I.C, S.I and C.I engines, working principle of superchargers and turbo chargers.

**CO5:** Understand ignition systems, clutches mechanisms, gear box principle of automatic transmission system, numerical problems on gear ratio. power trains and gear.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 3 |
| **CO2** | 3 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 3 |
| **CO3** | 3 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 3 |
| **CO4** | 3 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 3 |
| **CO5** | 3 | 2 | 2 | 1 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : MECHATRONICS AND MICROPROCESSORS (PROFESSIONAL ELECTIVE – 1)** | | |
|---|---|---|
| **Sub Code: 18ME554** | **No of Credits =03**<br>**L-T-P-SS:3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | | |

**Course objective:**

1. Substantiate the need for interdisciplinary study in technology education.
2. Understand the evolution and development of Mechatronics as a discipline.
3. Define various types of transducers used and understand analog to digital converter and vice versa.
4. Applications of microprocessors in various systems and to know the functions of each Element.
5. Describe the operation of mechanical, electrical pneumatic and hydraulic actuators.
6. Identify main parts, hardware forms and internal architecture of PLC.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **INTRODUCTION TO MECHATRONIC SYSTEMS** (ONLINE TEACHING) | **08** |
| | Measurement and control systems Their elements and functions, Microprocessor based controllers-engine management system, automatic camera and automatic washing machine, Mechanical components in mechatronics, force, friction and lubrication, materials, mechanical behaviour of materials, mechanisms used in mechatronics, lever and four bar mechanisms, bearing, belt, chain, cam, slider crank, clutches etc. | |
| **UNIT-2** | **REVIEW OF TRANSDUCERS AND SENSORS** (BLENDED MODE TEACHING) | **08** |
| | Definition and classification of transducers. Definition and classification of sensors. Principle of working of and applications of light sensors, proximity sensors – magnetic switch, eddy current type, pneumatic type, ultrasonic type and Hall effect sensors, Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter, digital computer, microprocessor and its architecture, micro-controllers, programming logic controllers, their basic structures, mnemonics. | |
| **UNIT-3** | **ELECTRICAL ACTUATION SYSTEMS:** (CLASS ROOM TEACHING) | **08** |
| | Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits. Signal Conditioning: Introduction to signal conditioning. The operational amplifier. | |
| **UNIT-4** | **INTRODUCTION TO MICROPROCESSORS** (CLASS ROOM TEACHING) | **08** |
| | Evolution of Microprocessor, Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors. Review of concepts - Boolean algebra, Logic Gates and Gate Networks, Binary & Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real, numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation. Central Processing Unit of Microprocessors**:** Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085 and 4004 register organization. | |
| **UNIT-5** | **DATA WORD REPRESENTATION** (CLASS ROOM TEACHING) | **07** |

| | | |
|---|---|---|
| | Data word representation. Basic elements of control systems 808SA processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers. Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers. Organization & Programming of Microprocessors**:** Introduction to organization of INTEL 808S-Data and Address buses, Instruction set & programming of 8085. | |

**TEXTBOOKS:**


1. A Kuttan, "Introduction to Mechatronics, Oxford University Press, 2010.
2. Alciatore & Histand, "Introduction to Mechatronics & Measurement Systems, 4e", McGrawHill Education, 2014.
3. M Jouaneh, "Fundamentals of Mechatronics", Cengage Learning, 2013.
4. W. Bolton, "Mechatronics", Pearson Education, Second Edition, 1999.Bradley
5. D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993


**REFERENCE BOOKS:**


1. Dan Necsulesu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).
2. NitaigourPremchandMahadik, "Mechatronics", McGraw-Hill Education, 2015.
3. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics", Prentice – Hall of India Pvt., Ltd., 2000.
4. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. "Mechatronics: Integrated Mechanical Electronic Systems", Wiley


**CO1:**
**CO2:**
**CO3:**
**CO4:**
**CO5:**

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 0 | 0 | 1 | 0 | 3 |
| **CO2** | 3 | 3 | 2 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 2 |
| **CO3** | 3 | 3 | 2 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : PRINCIPLES OF METAL FORMING (PROFESSIONAL ELECTIVE - 1)** | | |
|---|---|---|
| **Sub Code: 18ME555** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Metallurgy, Strength of Materials, Manufacturing process** | |

**COURSE OBJECTIVES**

1. Express and analyze the concept of different metal forming process, concepts of stress and Strain and its elastic relationships.
2. Express and analyze the concept of Plasticity, flow curve, yield criteria, plastic stress-strain relationship and effects of various parameters on flow properties.
3. Analyze and demonstrate hot and cold metal working, metallurgical consideration in metal working -forging and rolling process.
4. Analyze and demonstrate extrusion process.
5. Analyze and demonstrate sheet metal forming and powder metallurgy.

| **UNIT** | **CONTENTS** | **Hrs.** |
|---|---|---|
| **UNIT-1** | | **08** |
| | Introduction to metal Forming, classification of metal working process, behaviour of materials and its failure. Concept of stress-strain, description and state of stress in 3 dimension, description of strain, hydrostatic and deviator components of stress and strain. Elastic stress-strain relationships. | |
| **UNIT-2** | | **08** |
| | Introduction to theory of plasticity and flow curve, true stress and true strain, yield criteria for ductile materials, plastic stress-strain relationships. Measure of yielding and ductility in tensile testing, instability in tension, strain rate and temperature effects on flow properties, influence of parameters on flow properties. | |
| **UNIT-3** | | **08** |
| | Mechanics of metal working and analysis method, determination of flow stress in metal working, hot working and cold working, metallurgical consideration in metal forming. introduction and classification of forging process, forging in plane strain, Introduction and classification of rolling process, analysis of rolling load calculation | |
| **UNIT-4** | (**For Online class**) | **08** |
| | Introduction and classification of extrusion process, analysis of extrusion process, extrusion of tubes and pipes, introduction of rod and wire drawing, analysis of wire and tube drawing process. | |
| **UNIT-5** | Introduction and classification of sheet metal working operations and powder metallurgy forming. | **07** |

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

**CO1:** Ability to define Metal forming process and classification, concepts of stress-strain and its elastic relationships.
**CO2:** Concept of Plastic deformation in Metals and its flow characteristics with certain phenomenon.
**CO3:** The difference between Hot and cold forming, its associated metallurgical behavior and working principles of Forging and Rolling process.
**CO4:** Working principles of Extrusion, various classification of it. Wire drawing principle
**CO5:** Sheet Metal forming operations and its application and Powder metallurgy and its application

**TEXT BOOKS:**


1. Mechanical metallurgy (SI Units), G.E.Dieter, McGraw hill Pub-2001.
2. Ghosh A. Mallik A K Manufacturing science, Affiliated East-West press Pvt Ltd
3. Rowe, Geoffrey W. An Introduction to the principles of Metal working, TMH


**REFERENCE BOOKS:**


1. Materials & Process in Manufacturing – E.Paul, Degramo, J.T.Black, Ranold, A.K.Prentice-hall of India 2002
2. Fundamentals of Manufacturing Processes by Lal G K, Narosa
3. Textbook of Production Engineering by P. C. Sharma, S Chand & Company Ltd


| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 2 | 3 | | | | | | | | | | |
| **CO2** | 2 | 3 | | | | | | | | | | |
| **CO3** | 2 | 3 | 3 | 3 | 3 | | | | 1 | 1 | 1 | 1 |
| **CO4** | 2 | 3 | 3 | 3 | 3 | | | | 1 | 1 | 1 | 1 |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : EXPERIMENTAL STRESS ANALYSIS (PROFESSIONAL ELECTIVE – 1)** | | |
|---|---|---|
| **Sub Code: 18ME556** | **No of Credits : L-T-P-SS 3:0:0:0 =3** | **No. of lecture hours/week : 03 Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Mechanics of materials** | |

**COURSE OBJECTIVES:**

1. Analyze stresses within the elastic range in 3D.
2. Compile strains and displacements.
3. Evaluate stress and strain relations for linear elastic materials.
4. Demonstrate the experimental methods for analyzing stresses and strains in given specimen.
5. Develop photo-elastic, Moire techniques and holography methods for analysing stresses experimentally.

| . # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **PHOTOELASTICITY** (ONLINE TEACHING) | **07** |
| | Nature of light, Wave theory of light - optical interference, stress optic law – effect of stressed model in plane and circular polariscopes, Analysis of plane polariscope by Jones calculus, isoclinics & isochromatics, Fringe order determination, determination of fractional fringe order, photo-elastic model materials and Applications. | |
| **UNIT-2** | **TWO DIMENSIONAL PHOTOELASTICITY** (BLENDED TEACHING ) | **08** |
| | Separation methods: Shear difference method, Analytical separation methods, Model to prototype scaling, Properties of 2D photo-elastic model materials, materials for 2D photo-elasticity. | |
| **UNIT-3** | **BRITTLE COATINGS** (BLENDED TEACHING) | **08** |
| | Coatings stresses, crack patterns, refrigeration techniques, load relaxation techniques, crack detection methods, types of brittle coatings, resin and ceramic based brittle coatings, calibration of coating, advantages and brittle coating applications. | |
| **UNIT-4** | **PHOTOELASTIC(BIREFRINGENT) COATINGS** (CLASSROOM TEACHING) | **08** |
| | Theory of birefringence coating stresses, sources of error, effects of coating thickness: reinforcing effects, poission's, stress separation techniques: oblique incidence, strip coatings.stress freezing technique, birefregent coating materials.<br>**MOIRE METHODS:** Moire fringes produced by mechanical interference. Geometrical approach, out of plane displacement measurements, applications and advantages. | |
| **UNIT-5** | **ELECTRICAL RESISTANCE STRAIN GAUGES** (CLASSROOM TEACHING) | **08** |
| | Gauged factors & strain sensitivity in metallic alloys, gauge construction, characteristics of strain gauges, adhesives and mounting techniques, gauge sensitivity and gauge factor, performance characteristics, environmental effects, strain gauge circuits. wheatstone's potentiometer bridges, constant current strain gauge circuits.<br>**STRAIN ANALYSIS METHODS:** Two element, three element rectangular and delta rosettes, stress-strain relations, correction for transverse strain effects. | |

**TEXT BOOKS:**


1. "Experimental Stress Analysis", Dally and Riley, McGraw Hill.
2. "Experimental Stress Analysis". Sadhu Singh, Khanna publisher.

3. Experimental stress Analysis, Srinath L.S tataMcGraw Hill.

**REFERENCES BOOKS:**


1. "PhotoelasticityVol I and VolII,M.M.Frocht, John Wiley & sons.
2. "Strain Gauge Primer", Perry and Lissner,
3. "Photo Elastic Stress Analysis", Kuske, Albrecht & Robertson John Wiley &Sons.
4. "Motion Measurement and Stress Analysis", Dave and Adams.


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

**CO1:** Analyze stresses within the elastic range of materials.

**CO2:** Compile strains and displacements.

**CO3:** Evaluate stress and strain relations for linear elastic materials.

**CO4:** Describe the importance of experimental methods in analyzing stress and strain.

**CO5:** Describe photo elastic, Moiré technique of experimental stress analysis Validate results with experiments.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : COMPUTER AIDED MANUFACTURING LABORATORY** | | |
|---|---|---|
| **Sub Code: 18MEL56** | **No of Credits =01**<br>**L-T-P-SS::0:0:2:0** | **No. of practical hours/week : 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **CAD/CAM** | |

**COURSE OBJECTIVES:**

1. Computer based numerically controlled machine tools are increasingly finding place in industries.
2. Further integration of the computer Aided Design Drafting (CADD), which has been in use in the industry for some years now, with (CAM) Operations has led to efficient product design & prototyping and shorter production runs.
3. The need to absorb, CAD/ CAM technology for its effectives has, therefore, become imperative.
4. This course is being introduced as Practical course of BE programme in mechanical engineering.
5. The course aims at developing appreciation of the use of CAD/CAM environment, its Components, their functions, and methods of using the existing CAD/ CAM software, in general, with a view to improve efficiency in drafting and designing.

| **SL No.** | **CONTENTS** | **Hrs** |
|---|---|---|
| **PART A** | ➢ Three typical simulations to be carried out using simulation packages like Master-CAM, or any equivalent software.<br>➢ Simulation of Turning, Drilling, Milling operations. | **10** |
| **PART B** | ➢ Executing NC part programming using software package like Spectra light or any equivalent software<br>➢ NC programming on milling operations, turning operations and drilling operations has to be written and executed. | **10** |
| **PART C** | **(ONLY FOR DEMO/VIVA VOCE)** | **06** |
| | ➢ Pneumatics and Hydraulics, Electro-Pneumatics: Three typical experiments on Basics of these topics to be conducted.<br>➢ FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.<br>➢ Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects, 2 programs. | |

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1**: Gain the knowledge on CNC programming using CAM packages.

**CO2:** Learn and perform the programming and simulation robots.

**CO3:** Learn and understand the programming of automatic storage, retrieval system and linear shuttle conveyor system through demo.

**CO4:** Understand the function and handling of hydraulic, pneumatic and electro-pneumatic systems through demo.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 3 | 1 |
| **CO3** | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 1 |
| **CO4** | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| SCHEME OF EXAMINATION | |
|---|---|
| Two questions from Unit 1(Milling and turning) | 40 Marks (10 Write up +30) |
| Viva Voce | 10 Marks |
| **Total** | **50 Marks** |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : FIFTH**

| **COURSE TITLE : FUEL TESTING AND INTERNAL COMBUSTION ENGINES LABORATORY** | | |
|---|---|---|
| **Sub Code: 18MEL57** | **No of Credits : L-T-P-SS 0:0:2:0 = 1** | **No. of practical hours/week: 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Basic Thermodynamics, Applied Thermodynamics** | |

**COURSE OBJECTIVES**

1. To conduct tests on oils to determine flash, fire points and viscosity.
2. To determine calorific value of a given fuel.
3. To plot the valve timing diagram of 2-stroke and 4-stroke IC engine.
4. To calculate the area of an irregular shape using planimenter.
5. To conduct performance test on petrol and diesel IC engine and evaluate the power produced and efficiencies; to conduct Morse test on 4-stroke multi cylinder engine to determine the utility heat input and draw heat balance sheet.

| UNIT | CONTENT | Hrs |
|---|---|---|
| 1. | **MINOR EXPERIMENTS**<br>(i) Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Martin (closed) **(or)** Cleave land (Open Cup) Apparatus.<br>(ii) Determination of Calorific value of solid, liquid and gaseous fuels.<br>(iii) Determination of Viscosity of lubricating oil using Redwoods Saybolts and Torsion Viscometers.<br>(iv) Valve Timing of a four stroke I.C. engine. **(or)** port opening diagram of an 2 stroke I.C. engine.<br>(v) Use of planimeter | **10** |
| 2. | **MAJOR EXPERIMENTS**<br>Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for<br>(i) Four stroke Diesel Engine<br>(ii) Four stroke Petrol Engine<br>(iii) Two stroke Petrol Engine<br>(iv) Morse test to evaluate the friction power in Multi Cylinder Diesel/Petrol Engine | **16** |

**REFERENCE BOOKS**


1. Basic and Applied Thermodynamics, P.K. Nag, Tata McGraw-Hill Publications, 2nd Edition, 2010.
2. Internal Combustion Engines, V Ganeshan, Tata McGraw-Hill Publications, 4th Edition, 2012.


**COURSE OUTCOMES:** On completion of the course, student should be able to

**CO1:** Understand the importance of lubricating oil properties such as fire, flash, cloud, pour points and viscosity to know their operating conditions.

**CO2:** Analyse and compare the calorific values of various types of fuels.

**CO3:** Determine area of irregular shapes using Planimeter.

**CO4:** Plot valve timing diagram and then to conduct performance tests on different types of IC engines. Also to determine various parameters including heat balance sheet.

| MAPPING OF COs WITH Pos | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 1 | 3 | 0 | 1 | 2 | 1 | 2 | 1 | 3 | 3 |
| **CO2** | 3 | 3 | 1 | 3 | 0 | 1 | 2 | 1 | 2 | 1 | 3 | 3 |
| **CO3** | 3 | 3 | 1 | 3 | 0 | 1 | 2 | 1 | 3 | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 1 | 3 | 0 | 1 | 2 | 1 | 3 | 2 | 3 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **Sl. No.** | **Particulars** | **Max Marks** | **Break up Max. Marks** | | |
|---|---|---|---|---|---|
| | | | **Write up** | **Conduction of experiment** | **Calculations, Results and graphs** |
| 1 | **MINOR EXPERIMENTS** Any one from list of experiments | 15 | 5 | 5 | 5 |
| 2 | **MAJOR EXPERIMENTS** Any one from list of experiments | 25 | 5 | 10 | 10 |
| 3 | **Viva Voice** | 10 | - | - | - |
| | | 50 | 10 | 15 | 15 |

**ADMISSION YEAR : 2018-19** **ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : DESIGN OF MACHINE ELEMENTS – II** | | |
|---|---|---|
| **Sub Code: 18ME61** | **No of Credits =04**<br>**L-T-P-SS:: 3:2:0:0** | **No. of lecture hours/week: 04**<br>**Total Number of Lecture hours : 65** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **MOM, KOM, Design of Machine Elements-I** | |

**COURSE OBJECTIVES:**

1. The student shall gain appreciation and understanding straight and curved beams and general applications of curved beams such as machine frame, punching machine and crane hook, bending and resultant stress occurs at various symmetrical and non-symmetrical crass sections and extended chain links used for curved beams. Student shall be able to understand the concept of thick cylinders and calculate the pressure developed in thick cylinder using lame's equation.
2. The student shall be able to understand functions of various spring and its application, types of springs, such as helical, spiral, buffer, concentric and leaf springs and stress induced, deflection, energy stored in the spring, design procedure, selection of suitable material to design and design springs for various suitable applications.
3. The student shall be able to understand meaning of gear drive importance of gear drive, various fields of applications, general classifications, general characteristics, requirements of gear drive, types of tooth profile, loads, selection of suitable material for gear design stress acting on gears and design procedure to design a different gear for various applications.
4. The student shall be able to understand functions of lubrications, desirable properties, types of lubrications system, selection proper grade of lubrication for particular application and also to understand functions of bearing, general classification, design procedure to design any bearing, selection of various factors for bearings, determination of life of bearing, selection of proper grade of lubrication suitable and heat generated, heat dissipated etc.

| **UNIT** | **CONTENTS** | **Hrs** |
|---|---|---|
| **UNIT-1** | **CURVED BEAMS** and **THICK CYLINDERS** (CLASS ROOM TEACHING) | **9L+4T** |
| | **CURVED BEAMS**: Assumptions made in the analysis of curved beams, stress equation, difference between straight and curved beam, Design of curved beams: Bending stresses and resultant normal stress in curved beams of standard cross sections used in crane hook, punching presses & clamps, closed rings and links. Numericals<br>**THICK CYLINDERS**: Design of thick cylinders subjected to an internal pressure using Lame's equation. Numericals | |
| **UNIT-2** | **SPRINGS** (BLENDED TEACHING) | **9L+4T** |
| | **SPRINGS**: Introduction, classification of springs, stresses in helical coil springs of circular sections, deflection equation, energy stored in springs and problems on helical coil springs, buffer springs, concentric springs- advantages, applications and design of concentric springs, springs under fluctuating loads. Leaf Springs, advantages and applications, nipping, stresses in leaf springs, semi elliptical leaf spring. Numericals | |
| **UNIT-3** | **POWER TRANSMISSION** (CLASS ROOM TEACHING) | **9L+4T** |

| | | |
|---|---|---|
| | **SPUR GEAR DRIVES:** Introduction, classification, advantage, dis-advantages and applications, terminology of spur gears, material selection for spur gear design, stresses in gear tooth, Lewis equation and form factor, calculation of centre distance, module and face width, Check for dynamic and wear load considerations and numerical problems on spur gear.<br><br>**HELICAL GEARS:**<br>Introduction, classification, advantage, dis-advantages and applications, terminology of helical gears, formative number of teeth, material selection for helical gear design, stresses in gear tooth, Lewis equation and form factor, Estimation of centre distance, module and face width, Check for dynamic and wear load considerations and numerical problems on spur gear. | |
| **UNIT-4** | **BEVEL GEARS and WORM GEARS** (CLASS ROOM TEACHING) | **9L+4T** |
| | **BEVEL GEARS**:<br>Introduction, classification, advantage, applications, terminology of bevel gears, formative number of teeth, material selection for bevel gear design, stresses in gear tooth: Lewis equation and form factor, design for strength, dynamic load and wear load, problems on bevel gear.<br>**WORM GEARS**:<br>Introduction, classification, advantage, applications, terminology of worm gears, material selection for worm gear design, stresses in gear tooth: Lewis equation, Design for strength, Dynamic load and wear loads and efficiency of worm gear drives and Numerical problems on worm gears. | |
| **UNIT-5** | **LUBRICATION and BEARINGS** (ONLINE TEACHING) | **9L+4T** |
| | **LUBRICATION:**<br>Introduction to Lubrication and their properties, types of lubrication, Mechanisms of Lubrication, bearing modulus, coefficient of friction, minimum oil film thickness, Heat generated, Heat dissipated. Types and selection of Mechanical Seals.<br>**BEARINGS:**<br>Classification, Bearing Materials, types of bearing and designation, Selection of rolling contact bearings based on constant / variable load & speed conditions (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing). Design of ball bearing and journal bearing. Thrust bearings. Numerical problems**.** | |

**TEXT BOOKS**


1. **Mechanical Engineering Design**, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.
2. **Design of Machine Elements**, V. B Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.


**REFERENCE BOOKS**


1. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.

4. Machine Design, A CAD Approach: Andrew D DIMAROGONAS, John Wiley Sons, Inc, 2001.

**DESIGN DATA HANDBOOK**

1. **Design Data Hand Book**, K. Lingaiah, McGraw Hill, 2nd Edition.
2. **Data Hand Book,** K. Mahadevan and Balaveera Reddy, CBS Publication
3. **Design Data Hand Book,** H.G. Patil, ShriShashi Prakashan, Belgaum.

**COURSE OUTCOMES:** After completion of the course, students will be able to:

**CO1:** Design and evaluate a mechanical system (straight and curved beams with symmetric and non-symmetric sections for various engineering applications)/process which is environment friendly with appropriate consideration for public health and safety

**CO2:** Analyze & design helical compression & tension springs with respect to static & dynamic axial loads

**CO3:** Design gears based on the given conditions and select appropriate gears for power transmission on the basis of given load and speed experienced to design spur and helical gears with respect to tooth bending strength.

**CO4:** Design gears based on the given conditions and select appropriate gears for power transmission on the basis of given load and speed experienced to design bevel, & worm gears with respect to tooth bending strength

**CO5:** Compute equivalent radial loads for rolling contact bearing & select appropriate bearing for industrial applications using manufacturer's catalogue data.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 3 | 3 |
| **CO2** | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 3 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3.Design Data Hand Book is permitted | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : HEAT TRANSFER** | | |
|---|---|---|
| **Sub Code: 18ME62** | **No of Credits : L-T-P-SS 3:2:0:0 =4** | **No. of lecture hours/week : 04 Total Number of Lecture hours : 65** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Basic thermodynamics, Fluid mechanics** | |

**COURSE OBJECTIVES:**

1. To outline the basic concepts of conduction, convection and radiation heat transfer. 2. To discuss and illustrate the application of various boundary conditions giving heat transfer examples.
3. To understand the unsteady heat conduction and convection heat transfer and apply the knowledge to solve real time problems.
4. To demonstrate the use of graphical charts for solving analytical problems.
5. To design heat exchangers based on the input variables such as inlet temperature of hot and cold fluids.
6. To evaluate various heat transfer parameters and predict the rate of heat transfer and heat transfer coefficients.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **BASIC CONCEPTS AND CONDUCTION HEAT TRANSFER** (BLENDED MODE) | **9L+4T** |
| | Introduction - Modes of heat transfer, Basic laws, Combined heat transfer mechanism, Resistance concept, Boundary conditions of 1$^{st}$, 2$^{nd}$ and 3$^{rd}$ kind; Thermal contact resistance; Overall heat transfer coefficient; Illustrations of applying the boundary conditions to heat transfer problems; Derivation of general equation of heat conduction in Cartesian coordinates; Special cases; Discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation);Steady state heat conduction in simple and composite slabs, cylinders and spheres (uniform thermal conductivity and without heat generation); Related numerical problems; Introduction to variable thermal conductivity and heat generation; Concept and derivation of critical thickness of insulation in cylinders and spheres (No numerical problems on variable thermal conductivity, heat generation and critical thickness) | |
| **UNIT-2** | **EXTENDED SURFACES AND UNSTEADY STATE HEAT CONDUCTION TRANSFER** (CLASSROOM MODE) | **9L+4T** |
| | Introduction to extended surfaces; Derivation of heat transfer and temperature distribution in fins (uniform cross-section without heat generation); Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources; Fin efficiency and effectiveness; Related numerical problems.<br>Unsteady state heat conduction - Introduction; Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere; Use of transient temperature charts for transient conduction in semi-infinite solids; Related numerical problems. | |
| **UNIT-3** | **CONVECTION HEAT TRANSFER** (CLASSROOM MODE) | **9L+4T** |
| | Introduction – Boundary layer concept in external and internal flow; Forced Convection - Dimensional analysis for forced convection; Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers; Use of correlations for flow over simple geometries (flat plate, cylinder and sphere); Use of correlations for flow inside a duct; Numerical problems; Free | |

| | | |
|---|---|---|
| | or natural convection - Dimensional analysis for free convection; Physical significance of Grashof number; Use of correlations of free convection over flat plates (vertical, horizontal and inclined), cylinders (vertical and horizontal) and spheres; Related numerical problems; Introduction to boiling: pool boiling, Bubble Growth Mechanisms, Nucleate Pool Boiling, Critical Heat Flux in Nucleate Pool Boiling, Pool Film Boiling, Critical Heat Flux, Heat Transfer beyond the Critical Point, filmwise and dropwise Condensation (No numerical problems on boiling and condensation) | |
| **UNIT-4** | **HEAT EXCHANGERS** (CLASSROOM MODE) | **9L+4T** |
| | Introduction; Classification of heat exchangers; Compact, Shell-and-tube and Plate heat exchangers; Overall heat transfer coefficient and fouling factor; Parallel and counter flow heat exchangers; Use of LMTD; Cross flow heat exchangers; Comparison of parallel and counter flow heat exchangers; Heat transfer with phase change; Multi pass heat exchangers; Effectiveness-NTU method; Limiting cases; Related numerical problems; Compact heat exchangers – Introduction, types, advantages; Heat pipes – Introduction; Working principle; components; Applications; Limitations | |
| **UNIT-5** | **RADIATION HEAT TRANSFER** (ONLINE MODE) | **9L+4T** |
| | Introduction; Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's displacement law, Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws; Black bodies separted by a non-absorbing medium; Shape factor; Electrical analogy; Two black surfaces connected by non-conducting and re-radiating walls; Evaluation of shape factor; Radiation heat transfer between gray bodies; Radiosity and Irradiation; Radiation network for gray surfaces exchanging energy; Hottel's crossed string method; Radiation shields; Related numerical problems | |

**TEXT BOOKS**

**1. Heat and Mass Transfer,** P.K. Nag, 3rd Edition, Tata McGraw-Hill Publications, 2011.

**2. A Course in Heat and Mass Transfer,** Domkundwar, Arora, Domkundwar, Dhanpat Rai Publications, 2005.

**REFERENCE BOOKS**

1. **Heat and Mass Transfer: Fundamentals and Applications**, Cengel,Y.A., and Ghajar, A.J., 5th Edition, McGraw-Hill Publications (SIE), 2015.
2. **Principles of Heat and Mass Transfer**, Frank P. Incropera, David P. Dewitt, Theodore L. Bergman, and Adrienne S. Lavine, 7th Edition, Wiley Student Edition, 2013.

**e-LEARNING RESOURCES**

1. **A Heat Transfer Text Book**, John H Leinard IV and John H Leinard V, 3rd Edition, Phlogiston Press, Cambridge, Massachusetts, USA, 2008.
2. **Heat and Mass Transfer: Mechanical Engineering Handbook**, Kreith, F., Boehm, R.F., et. al., Frank Kreith (Ed), Boca Raton: CRC Press LLC, 1999.
3. **Fundamentals of Heat and Mass Transfer**, Frank P. Incropera, David P. Dewitt, et. al. Frank P. Incropera (Ed), 6th Edition, John Wiley and Sons, 2007.
4. **e-Journal: Frontiers in Heat and Mass Transfer**, http://www.ThermalFluidsCentral.org
5. **Videos, Student slides, Handouts, Lecture notes:** http://www.nptel.ac.in

**DATA HAND BOOK AND CHARTS**

1. **Heat and Mass Transfer Data Hand Book,** C.P. Kothandaraman, S. Subramanyan, New Age International Publishers, 8th Edition, 2014.
2. **Steam Tables with Mollier Diagram: SI Units**, Mahesh M.Rathore, Dhanpat Rai Publishing Company, 2014.

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

**CO1:** *Understand* the basic modes of heat transfer applied to simple and composite solids; *understand* the numerical analysis of one dimensional steady state heat transfer. (RBTL: 1, 2, 3)

**CO2:** *Understand* the application of extended surfaces in heat conduction and *analyse* the unsteady conduction heat transfer in infinite and semi-infinite bodies; *use* transient charts to *solve* to problems of different complexity; *understand* the numerical analysis of one dimensional steady state heat transfer. (RBTL: 1, 2, 3)

**CO3:** *Interpret* and *analyse* forced and free convection heat transfer; *Understand* the phenomenon of boiling and condensation and *use* correlations to solve numerical problems. (RBTL: 1, 2, 3)

**CO4:** *Analyse* temperature distribution in heat exchangers; *develop* expressions and *design* the heat exchanger for the maximum effectiveness; *solve* numerical problems. (RBTL: 1, 2, 3)

**CO5:** *Understand* the principles thermal radiation heat transfer; *develop* expressions for net radiation between various types of bodies; *solve* numerical problems. (RBTL: 1, 2, 3)

(RBTL: Revised Bloom's Taxonomy Levels; 1 – Remembering, 2 – Understanding, 3 – Applying, 4 - Analyzing, 5 - Evaluating, 6 - Creating)

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3. Each full question shall have maximum of 3 sub-divisions | | | | | | | | | | |

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO2** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO3** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO4** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **CO5** | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : MECHANICAL VIBRATIONS** | | |
|---|---|---|
| **Sub Code: 18ME63** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 3** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Engineering physics, DOM** | |

**COURSE OBJECTIVES:**

1.To study basic concepts of vibration analysis and observe, analyze, understand the concept of vibrations in mechanical systems , various technique to solve single degree freedom and single DOF without damping with damping, 2-degree, forced vibration and, Estimate natural frequency of mechanical system multi degree freedom system using various numerical techniques.

2. To acquaint with the principles of vibration measuring instruments

3. To recognize how to apply theory of vibration to engineering problems.

4. To study balancing of mechanical systems, and able to mathematically formulate real-world vibration problems in engineering.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **BASIC CONCEPTS OF VIBRATION** (ONLINE TEACHING)<br>Vibration and oscillation, causes and effects of vibrations, Vibration parameters – spring, mass, damper, Damper models, Motion – periodic, non-periodic, harmonic, non- harmonic, Degree of freedom, static equilibrium position, Vibration classification, Steps involved in vibration analysis. Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Beats.<br>**FREE UNDAMPED SINGLE DEGREE OF FREEDOM VIBRATION SYSTEMS** (CLASSROOM TEACHING)<br>Longitudinal, transverse, torsional vibration system, Methods for formulation of differential equations by Newton, Energy and Rayleigh's Method, Different methods of determination of natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and problems. | **08** |
| **UNIT-2** | **FREE DAMPED SINGLE DEGREE OF FREEDOM VIBRATION SYSTEMS:** (CLASSROOM TEACHING)<br>Types of damping**,** Analysis with viscous damping - Derivations for over damped, critically damped and under damped systems, Logarithmic decrement and numericals.<br>**Rotor Dynamics:** Critical speed of single rotor, undamped and damped vibrations and numericals. | **07** |
| **UNIT-3** | **FORCED VIBRATIONS** (CLASSROOM TEACHING)<br>Introduction**,** Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, support excitation for relative and absolute amplitudes, force and motion transmissibility and numericals.<br>**Vibration Measurement**: (BLENDED TEACHING)<br>Principle of seismic instruments, vibrometer, and accelerometer - undamped, damped, Frequency measuring instruments. | **08** |

| | | |
|---|---|---|
| **UNIT-4** | **SYSTEMS WITH TWO DEGREES OF FREEDOM** (CLASSROOM TEACHING) Principle modes and normal modes of vibrations, natural frequencies of systems (without damping) – Simple spring mass systems, torsional systems, combined rectilinear and angular systems, geared semi-defined systems, semi-definite systems, Dynamic vibration absorber and numericals. | **08** |
| **UNIT-5** | **NUMERICAL METHODS FOR MULTI DEGREE FREEDOM OF SYSTEMS**: (CLASSROOM TEACHING) **(i)(A) Free Undamped Multi Degree Freedom System:** Introduction, Maxwell's reciprocal theorem, Influence coefficients, and numerical. **(B) Multi Degree System Numerical Methods:-** (i) Rayleigh`s, (ii) Dunkerley's (iii) Stodola (iv) Holzer`s Numericals | **8** |

**TEXT BOOKS:**

1. **Mechanical Vibrations,** G. K.Grover, Nem Chand and Bros, 7th edition, 2003.
2. **Mechanical Vibrations,** S. S. Rao, Pearson Education Inc, 4th edition, 2003.
3. **Mechanical Vibrations,** V. P. Singh, DhanpatRai& Company, 3rd edition, 2006.

**REFERENCE BOOKS:**

1. **Theory of Vibration with Applications,** W. T. Thomson, M. D. Dahleh and C. Padmanabhan, Pearson Education Inc, 5th edition, 2008.
2. **Mechanical Vibrations:** S. Graham Kelly, Schaum's outline Series, Tata McGraw Hill, Special Indian Edition, 2007.
3. **Theory and Practice of Mechanical Vibrations:** J. S. Rao& K. Gupta, New Age International Publications, New Delhi, 2001.
4. **Vibration Fundamentals**, R. Keith Mobley, Newness, 1999.

**COURSE OUTCOMES:** After completion of the course, students will be able to:
Understand the different method to determine the fundamental natural frequencies of SDOF without damping.
**CO2:** Solve the different parameters of single degree damped vibrations by the basic knowledge of damped vibration and also rotor dynamics.
**CO3:** Ability to find vibration parameters numerically for forced vibration and also explore modern vibration measuring instruments, condition monitoring of working machineries.
**CO4:** Determine fundamental natural frequencies of two degree freedom systems without damping, semi definite systems.
**CO5:** Find influence coefficient of spring mass system and apply the numerical methods to find the frequency of multi degree freedom system

| **MAPPING OF COs WITH Pos** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| **CO2** | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 0 | 1 | 0 | 1 | 3 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 0 | 1 | 0 | 2 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 0 | 1 | 0 | 2 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19** **ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : INSPECTION AND QUALITY CONTROL (PROFESSIONAL ELECTIVE – 2)** | | |
|---|---|---|
| **Sub Code: 18ME641** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Engineering Mathematics** | |

**COURSE OBJECTIVES:**

1. The student should learn different inspection procedures, objectives in industry and economic aspects.
2. To impart definition of quality, components, concepts and different approaches followed like quality circles, cost of quality and economic considerations in quality.
3. To impart knowledge on various quality standards followed.
4. To impart fundamentals of statistical quality control charts, and process capability.
5. To impart different sampling techniques and reliability.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **INDUSTRIAL INSPECTION and CONCEPT OF QUALITY IN ENGINEERING** (BLENDED TEACHING) | **08** |
| | **Industrial inspection:** Objectives and functions of inspection in industry, types of inspection, production / inspection interaction, organization for industrial inspection, inspection procedures, economic aspect of inspection.<br>**Concept of Quality in Engineering:** Meaning and significance of quality; essential components of quality; phases or elements for building quality; evolution of the concepts of quality; spiral of progress of quality; quality cost, hidden quality costs; economic models of quality costs, changing scope of quality activities. | |
| **UNIT-2** | **QUALITY MANAGEMENT SYSTEMS , QUALITY CONTROL FUNCTION and ASPECTS OF SPECIFICATION AND TOLERANCES** (BLENDED TEACHING) | **08** |
| | **Quality Control Function:** Inspection versus quality control techniques, quality planning activities, organization for quality control. Fundamentals of statistical quality control, Juran's quality trilogy.<br>**Aspects Of Specification And Tolerances:** Aspects of Specification and Tolerances: purpose of specification and tolerances, effect of careless setting of specification limits, setting realistic tolerances, statistical tolerancing, statistical theorem, Precision. Reproducibility and Accuracy, Simple numerical problems. | |
| **UNIT-3** | **CONTROL CHARTS** (CLASSROOM TEACHING) | **07** |
| | **Control Charts: Basics of Control Chart:** Variability, Kinds of variations, Types of errors, Control limits specification limits and Natural Tolerance limits, Charts for variables and attributes, application of control charts for averages, range, standard deviation, Interpretation of X-bar and R Charts- cyclic patterns, mixture, shift, trend and stratification, fraction defectives (p Chart) and number of non-conformities per unit (c Chart), process capability analysis and simple numerical problems. | |
| **UNIT-4** | **ACCEPTANCE SAMPLING & RELIABILITY** (CLASSROOM TEACHING) | **08** |
| | **Acceptance Sampling:** Elementary concepts, sampling by attributes, single, double and multiple sampling plans, construction and use of operating characteristic curves and simple problems. | |

| | | |
|---|---|---|
| | **Reliability:** Reliability engineering, rectification processes in industries, practical activity – quality report building, reliability function, failure rate, mean time between failures (MTBF), mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness and simple numerical problems on reliability, MTBF and MTTF. | |
| **UNIT-5** | **QUALITY TOOLS AND SYSTEMS & TOTAL QUALITY MANAGEMENT** (BLENDED TEACHING) | **08** |
| | **Quality Management Systems:** Introduction to various quality standards - ISO 9000, BIS. **Quality Tools:** Ishikawa's seven quality tools; Quality Circles; Quality system economics, **Total Quality Management (TQM)** – definition, objectives, philosophy, and total productive maintenance (TPM) – definition, objectives, principles, implementation of TPM. Difference between TQM and TPM. | |

**TEXT BOOKS**


1. Juran, J. M. and Gryna, F. M., Quality Planning & Analysis, Tata McGraw Hill, New Delhi (1995).
2. Grant, E. L., Statistical Quality Control, McGraw Hill International, New York (2005).
3. Charles E Ebling, An introduction to reliability and maintainability engineering, Tata McGraw-Hill Education, 2004 – Maintainability (Engineering).


**REFERENCE BOOKS**


1. Feignbaum, A. V., Total Quality Control, McGraw Hill International, New York (1991).
2. Besterfield, D.H., Total Quality Management, Pearson Education Asia, New Delhi (2003)


**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Gain a knowledge on industrial inspection activity and concept of quality in engineering.

**CO2:** Understand various quality systems, quality control function, specification and tolerances prevalent in industry.

**CO3:** Construct various control charts based on data available in an industrial production, can also dwell upon the status of a process whether in control or out of control and find number of defectives.

**CO4:** Carry out sampling, reliability techniques with an industrial application.

**CO5:** Learn about applying different quality tools and total quality management.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 3 | 1 | 0 | 0 | 2 | 1 | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 1 | 0 | 0 | 1 | 1 | 2 | 1 |
| **CO3** | 3 | 3 | 2 | 1 | 3 | 1 | 0 | 0 | 2 | 1 | 2 | 2 |
| **CO4** | 3 | 2 | 3 | 1 | 3 | 1 | 0 | 0 | 2 | 1 | 2 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 3 | 1 | 0 | 0 | 2 | 1 | 2 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : ADVANCED WELDING TECHNOLOGY (PROFESSIONAL ELECTIVE – 2)** | | |
|---|---|---|
| **Sub Code: 18ME642** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks : 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Manufacturing process** | |

**COURSE OBJECTIVES**

1. To understand the working principle, advantages, disadvantages of arc, gas and thermit welding.
2. The student gains information on different solid-state welding processes.
3. To understand the working principle, weld characteristics and process parameters of power beam welding.
4. To understand the process of thermal cutting of materials, brazing and soldering.
5. To understand the concept about underwater welding, welding in space and welding metallurgy.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT 1** | **ARC, GAS AND THERMIT WELDING PROCESSES** (CLASSROOM TEACHING) | **08** |
| | Classification of welding processes, energy sources used in welding, working principle, process variables, advantages, limitations and applications of electro slag and electro gas welding, resistance welding, gas welding, plasma arc welding and thermit welding. | |
| **UNIT 2** | **SOLID STATE WELDING PROCESSES**(CLASSROOM TEACHING) | **08** |
| | Working principle, process variables, advantages, limitations and applications of Friction welding friction stir welding, ultrasonic welding, diffusion welding and explosion welding | |
| **UNIT 3** | **POWER BEAM WELDING PROCESSES** (CLASSROOM TEACHING) | **07** |
| | Working principle, process variables, advantages, limitations and applications of Electron beam and Laser beam welding | |
| **UNIT 4** | **BRAZING, SOLDERING AND THERMAL CUTTING** (ONLINE TEACHING) | **08** |
| | Introduction, brazing, soldering, various techniques, their advantages, limitations and applications; brazing & soldering consumables. Oxy- Acetylene cutting-working principle, metal powder cutting, introduction to oxygen/air / plasma / metal arc cutting arc cutting and gouging; advantages, limitations and applications of various techniques | |
| **UNIT 5** | **UNDERWATER WELDING, WELDING IN SPACE AND WELDING METALLURGY**(BLENDED TEACHING) | **08** |
| | Introduction to wet and dry under water welding & cutting Introduction, welding techniques, difficulties and advantages of welding in space. Welding metallurgy: Introduction, thermal cycles, prediction of peak temperature, pre heat and cooling rate, weldability of carbon steel, stainless steel & aluminum. Hot & cold cracking phenomenon, weld defects, causes and their remedies. Welding of Cu, Al, Ti and Ni alloys – processes, difficulties, microstructures, defects and remedial measures | |

**TEXT BOOKS:**

1. S.V.Nadkarni, "Modern Arc Welding Technology", Oxford & IBH.
2. R.Little, "Welding Technology, TMH. WELDING CODES AND STANDARDS ME-9111 L T P.
3. Welding metallurgy by Sindo Kou, Welding metallurgy, 2nd Edition Nov. 2002, Wiley

**REFERENCE BOOKS:**

1. H.B.Cary, "Modern Arc Welding Technology", Englewood Cliffs, Prentice Hall.
2. Leonard P Connor, Welding Hand book, Volume I-III, AWS.
3. Metals Hand book, Volume 6, American Society of Metals.
4. Dave Smith, "Welding skills and technology", McGraw Hill.
5. Parmer R. S., 'Welding processes and Technology", Khanna Publishers, 1997
6. Robert W Messler, Jr. " Principles of welding, Processes, physics, chemistry and metallurgy", Wiley,2004.
7. Larry Jeffus, " Welding Principles and Applications" Fifth edition, Thomson,2002
8. Christopher Davis, 'Laser Welding - A Practical Guide', Jaico Publishing House, 1994.
9. Mishra. R.S and Mahoney. M.W, Friction Stir Welding and Processing, ASM,2007

**COURSE OUTCOMES:** On completion of the course, student should be able to;

**CO1:** Understand the mechanism, working principle and process characteristics of different arc, gas and thermit welding processes.

**CO2:** Have in depth knowledge on working principle, process characteristics of friction, friction stir, ultrasonic, explosion welding and diffusion bonding.

**CO3:** Describe the mechanism, working principle and process characteristics of high energy beam welding.

**CO4:** Differentiate between **s**oldering and brazing, their techniques, advantages and limitations, applications and also decide on best cutting techniques for a specific application and their limitations.

**CO5:** Describe working principle and process characteristics of underwater welding processes, welding in space. And also Welding and weldability of different metals, hot& cold cracking phenomenon, weld defects and their causes and remedies

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 2 | 3 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| **CO2** | 2 | 3 | 2 | 1 | 2 | 0 | 0 | 1 | 1 | 2 | 1 | 1 |
| **CO3** | 3 | 3 | 2 | 1 | 2 | 0 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO4** | 2 | 3 | 3 | 1 | 2 | 0 | 0 | 1 | 1 | 2 | 0 | 1 |
| **CO5** | 3 | 2 | 3 | 1 | 2 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE: INTERNAL COMBUSTION ENGINES (PROFESSIONAL ELECTIVE - 2)** | | |
|---|---|---|
| **Sub Code: 18ME643** | **No of Credits: L-T-P-SS 03:00:00:00 =03** | **No. of lecture hours/week: 03 Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Basic and Applied Thermodynamics** | |

**COURSE OBJECTIVES:**

1. To understand the basic principle of thermodynamic process
2. To understand the basic components and structure of IC engines (both SI and CI engines), process parameters.
3. Understanding the performance of the engine, combustion and exhaust parameters.

| UNIT NO. | CONTENTS | Hrs. |
|---|---|---|
| **1** | **REVIEW OF I.C. ENGINE CYCLES AND CARBURETION** (BLENDED MODE) | **07** |
| | Review of thermodynamics cycles used in IC engines; Introduction to carburetion, air-fuel mixture requirement at different loads and speeds, Automotive air-fuel mixture requirement, principle of carburetion, simple carburettor, calculation of air-fuel ratio, essential parts of a carburettor, compensating devices, additional systems in modern carburettors, types of carburettors, automobile carburettors, altitude compensation, Numerical problems air-fuel mixture and carburetion. | |
| **2** | **MECHANICAL AND ELECTRONIC INJECTION SYSTEMS** (CLASSROOM MODE) | **09** |
| | Introduction to mechanical injection system; Functional Requirements of an Injection System; Classification of Injection Systems; Fuel Feed Pump, Injection Pump - Jerk Type Pump, Distributor Type Pump; Injection Pump Governor, Mechanical Governor; Pneumatic Governor; Fuel Injector; Nozzle - Types of Nozzle; Spray Formation, Quantity of Fuel and the Size of Nozzle Orifice; Injection in SI Engine; Introduction to electronic injection system; Gasoline injection - Types of Injection Systems, Components of Injection System; Electronic Fuel Injection System - Merits and Demerits of EFI System; Multi-Point Fuel Injection (MPFI) System; Functional Divisions of MPFI System; Injection Timing; Group Gasoline Injection System; Electronic Diesel Injection System; Electronic Diesel Injection Control; Numerical problems on mechanical injection system. | |
| **3** | **COMBUSTION IN SPARK IGNITION AND COMPRESSION IGNITIION ENGINES** (CLASSROOM MODE) | **09** |
| | Introduction; Homogeneous Mixture; Heterogeneous Mixture; Combustion in Spark–Ignition Engines; Stages of Combustion in SI Engines; Flame Front Propagation; Factors Influencing the Flame Speed; Rate of Pressure Rise; Abnormal Combustion; The Phenomenon of Knock in SI Engines, Effect of Engine Variables on Knock; Combustion Chambers for SI Engines; Combustion in Compression-Ignition Engines; Stages of Combustion in CI Engines; Factors Affecting the Delay Period; The Phenomenon of Knock in CI Engines; Comparison of Knock in SI and CI Engines; Combustion Chambers for CI Engines. | |
| **4** | **ENGINE ELECTRONICS AND SUPERCHARGING** (CLASSROOM MODE) | **07** |

| | | |
|---|---|---|
| | Introduction; Typical Engine Management Systems; Different types of Position Displacement and Speed, Pressure, Temperature, Intake air flow and Exhaust oxygen measurement sensors and transducers; Supercharging – Introduction; Types Of Superchargers – Centrifugal, Root's and Vane Type; Methods of Supercharging - Electric Motor Driven, Ram Effect, Under Piston, and Kadenacy System of Supercharging; Effects of Supercharging; Limitations to Supercharging; Thermodynamic Analysis of Supercharged Engine Cycle; Power Input for Mechanical Driven Supercharger; Gear Driven and Exhaust Driven Supercharging Arrangements; Turbocharging - Charge Cooling; Numerical problems on supercharged engines. | |
| **5** | **NON CONVENTIONAL ENGINES** (ONLINE MODE) | **07** |
| | Introduction; Comprehensive study on working principle, thermodynamic analysis, design, types, advantages and disadvantages of the following types of engines - Common Rail Direct Injection Engine; Dual Fuel and Multi-Fuel Engines; Multi-fuel Engines; Gasoline Direct Injection Engine; Homogeneous Charge Compression Ignition (HCCI) Engine; Lean Burn Engine; Stirling Engine; Stratified Charge Engine; Variable Compression Ratio Engine; Wankel Engine; Hybrid electric vehicle (HEV), Introduction to Electric Vehicle Propulsion Systems, Motors and Controls for Electric Vehicles Applications, Storage technologies for EV, Battery pack and battery management system, Solar powered EVs. | |

**TEXT BOOKS**

1. **Internal Combustion Engines**, V. Ganesan, Tata Mc-Graw Hill Publications,4th Edition, 2012.
2. **A Text Book of Internal Combustion Engines**, R.K. Rajput, Laxmi Publishers, 2007.
3. **Internal Combustion Engines**, M. L. Mathur and R. P. Sharma, Dhanpat Rai Publications, 2014.

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**REFERENCE BOOKS**

1. **Internal Combustion Engine Fundamentals**, John B. Heywood, Mc-Graw Hill Education India Limited, 2011.
2. **Engineering Fundamentals of the Internal Combustion Engines,** WillardW Pulkrabek. Pearson Education, 2nd Edition, 2015.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Describe the carburetion and working principle of different type of carburettor. (RBTL: 1, 2, 3)

**CO2:** Explain the fuel injection systems in IC engines. (RBTL: 1, 2, 3)

**CO3:** Describe the combustion process and select suitable combustion chambers for IC engines. (RBTL: 1, 2, 3)

**CO4**: Understand the engine electronics and supercharging and solve problems on supercharged engines. (RBTL: 1, 2, 3)

**CO5:** Differentiate and select non-conventional engines in the context of modern developments. (RBTL: 1, 2, 3)

(RBTL: Revised Bloom's Taxonomy Levels; 1 – Remembering, 2 – Understanding, 3 – Applying, 4 - Analyzing, 5 - Evaluating, 6 - Creating)

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO2** | 3 | 3 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| **CO3** | 3 | 3 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : PRODUCTION AND OPERATIONS MANAGEMENT (PROFESSIONAL ELECTIVE - 2)** | | |
|---|---|---|
| **Sub Code: 18ME644** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | Elementary knowledge of calculus and probability | |

**Course Objective:**

1. Develop an understanding of and an appreciation for the production and operations management function in any organization.
2. To understand the importance of productivity and competitiveness to both organizations and nations.
3. To understand the importance of an effective production and operations strategy to an organization.
4. To understand the various production and operations design decisions and how they relate to the overall strategies of organizations.
5. To understand the relationship of the various planning practices of capacity planning, aggregate planning, project planning and supply management.

| UNITS | CONTENTS | Hrs. |
|---|---|---|
| **UNIT- 1** | **PRODUCTION & OPERATIONS MANAGEMENT CONCEPTS** (ONLINE TEACHING) | **08** |
| | Introduction, Historical Development, Operations Management Definition, Production and Manufacturing Systems, Products v/s Services, Productivity, Factors affecting Productivity, International Dimensions of Productivity, The environment of operations, Operational excellence and world class manufacturing practices. OPERATIONS DECISION MAKING: Introduction, Characteristics of decisions, framework for Decision Making, Decision methodology, Decision supports systems, Economic models, Statistical models. (Simple numericals) | |
| **UNIT- 2** | **SYSTEM DESIGN & CAPACITY PLANNING**(BLENDED TEACHING) | **08** |
| | Design capacity, System capacity, and Determination of Equipment requirement. Facility Location and Facility Layout, Location Planning for Goods and Services, Foreign locations and facility layout. (Simple numericals) | |
| **UNIT- 3** | **FORECASTING**, **AGGREGATE PLANNING AND MASTER SCHEDULING**(ONLINE TEACHING) | **08** |
| | **Forecasting**: Forecasting Objectives and Uses, Forecasting Variables, Opinion and Judgmental methods, Time Series methods, Exponential smoothing, Regression and Correlation methods, Application and Control of Forecasts. (Simple numericals)<br>**Aggregate Planning And Master Scheduling:** Introduction, Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods. (Simple numericals) | |
| **UNIT- 4** | **INVENTORY CONTROL AND MATERIALS MANAGEMENT** (ONLINE TEACHING) | **08** |
| | Definition and Need, Components Inventory, inventory control. Scope of Materials | |

| | | |
|---|---|---|
| | Management, Material handling, storage and retrieval, purpose of inventories, Dependent and Independent demand, Inventory cost and Order quantities, Inventory classification and counting (Simple numericals) | |
| **UNIT- 5** | **MATERIAL, CAPACITY REQUIREMENTS PLANNING AND PURCHASING & SUPPLY MANAGEMENT** (CLASS ROOM TEACHING) | **07** |
| | **Material and Capacity Requirements Planning: Overview**: MRP and CRP, MRP: Underlying Concepts, System Parameters, MRP Logic, System refinements, Capacity Management, CRP activities. Concept of continuous improvement of process. (Simple numericals)<br>**Purchasing & Supply Management**: Purchase and supply chain management. Approaches to purchase and supply chain management, make or buy decision, eProcurement, Vender development, rating, and certification. | |

**TEXT BOOKS:**

1. Operations Management, I. B. Mahadevan. Theory and practice, Pearson, 2007.
2. Operations Management, Monks, J.G., McGraw-Hili International Editions, 1987.

**REFERENCE BOOKS:**

1. Modern Production/Operations Management, Buffa, Wiley Eastern Ltd.2001
2. Production and Operations Management, Pannerselvam. R., PHI. 2002
3. Productions & Operations Management, Adam & Ebert. 2002
4. Production and Operations Management, Chary, S. N., Tata-McGraw Hill. 2002

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Appreciate the production and operations management function in any organization.

**CO2:** Explain importance of productivity and competitiveness to both organizations and nations.

**CO3:** Explain importance of an effective production and operations strategy to an organization.

**CO4**: Explain various production and operations design decisions and how they relate to the overall strategies of organizations.

**CO5:** Explain relationship of the various planning practices of capacity planning, aggregate planning, project planning and supply management.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO** | **PO** | **PO** | **PO** | **PO** | **PO** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| **CO3** | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2019-20**
**SEMESTER : SIXTH**

| **COURSE TITLE : FINITE ELEMENT METHODS (PROFESSIONAL ELECTIVE – 2)** | | |
|---|---|---|
| **Sub Code: 18ME645** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Engineering mathematics, MOM, DOM** | |

**COURSE OBJECTIVES:**

1. To impart structures analysis for stress, strain & dynamic loading knowledge
2. To enable formulation of the dimensional structure, mechanical and thermal problems into FEA.
3. To comprehend the basic concepts and enhance capabilities for solving 2 D complex problems.
4. To introduce the concepts of elastic and static analysis problems.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **INTRODUCTION** (BLENDED TEACHING) | **10** |
| | General description of Finite Element Method, Geometry, Elements, Node Numbering Schemes, Application and limitations. Equilibrium equations in elasticity. Definitions of FEA and FDM.<br>**Interpolation and One – Dimensional Problems**<br>Euler – Lagrange's equation for bar, beam (cantilever / simply supported fixed) Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method and Galerkin's method boundary conditions. Interpolation polynomials- Linear, quadratic and cubic, 2D PASCAL's triangle. CST elements-Shape functions. Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Guass-elimination technique. Applications. | |
| **UNIT-2** | **HIGHER ORDER ELEMENTS** (ON-LINE TEACHING) | **08** |
| | Lagrange's interpolation, Higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Iso-parametric, Sub parametric and Super parametric elements. | |
| **UNIT-3** | **TRUSSES** (CLASS ROOM TEACHING) | **06** |
| | 2D truss Elements Stiffness matrix of Truss element. Examples illustrating how to obtain various internal force diagrams for different types of structural member like trusses Numerical problems. | |
| **UNIT-4** | **BEAMS** (CLASS ROOM TEACHING) | **08** |
| | Governing Differentia Equation for beam bending Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads. | |
| **UNIT-5** | **THERMAL ANALYSIS** (CLASS ROOM TEACHING) | **07** |
| | Steady state Heat Transfer, One Dimensional Heat Conduction – Governing Equation – Boundary Condition. Temperature Gradient & B matrix functional approach to Heat Conduction – Element Conductivity Matrix. Assembly & Boundary Conditions, Heat Flux Boundary Conditions, Forced and Natural Boundary Conditions – Numerical problems. Simple Problems. | |

**TEXT BOOKS:**

1. **Finite Elements in Engineering**, T.R.Chandrupatla, A.D Belegunde, 3rd Ed PHI.
2. **Finite Element Method in Engineering**, S.S. Rao, 4th Edition, Elsevier, 2006.
3. **Fundamentals of Finite Element Method** by Dr. S. M. Murigendrappa, International Publication – 2nd Edition 2009.
4. **Finite Element Methods by S .B. Halesh , Sapna Book House - Bangalore.**

**REFERENCE BOOKS:**

1. **"Finite Element Methods for Engineers"** U.S. Dixit, Cengage Learning, 2009.
2. **Concepts and applications of Finite Element Analysis**, R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009
3. **Finite Element Methods**, Daryl. L. Logon, Thomson Learning 3rd edition, 2001.
4. **Finite Element Method**, J.N. Reddy, McGraw -Hill International Edition.

**COURSE OUTCOMES: on completion of the course, student should be able to:**

**CO1:** Understand the fundamental concepts of FEM and develop an ability to generate the governing FE equations for systems governed by partial differential Equations.
**CO2:** Understand the concept of shape and interpolation function for higher order elements.
**CO3:** Understand and analyze the structural applications of trusses.
**CO4:** Gain the knowledge and able to do analysis of beam structure subjected to different loading conditions.
**CO5:** Obtain the ability to understand heat conduction, heat flux and apply the boundary conditions with analysis to solve numerical problems.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 0 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 0 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 0 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 0 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 0 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : FLUID POWER CONTROL SYSTEMS (PROFESSIONAL ELECTIVE – 1)** | | |
|---|---|---|
| **Sub Code: 18ME646** | **No of Credits : L-T-P-SS 3:0:0:0 =3** | **No. of lecture hours/week : 03 Total Number of Contact Hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Fluid mechanics** | |

**COURSE OBJECTIVES:**

1. To outline the introductory concepts on fluid power control systems.
2. To explain various types of hydraulic pumps and actuators, and their classification and application.
3. To describe the operation of a complete hydraulic circuit drawn with symbols for all components.
4. To outline the basics of a pneumatic system with its components.
5. To describe the pneumatic control system and various logic devices and pneumatic circuits.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **INTRODUCTION TO FLUID POWER CONTROL** (BLENDED MODE) | **06** |
| | Review of fluid mechanics (Pascal's law, continuity equation, Bernoulli's equation, Torricelli theorem, Air-to-hydraulic pressure booster, the siphon); Introduction to fluid power: advantages and applications; Types of fluid power control systems: Environmental issues; Fluids in hydraulic system: fluid properties, general types of fluids; Seals, sealing materials and compatibility with fluids; pipe sizing for flow rate and pressure rating requirement, different pipes, tubing and hoses, quick disconnect couplings; Flow through pipes: Laminar and turbulent, Reynolds number, Darcy equation, frictional losses, equivalent thickness technique; Numerical problems. | |
| **UNIT-2** | **HYDRAULIC PUMPS AND ACTUATORS** (CLASSROOM MODE) | **09** |
| | Introduction, Pumping theory, Classification of pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump noise, pump selection factors; Accumulators: Types, and applications of accumulators; Types of Intensifiers; Pressure switches /sensor, Temperature switches/sensor, Level sensor; Actuators: Classification, cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders; Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flow rate, and hydraulic motor performance; Symbolic representation of hydraulic actuators (cylinders and motors); Numerical problems. | |
| **UNIT-3** | **HYDRAULIC CIRCUIT DESIGN AND ANALYSIS** (CLASSROOM MODE) | **09** |
| | Components and hydraulic circuit design Components: Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves; Pressure control valves - types, direct operated types and pilot operated types; Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation; Hydraulic Circuit Design: Control of single and Double -acting hydraulic cylinder, regenerative circuit, pump unloading circuit, counter balance valve application, | |

| | | |
|---|---|---|
| | hydraulic cylinder sequencing circuits, hydraulic circuit for force multiplication; speed control of hydraulic cylinder- metering in, metering out and bleed off circuits. Pilot pressure operated circuits; Hydrostatic transmission; Numerical problems. | |
| **UNIT-4** | **INTRODUCTION TO PNEUMATIC CONTROL** (CLASSROOM MODE) | **09** |
| | Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit.<br>**PNEUMATIC ACTUATORS:** Linear cylinder - types, conventional type of cylinder r-working, end position cushioning, seals, mounting arrangements- applications. Rod - less cylinders types, working, advantages, rotary cylinders- types construction and application, symbols.<br>**COMPRESSED AIR:** Production of compressed air- preparation of compressed air-driers, filters, regulators, lubricators, distribution of compressed air piping layout. | |
| **UNIT-5** | **PNEUMATIC CONTROL VALVES AND CIRCUITS** (ONLINE MODE) | **06** |
| | DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. simple pneumatic control: direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling.<br>**SIGNAL PROCESSING ELEMENTS:** Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Signal elimination and cascading methods, Time dependent controls principle. Construction, practical applications.<br>**ELECTRO-PNEUMATIC CONTROL:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, relay and contactors. Control circuitry for simple signal cylinder application. Numerical problems on pneumatic circuits. | |

**TEXT BOOKS**


1. **Fluid Power with Applications,** Anthony Esposito, Pearson, 7th Edition, 2013**.**
2. **Hydraulics and Pneumatics,** Andrew Par, Jaico Publishing House, 2005.
3. **Fluid Power: Theory and Applications**, James Sullivan, 3rd Edition, Prentice Hall, 1989.


**REFERENCE BOOKS**


1. **Oil Hydraulics,** Majumdar, S.R., Tata McGraw-Hill Publications, 2002.
2. **Pneumatic Systems: Principles and Maintenance,** Majumdar, S.R., Tata McGraw-Hill Publications, 2005
3. **Fundamentals of Fluid Power Control,** John Watton, Cambridge University Press, 2012..


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

**CO1:** *Understand* the fundamental theoretical concepts governing the fluid power. (RBTL: 1, 2, 3)

**CO2:** *Familiarize* with common hydraulic components (such as pumps, actuators, motors, and valves), their use, symbols and their performance characteristics. (RBTL: 1, 2, 3)

**CO3:** *Formulate* and *analyse* mathematical models of hydraulic circuits and design them for directional, speed, pressure, force and flow control. (RBTL: 1, 2, 3)

**CO4:** *Understand* the basics of the structure of a pneumatic system and its components. (RBTL: 1, 2, 3)

**CO5:** *Familiarize* with the pneumatic control valves and circuits, signal processing elements and electro-pneumatic control circuits. (RBTL: 1, 2, 3)
(RBTL: Revised Bloom's Taxonomy Levels; 1 – Remembering, 2 – Understanding, 3 – Applying, 4 - Analyzing, 5 - Evaluating, 6 - Creating)

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO2** | 3 | 3 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| **CO3** | 3 | 3 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3. Each full question shall have maximum of 3 sub-divisions | | | | | | | | | | |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : FLUID MECHANICS AND MACHINES LABORATORY** | | |
|---|---|---|
| **Sub Code: 18MEL65** | **No of Credits : L-T-P-SS 0:0:2:0 = 1** | **No. of practical hours/week: 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Fluid Mechanics, Turbomachines** | |

**COURSE OBJECTIVES:**

1. To conduct experiment to determine coefficient of impact of water jet on vanes.
2. To determine coefficient of discharge of orifice meter, venturimeter and V-notch.
3. To conduct experiment to determine major loss of head in flow through a pipe.
4. To conduct performance test on Pelton, Francis and Kaplan turbines and evaluate the efficiency of these turbines.
5. To determine the efficiency of single stage and multi stage centrifugal pump and plot the characteristic curves; to conduct performance test on reciprocating pump and determine the percentage slip.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **MINOR EXPERIMENT** | **10** |
| | 1) Impact of jet on vanes - Determination of coefficient of impact of water jet on flat vane, inclined vane and hemispherical vane.<br>2) Orifice meter – Determination of coefficient of discharge (Calibration of orifice meter)<br>3) Venturimeter – Determination of coefficient of discharge (Calibration of venturimeter)<br>4) V- notch – Determination of coefficient of discharge (Calibration of V notch)<br>5) Flow through a pipe - Determination of major losses. | |
| **UNIT-2** | **MAJOR EXPERIMENT** | **12** |
| | **I.** Performance testing, plotting the characteristic curves and determination of unit quantities and specific speed of<br>1) Pelton turbine<br>2) Francis turbine<br>3) Kaplan turbine<br>**II.** Performance testing, plotting the characteristic curves and determination of specific speed of<br>4) Single stage centrifugal pump<br>5) Multi stage centrifugal pump<br>**III.** Coefficient of discharge and percentage slip of a reciprocating pump. | |

**REFERENCE BOOKS**

1) **Hydraulics and Fluid Mechanics including Hydraulic Machines**, Dr. P.N. Modi and S.M. Seth, Rajsons Publications Private Limited, Standard Book House, 2009.

**COURSE OUTCOMES:** After completion of the course, students will be able to:
**CO1:** Determine the coefficient of impact of jet on flat, inclined and hemispherical vanes.
**CO2:** Conduct the experiments on orifice meter, venturimeter and V-notch to calibrate them and determine their coefficient of discharge; determine the loss of head due to friction in pipes of different diameters.

**CO3:** Demonstrate the working of Pelton, Francis and Kaplan turbines and plot their operating characteristic curves by conducting performance test on them.
**CO4:** Conduct the performance test on single and four stage centrifugual pumps to plot their characteristic curves.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO2** | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO3** | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| SCHEME OF EXAMINATION (SEE) | | | | | |
|---|---|---|---|---|---|
| **Sl. No.** | **Particulars** | **Max. Marks** | **Break Up of Max. Marks** | | |
| | | | **Write Up** | **Conduction of experiment** | **Specimen Calculation, Tabulation of Results and Plotting of Graph** |
| **1** | **Unit-1: Minor Experiment** (Any ONE from the list of experiments) | **15** | 05 | 05 | 05 |
| **2** | **Unit-2: Major Experiment** (Any ONE from the list of experiments) | **25** | 05 | 10 | 10 |
| **3** | Viva Voce | **10** | -- | -- | -- |
| | **TOTAL MARKS** | **50** | **10** | **25** | **15** |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : HEAT TRANSFER LABORATORY** | | |
|---|---|---|
| **Sub Code: 18MEL66** | **No of Credits : L-T-P-SS 0:0:2:0 = 1** | **No. of practical hours/week: 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Basic Thermodynamics, Fluid Mechanics, Heat Transfer** | |

**COURSE OBJECTIVES:**

1. To understand the basic conduction, convection and radiation heat transfers.
2. To study combined conduction and convection states of heat transfer.
3. To determine emissivity of a grey body and verify Stefan Boltzmann constant.
4. To determine effectiveness of parallel flow and counter flow heat exchangers.
5. To conduct tests on vapor compression refrigeration.

| # | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **MINOR EXPERIMENT** | **10** |
| | 1. Composite wall - Determination of overall heat transfer coefficient of a composite wall.<br>2. Metal rod - Determination of thermal conductivity of a metal rod.<br>3. Fin – Determination of efficiency and effectiveness of a fin free convection mode.<br>4. Emissivity - Determination of emissivity of a given grey surface | |
| **UNIT-2** | **MAJOR EXPERIMENT** | **16** |
| | 1. Vertical pipe - Determination of heat transfer coefficient in free convection mode.<br>2. Pipe flow - Determination of heat transfer coefficient in forced convection mode for hot air flowing through a circular pipe.<br>3. Stefan Boltzmann constant - Verification of Stefan Boltzmann Constant.<br>4. Fin - Determination of efficiency and effectiveness of a fin in forced convection mode.<br>5. Shell and Tube heat exchanger - Determination of Log Mean Temperature Difference (LMTD) and Effectiveness in (i) Parallel Flow mode and (ii) Counter Flow mode<br>6. Vapour Compression Refrigerator (VCR) – Determination of COP. | |

**REFERENCE BOOKS**


1. **Heat and Mass Transfer,** P.K. Nag, 3rd Edition, Tata McGraw-Hill, 2011.

**2.A Course in Heat and Mass Transfer,** Domkundwar, Arora, Domkundwar, Dhanpat Rai Publications, 2005.

**3. Basic and Applied Thermodynamics,** P.K. Nag, Tata McGraw-Hill Publications, 2nd Edition, 2010.


**COURSE OUTCOMES:** After completion of the course, students will be able to:

**CO1:** Conduct the experiments on conduction heat transfer.
**CO2:** Demonstrate the working of test rigs on convection heat transfer.
**CO3:** Illustrate the procedure and demonstrate the experiments on radiation heat transfer.
**CO4:** Calculate the thermal conductivity heat transfer coefficient, Stefan Boltzmann constant and performance parameters related to the conduction, convection and radiation heat transfer after conducting the experiments.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO2** | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO3** | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| SCHEME OF EXAMINATION (SEE) | | | | | |
|---|---|---|---|---|---|
| **Sl. No.** | **Particulars** | **Max. Marks** | **Break Up of Max. Marks** | | |
| | | | **Write Up** | **Conduction of experiment** | **Specimen Calculation, Tabulation of Results and Plotting of Graph** |
| **1** | **Unit-1: Minor Experiment** (Any ONE from the list of experiments) | **15** | 05 | 05 | 05 |
| **2** | **Unit-2: Major Experiment** (Any ONE from the list of experiments) | **25** | 05 | 10 | 10 |
| **3** | Viva Voce | **10** | -- | -- | -- |
| **TOTAL MARKS** | | **50** | **10** | **25** | **15** |

**ADMISSION YEAR : 2018-19 ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : MINI - PROJECT WORK** | | |
|---|---|---|
| **Sub Code: 18MEP67** | **No of Credits =02**<br>**L-T-P-SS::0:0:4:0** | **No. of contact hours/week : 04** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |

**COURSE OBJECTIVES:**

1. To instill an atmosphere in students to find a working situation and discover the workable area.
2. To insure a transition from planned laboratory course to planning one independently.

| **CONTENTS** |
|---|
| **FABRICATION, MODELING & ANALYSIS** |
| Students have to make simple projects with fabrication related to mechanical projects on a mini scale and/or projects using Modeling and analysis tools project related to realistic problems of mechanical stream |

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Literature review on national and international journals and define the problem.

**CO2:** Design Experiments scientifically / Perform Numerical Analysis / Develop Analytical models to Interpret the Results and Prepare quality document

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COS/POS** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**SCHEME OF VALUATION:**

Departments shall constitute a Departmental Project Review Committee (faculty + guide)

Project evaluation shall be done by the departmental committee along with the guide and the marks shall be submitted to exam section.

CIE-1: project evaluation in the middle of the semester for 25 marks.

CIE-2: project evaluation at the end of the semester for 25 marks.

SEE: evaluation by both internal and external examiners for 50 marks by conducting project viva-voce.

## GUIDELINES FOR PREPARING PROJECT REPORT

1. Project reports should be typed neatly only on one side of the paper with 1.5 or double line spacing on an A4 size bond paper (210 x 297 mm).
2. **The margins should be:** Left – 1.25″, Right – 1″, Top and Bottom – 0.75″.
3. The total number of reports to be prepared are
   i) A copy to the department library
   ii) A copy to the concerned guide(s)
   iii) Two copies to the sponsoring agency
   iv) Candidate's copy.

4. Before taking the final printout, the approval of the **concerned guide(s) is mandatory** with suggested corrections, if any, to be incorporated.
5. For making copies dry tone Xerox is suggested. Every copy of the report must contain Inner title page (White) Outer title page with a plastic cover Certificate in the format enclosed both from the college and the organization where the project is carried out.
6. An **abstract (synopsis)** not exceeding 100 words, indicating salient features of the work. (NB: four copies of the abstract are to be submitted to the Department on the date of submission separately)
7. The organization of the report should be as follows
   i) Inner title page
   ii) Abstract or Synopsis
   iii) Acknowledgments
   iv) Table of Contents
   v) List of table & figures (optional)
   vi) Usually numbered in roman
   vii) Chapters (to be numbered in Arabic) containing Introduction-, which usually specifies the scope of work and its importance and relation to previous work and the present developments, Main body of the report divided appropriately into chapters, sections and subsections.
   viii) The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.
   ix) The chapter must be left or right justified (font size 16). Followed by the title of chapter centered (font size 18), section/subsection numbers along with their headings must be left justified with section number and its heading in font size 16 and subsection and its heading in font size 14. The body or the text of the report should have font size 12.
   x) The figures and tables must be numbered chapter wise for e.g.: Fig. 2.1 Block diagram of a serial binary adder, Table 3.1 Primitive flow table, etc.
   xi) The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.
   xii) **Reference OR Bibliography:** The references should be numbered serially in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.
   **For textbooks –** A.V. Oppenheim and R.W. Schafer, Digital Signal Processing, Englewood, N.J., Prentice Hall, 3 Edition, 1975.
   **For papers** – Devid, Insulation design to combat pollution problem, Proc of IEEE, PAS, Vol 71, Aug 1981, pp 1901-1907.

8. Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g.

   $$V = IZ \text{ ……. } (3.2)$$

   All equation numbers should be right justified.
9. The project report should be brief and include descriptions of work carried out by others only to the minimum extent necessary. Verbatim reproduction of material available elsewhere should be strictly avoided. Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced. Proper attention is to be paid not only to the technical contents but also to the organization of the report and clarity of the expression. Due care should be taken to

avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project

10. Hardware projects must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix.
11. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.
12. Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run the same, etc. If the developed software uses any public domain software downloaded from some site, then the address of the site along with the module name etc. must be included on a separate sheet. It must be properly acknowledged in the acknowledgments.
13. Sponsored Projects must also satisfy the above requirements along with statement of accounts, bills for the same dully attested by the concerned guides to process further, They must also produce NOC from the concerned guide before taking the internal viva examination.
14. The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.
15. Separator sheets, used if any, between chapters, should be of thin paper.

**COLOUR OF THE OUTER COVER/FRONT PAGE OF UG DISSERTATION / PROJECT REPORT - SKY BLUE**

# Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY

(An autonomous institution, Aided by Govt. of Karnataka, Affiliated to VTU)
BDA Outer Ring Road, Near Jnana Bharathi Campus, Bengaluru - 560056

Aided By Govt. of Karnataka

## Department of Mechanical Engineering

# *CERTIFICATE*

Certified that the Mini project work (Sixth Semester) entitled…… is carried out by the following bonafide students of Mechanical Engineering in partial fulfillment for the award of Bachelor of Engineering, B. E (Mechanical) at **Dr. Ambedkar Institute of Technology, Bangalore,** during the academic year ..... .

| Sl. No | U S N (ascending order) | Name of Student |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the project report.

The project report has been approved satisfying the academic requirements prescribed for the said Degree.

| | | |
|---|---|---|
| **Guide** | **HOD** | **Principal** |

**External Viva:**

| Sl. No | Name of the examiner | Signature with date |
|---|---|---|
| 1 | | |
| 2 | | |

**ADMISSION YEAR : 2018-19** **ACADEMIC YEAR: 2020-21**
**SEMESTER : SIXTH**

| **COURSE TITLE : INDUSTRY INTERNSHIP** | | |
|---|---|---|
| **Sub Code: 18MEI68** | **No of Credits =00**<br>**L-T-P-SS::0:0:2:0** | |

**Internship:** All the students admitted to III year of BE/B. Tech have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. A University examination will be conducted during VIII semester and prescribed credit are added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent University examination after satisfy the internship requirements.

## SEVENTH SEMESTER (BATCH 2017-21)

| | | | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | HS04** | INTELLECTUAL PROPERTY RIGHTS | 02 | 00 | 00 | 2.0 |
| 2 | INTER – DEPARTMENTAL ELECTIVE / INSTITUTIONAL ELECTIVE | | 04 | 00 | 00 | 4.0 |
| 3 | ME71 | CONTROL ENGINEERING | 04 | 00 | 00 | 4.0 |
| 4 | ME72 | HYDRAULICS & PNEUMATICS | 04 | 00 | 00 | 4.0 |
| 5 | ME73X | PROFESSIONAL ELECTIVES – 5 | 03 | 00 | 00 | 3.0 |
| 6 | MEL74 | COMPUTER AIDED MODELING AND ANALYSIS LABORATORY | 00 | 02 | 02 | 2.0 |
| 7 | MEP75 | PROJECT WORK PHASE – I | 00 | 00 | 04 | 0.0 |
| **SEVENTH SEMESTER END CREDITS** | | | | | | **19.0** |

**PROFESSIONAL ELECTIVES – 5**

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | ME731 | RAPID PROTOTYPING | 03 | 00 | 00 | 3.0 |
| | ME732 | INTERNAL COMBUSTION ENGINES | 03 | 00 | 00 | 3.0 |
| | ME733 | ENGINEERING ECONOMICS | 03 | 00 | 00 | 3.0 |

# EIGHTH SEMESTER (BATCH 2017-21)

| | | | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | ME81X | PROFESSIONAL ELECTIVE – 6 | 03 | 00 | 00 | 3.0 |
| 2 | MEL82 | CONTROL ENGINEERING LABORATORY | 00 | 01 | 01 | 1.0 |
| 3 | MES83 | SEMINAR | 00 | 00 | 04 | 2.0 |
| 4 | MEP84 | PROJECT WORK PHASE – II | 00 | 00 | 12 | 12.0 |
| **EIGHTH SEMESTER END CREDITS** | | | | | | **18.0** |
| **FOURTH YEAR CREDITS** | | | | | | **37.0** |
| **CUMULATIVE CREDITS AT END OF 4th YEAR** | | | | | | **200.0** |

| **PROFESSIONAL ELECTIVE – 6** | | | | | | |
|---|---|---|---|---|---|---|
| 6 | ME811 | COMPUTER INTEGRATED MANUFACTURING | 03 | 00 | 00 | 3.0 |
| | ME812 | COMPUTATIONAL FLUID DYNAMICS | 03 | 00 | 00 | 3.0 |
| | ME813 | SMART MATERIALS | 03 | 00 | 00 | 3.0 |

## EQUIVALENT COURSES FOR THE STUDENTS ADMITTING TO 7TH AND 8TH SEMESTER B.E IN MECHANICAL ENGINEERING

Equivalent Courses for the students admitting with backlogs from the previous academic years to the current academic year 2020-21 will be recommended by their respective mentor, BOS members and chairman.

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : SEVENTH**

| **COURSE TITLE : CONTROL ENGINEERING** | | |
|---|---|---|
| **Sub Code: ME71** | **No of Credits =04**<br>**L-T-P-SS::4:0:0:0** | **No. of lecture hours/week : 04**<br>**Total Number of Lecture hours : 52** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Engineering mathematics** | |

**COURSE OBJECTIVES:**

1. Mathematical modeling of the mechanical systems using differential equations.
2. Deduction of Transfer functions using block Diagrams and signal flow graphs
3. Emphasize on transient characteristics and response of the systems and Routh-Hurwitz stability criteria
4. Analysis of frequency response characteristics of control systems.
5. Construction of root locus plots and to ascertain the stability of the control systems

.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **MECHANICAL CONTROL SYSTEMS** (ONLINE TEACHING) | **10** |
| | Introduction to the Concept of automatic controls, open loop and closed loop control systems, concepts of feedback, requirements of an ideal control system. Mathematical models**:** Transfer function models, models of mechanical systems, feed forward systems with examples. Positive Feedback systems. | |
| **UNIT-2** | **BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS** (CLASSROOM TEACHING) | **10** |
| | Transfer Functions definition, function, blocks representation of systems elements, reduction of block diagrams, signal flow graphs: Mason's gain formula. | |
| **UNIT-3** | **TRANSIENT AND STEADY STATE RESPONSE ANALYSIS** (BLENDED TEACHING) | **10** |
| | Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's-Hurwitz criterion; types of controllers- proportional, integral proportional integral, proportional integral differential controllers. | |
| **UNIT-4** | **FREQUENCY RESPONSE ANALYSIS** (CLASSROOM TEACHING) | **12** |
| | Bode attenuation diagrams, stability analysis using bode plots, simplified bode diagrams. Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin, M &;N circles. | |
| **UNIT-5** | **ROOT LOCUS PLOTS** (CLASSROOM TEACHING) | **10** |
| | Root Loci; Definition, general rules for constructing and analysis using root locus plots. | |

**TEXT BOOKS:**

1. **Modern Control Engineering,** Katsuhiko Ogatta, Pearson Education,2004.
2. **Control Systems Principles and Design,** M. Gopal, TMH,2000.

**REFERENCE BOOKS:**

1. **Modern Control Systems**, Richard.C.Dorf and Robert. H. Bishop, Addison Wesley,1999
2. **System dynamics & control**, Eronini-Umez,Thomson Asia pte Ltd. Singapore, 2002.
3. **Feedback Control System**, Schaum's series. 2001.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Describe fundamentals of control elements and mathematical modeling

**CO2:** To understand the block diagram and signal flow graphs.

**CO3:** Analyze steady state and transient response of first and second order systems.

**CO4:** Analyze system stability through Bode and Nyquist plots.

**CO5:** Construction and stability analysis using root locus plots.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/ POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 0 | 0 | 1 | 0 | 3 |
| **CO2** | 3 | 3 | 2 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 2 |
| **CO3** | 3 | 3 | 2 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : SEVENTH**

| **COURSE TITLE : HYDRAULICS AND PNEUMATICS** | | |
|---|---|---|
| **Sub Code: ME72** | **No of Credits : L-T-P-SS 04:00:00:00 =04** | **No. of lecture hours/week : 04 Total Number of Lecture hours : 52** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Fluid mechanics, Applied thermodynamics** | |

**COURSE OBJECTIVES:**

1. Impart the knowledge of basics of hydraulics.
2. Ability to identify components for the applications of hydraulic systems.
3. Learn and apply hydraulics circuits and design.
4. To impart the knowledge of pneumatics.
5. Ability to understand multidisciplinary systems like electro pneumatic controls in automation.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **INTRODUCTION** (BLENDED TEACHING) | **10** |
| | **INTRODUCTION TO HYDRAULIC POWER:** Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law.<br>**PUMPS:** Classification, pumping theory of positive displacement pumps, construction and working of gear pumps, vane pumps, piston pumps, fixed and variable displacement pumps, pump performance characteristics, pump selection factors. | |
| **UNIT-2** | **HYDRAULIC ACTUATORS AND MOTORS** (CLASSROOM TEACHING) | **10** |
| | Classification cylinder and hydraulic motors, linear hydraulic actuators [cylinders], single and double acting cylinder, mechanics of hydraulic cylinder loading, cushioning, special types of cylinders.<br>**CONTROL COMPONENTS IN HYDRAULIC SYSTEMS:** Classification of control valves, directional control valves-ANSI Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, pressure control valves - types, direct operated types and pilot operated types. Flow control valves - compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated pressure and temperature compensated FCV, symbolic representation. | |
| **UNIT-3** | **HYDRAULIC CIRCUIT ANALYSIS** (CLASSROOM TEACHING) | **10** |
| | Control of single and double acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application, hydraulic cylinder sequencing circuits, automatic cylinder reciprocating system, locked cylinder using pilot check valve, cylinder synchronizing circuit using different methods, factors affecting synchronization, speed control of hydraulic motors, safety circuit, accumulators, types, construction and applications with circuits. | |
| **UNIT-4** | **INTRODUCTION TO PNEUMATIC CONTROL** (CLASSROOM TEACHING) | **10** |
| | Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit.<br>**PNEUMATIC ACTUATORS:** Linear cylinder - types, conventional type of cylinder r-working,end position cushioning, seals, mounting arrangements- applications. Rod - less cylinders types, working, advantages, rotary cylinders- types construction and application, symbols. | |

| | | |
|---|---|---|
| | **COMPRESSED AIR:** Production of compressed air- preparation of compressed air-driers, filters, regulators, lubricators, distribution of compressed air piping layout. | |
| **UNIT-5** | **PNEUMATIC CONTROL VALVES** (ONLINE TEACHING) | **12** |
| | DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. simple pneumatic control: direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling and exhaust air throttling.<br>**SIGNAL PROCESSING ELEMENTS:** Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle. Construction, practical applications.<br>**ELECTRO- PNEUMATIC CONTROL:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, relay and contactors. Control circuitry for simple signal cylinder application. | |

**TEXT BOOKS:**

1. **"Fluid Power with Applications",** Anthony Esposito**,** Sixth edition, Pearson Education, Inc, 2000.
2. **'Pneumatics and Hydraulics',** Andrew Parr, Jaico Publilishing Co.

**REFERENCE BOOKS:**

1. **'Oil Hydraulic systems', Principles and Maintenance** S. R. Majumdar, Tata McGraw Hill Publishing Company Ltd. - 2001
2. **'Industrial Hydraulics',Pippenger, Hicks"** McGraw Hill, New York
3. **'Hydraulic & Pneumatic Power for Production'**, Harry L. Stewart
4. **'Pneumatic Systems',** S. R. Majumdar, Tata McGraw Hill Publish 1995
5. **'Power Hydraulics'** Michael J Pinches & John G Ashby, Prentice Hall.

**COURSE OUTCOME (CO):** After completion of the course, students will be able to:

**CO1:** Understand the basics of hydraulic systems and pumps with simple numerical.

**CO2:** Identify symbols and notations associated with hydraulics components. Also understand the concept of actuators and motors.

**CO3:** Apply the basics of hydraulic system to design hydraulic circuits.

**CO4:** Understand the basics of Pneumatic systems and also learn about the pneumatic actuators with production of compressed air.

**CO5:** Identify symbols associated with pneumatic control valves and apply to signal processing elements in multidisciplinary systems like electro pneumatic controls in automation.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 2 | 0 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 2 |
| **CO2** | 3 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-2018 ACADEMIC YEAR: 2020-21**
**SEMESTER : SEVENTH**

| **COURSE TITLE: RAPID PROTOTYPING (PROFESSIONAL ELECTIVE - 5)** | | |
|---|---|---|
| **Sub. Code: ME731** | **No of Credits :3 L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03 Total Number of Lecture hours:39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |
| **Pre-requisites** | **Manufacturing process** | |

**COURSE OBJECTIVES:**

1. Describe the manufacturing techniques of rapid prototyping process.
2. Successfully apply the following techniques in rapid prototyping process.
3. Analyze the different rapid tooling methods and its uses
4. Evaluate & optimization of different rapid manufacturing processes
5. Geared towards product design, prototyping, advancements and attractive applications

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **INTRODUCTION** (CLASS ROOM TEACHING) | **07** |
| | Additive Manufacturing, The Additive Manufacturing process, Uses, Time compression Engineering(TCE), Benefits of Additive Manufacturing, Rapid Prototyping, Origins of Rapid Prototyping, Rapid Prototyping Cycle, Rapid Prototyping Processes and Future of RP | |
| **UNIT-2** | **CLASSIFICATION OF RP SYSTEMS** (CLASS ROOM TEACHING) | **07** |
| | Classification of RP systems based upon the materials, Stereolithography: apparatus, Operation, process parameters, Applications of stereolithography parts, Advantages and Disadvantages, Solid ground Curing, Selective laser sintering: History, Mechanism, Materials of SLS, Data preparation for SLS, process parameters, Advantages and Disadvantages, Applications and Future of SLS**.** | |
| **UNIT-3** | **FUSED DEPOSITION MODELLING** (CLASS ROOM TEACHING) | **07** |
| | History, Principle, Machine Details, Process Parameters, Path Generation, Advantages and Disadvantages and Applications. **Laminated Object Manufacturing** (LOM): Principle of operation, LOM Materials, Process details, Techniques used in LOM, Applications and Typical uses, Advantages and Disadvantages, **Concept Modellers**: Introduction ,Thermal ink jet printer, Multi Jet Modelling, 3-D printers, Genesis Xs Printer HP System Object Quadra systems. | |
| **UNIT-4** | **RAPID TOOLING** (ONLINE TEACHING) | **09** |
| | Indirect tooling, silicon rubber tooling, Aluminium filled epoxy tooling, spray metal tooling, cast kirksite, 3Q keltool, Direct rapid tooling, Direct AIM (ACES Injection Moulding) Quick cast process, Copper polyamide, DMLS, ProMetal, Sand casting tooling, **Software for RP:** STL file, STL file Resolution, Solid View, Magics, Mimics, Mimics Z, Magics Communicator, **Process Optimization**: Factors influencing accuracy, Errors due to Tessellation: Errors due to slicing, Part building and part finishing. | |
| **UNIT-5** | **APPLICATIONS OF RAPID PROTOTYPING** (BLENDED TEACHING) | **09** |
| | **Rapid Prototyping in Medical Field**: Introduction, Prostheses and Implants, Surgical planning and scientific applications, Biologically active Implants and Tissue Engineering. RP medical materials**. Rapid Prototyping in Automotive Industry**: key benefits of Automotive Rapid Prototyping, Materials used in Automotive Prototypes, Examples of Automotive Rapid Prototypes**. Rapid Prototyping in Aeronautical Industry, Marine** | |

| | | |
|---|---|---|
| | **Applications, Industrial Prototyping, Industrial Rapid Prototypes**: Examples**,** Benefits, and Materials used, Industrial prototyping services and Industrial Applications. | |

**TEXT BOOKS:**

1. Stereolithography and other RP & M Technologies, Paul F, Jacob:SME,NY 1996
2. Rapid Manufacturing, Flham D.T & Dinjoy S S Verlog London 2001
3. Rapid Prototyping and Tooling, Hari prasad and K S Badarinarayan

**REFERENCES:**

1. Rapid Prototyping, Terry Wohler's Report 2000 " Wohler's " Association 2000
2. Rapid Prototyping Materials, Gurumurthy, IISc Bangalore
3. Rapid Automated, Lament Wood, Indus Press, New york

**COURSE OUTCOMES**: On completion of the course, student should be able to:

**CO1:** Describe the fundamentals of Rapid Prototyping technology and classification of RP techniques to prepare
prototypes for a different product.

**CO2:** RP techniques such as SLA, SLS, FDM, SGC, and LOM based on their applicability, materials used and advantages.

**CO3:** Specifically designed concept modelers can adopt to create various models quickly and inexpensively.

**CO4**: Apply rapid tooling technique for the different specified product easily.

**CO5:** Create RP models using different software tools. Analyze advanced RP techniques for their suitability and merits.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/ POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : SEVENTH**

| **COURSE TITLE : INTERNAL COMBUSTION ENGINES (PROFESSIONAL ELECTIVE - 5)** | | |
|---|---|---|
| **Sub Code: ME732** | **No of Credits : L-T-P-SS 03:00:00:00 =03** | **No. of lecture hours/week : 03 Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Basic and Applied, Thermodynamics** | |

**COURSE OBJECTIVES:**

1. To understand the basic principle of thermodynamic process
2. To understand the basic components and structure of IC engines (both SI and CI engines), process parameters.
3. Understanding the performance of the engine, combustion and exhaust parameters.

| UNIT NO. | CONTENTS | Hrs. |
|---|---|---|
| **1** | **CARBURETION** (BLENDED MODE) | **07** |
| | Introduction, Definition, factors affecting carburetion, air-fuel mixture, mixture requirement, principle of carburetion, simple carburettor, calculation of air-fuel ratio, essential parts of a carburettor, compensating devices, additional systems in modern carburettors, types of carburettors, automobile carburettors, altitude compensation, Numericals. | |
| **2** | **INJECTION SYSTEMS** (CLASSROOM MODE) | **06** |
| | Introduction, Functional requirements, Classification, Fuel feed pump, Injection pump, Injection pump governor, Mechanical and pneumatic governor, Fuel injector, nozzle, Injection in SI engine, Numerical problems, Gasoline injection, Electronic fuel injection system, Multipoint fuel injection system, Functional divisions of MPFI system, Electronic control system, Injection timing, Group gasoline and electronic diesel injection system, Injection control. | |
| **3** | **COMBUSTION AND COMBUSTION CHAMBERS** (CLASSROOM MODE) | **07** |
| | Introduction, homogeneous and heterogeneous mixture, combustion and its stages in SI and CI engine, flame front propagation, factors influencing the flame speed, rate of pressure rise, abnormal combustion, factors affecting the delay period, adiabatic flame temperature, phenomenon of knock in SI and CI engine, effect of engine variable in knock, combustion chambers for SI and CI engine, combustion and its stage in CI engine, comparison of knock in SI and CI engine. | |
| **4** | **MEASUREMENT AND TESTING OF PERFORMANCE PARAMETERS** (CLASSROOM MODE) | **10** |
| | Introduction, measurement of friction power, indicated power, brake power, fuel and air consumption, speed, exhaust and coolant temperature, emission, noise and combustion parameters; engine efficiencies, performance characteristics, factors affecting performance, methods of improving engine performance, heat balance, performance maps, analytical method of performance estimation, Numericals. | |
| **5** | **NON CONVENTIONAL ENGINES** (ONLINE MODE) | **09** |
| | Introduction, Construction, working principle and design of CRDI engine, dual fuel and multi-fuel engine, free piston engine, Gasoline Direct Injection Engine, HCCI engine, Lean burn engine, Stirling engine, Stratified charge engine, VCR engine and Wankel engine, Hybrid electric vehicle (HEV), Introduction to Electric Vehicle Propulsion Systems, Motors and Controls for Electric Vehicles Applications, | |

| | | |
|---|---|---|
| | Storage technologies for EV, Battery pack and battery management system, Solar powered EVs. | |

**TEXT BOOKS**

**1. Internal Combustion Engines**, V. Ganesan, Tata Mc-Graw Hill Publications,4 Edition, 2012.

**2. Internal Combustion Engines**, M. L. Mathur and R. P. Sharma, Dhanpat Rai Publications, 2014.

**REFERENCE BOOKS**

**1**. **Internal Combustion Engine Fundamentals**, John B. Heywood, Mc-GrawHill Education India Limited, 2011.

**2. Engineering Fundamentals of the Internal Combustion Engines,** WillardW , Pulkrabek. Pearson Education, 2 Edition, 2015.

**3. A Text Book of Internal Combustion Engines**, R.K. Rajput, Laxmi Publishers, 2007.

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Describe the carburetion and working principle of different type of carburettor.

**CO2:** Explain the fuel injection systems in IC engines.

**CO3:** Describe the combustion process and select suitable combustion chambers for IC engines.

**CO4**: Evaluate the performance parameters and characteristics of IC engines.

**CO5:** Differentiate and selection of non-conventional engines in the context of modern developments.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO2** | 3 | 3 | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| **CO3** | 3 | 3 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 0 | 0 | 2 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : SEVENTH**

| **COURSE TITLE : ENGINEERING ECONOMICS (PROFESSIONAL ELECTIVE - 5)** | | |
|---|---|---|
| **Sub Code: ME733** | **No of Credits =03 L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03 Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Engineering mathematics** | |

**COURSE OBJECTIVES:**

1. Helping decision making
2. Calculation of interest
3. Arriving at break-even point
4. Feasibility study from economic point of view
5. Preparation of budget
6. Understanding financial statements
7. Arriving at the product cost.

| UNIT | CONTENTS | Hrs. |
|---|---|---|
| **UNIT-1** | **INTRODUCTION** (CLASS ROOM TEACHING) | **07** |
| | Elements of engineering economics, engineering decision- makers, engineering and economics, problem solving and decision making, intuition and analysis, tactics and strategy. Engineering economic decision, maze. Law of demand and supply, law of returns, interest and interest factors: interest rate, simple interest, compound interest, cash - flow diagrams, personal loans and EMI payment, exercises and discussion. | |
| **UNIT-2** | **PRESENT-WORTH COMPARISONS** (CLASS ROOM TEACHING) | **08** |
| | Conditions for present worth comparisons, basic present worth comparisons, present-worth equivalence, net present-worth, assets with unequal lives, infinite lives, future-worth comparison, pay-back comparison, exercises, discussions and problems. | |
| **UNIT-3** | **RATE-OF-RETURN CALCULATIONS AND DEPRECIATION (**CLASSROOM TEACHING) | **07** |
| | Rate of return, minimum acceptable rate of return, IRR, IRR misconceptions, cost of capital concepts. Causes of depreciation, basic methods of computing depreciation charges, tax concepts, and corporate income tax. | |
| **UNIT-4** | **INTRODUCTION, SCOPE OF FINANCE, FINANCE FUNCTIONS** (CLASS ROOM TEACHING) | **08** |
| | Statements of financial information: introduction, source of financial information, financial statements, balance sheet, profit and loss account, relation between balance sheet and profit and loss account. Simple Numericals.<br>**FINANCIAL RATIO ANALYSIS**: Introduction, nature of ratio analysis, liquidity ratios, leverage ratios, activity ratios, profitability ratios, evaluation of a firm's earning power. Comparative statements analysis. Simple Numericals. | |
| **UNIT-5** | **FINANCIAL AND PROFIT PLANNING** (BLENDED TEACHING) | **09** |
| | Introduction, financial planning, profit planning, objectives of profit planning, essentials of profit planning, budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting. Introduction to bench marking of manufacturing operation.<br>**ESTIMATING AND COSTING**<br>Components of costs such as direct material costs, direct labor costs, fixed over-heads, | |

| | | |
|---|---|---|
| | factory cost, administrative overheads, first cost, marginal cost, selling price, estimation for simple components. | |

**TEXT BOOKS:**

1. Engineering Economy, Riggs J.L., McGraw Hill, 2002
2. Engineering Economy, Thuesen H.G. PHI , 2002

**REFERENCE BOOKS:**

1. Engineering Economy, Tarachand, 2000.
2. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000
3. Financial Management, Prasanna Chandra, TMH, 2004
4. Financial Management, IM PANDEY, Vikas Publisahing House, 2002

**COURSE OUTCOMES:** At the end of the course the student will be able to:

**CO1:** Take the right financial decision.
**CO2:** Help in calculating the financial factors.
**CO3:** Arrive at feasibility study of the project.
**CO4:** Training the students for preparing the budget.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : SEVENTH**

| **COURSE TITLE : COMPUTER AIDED MODELING AND ANALYSIS LABORATORY** | | |
|---|---|---|
| **Sub Code: MEL74** | **No of Credits =02**<br>**L-T-P-SS::0:2:2:0** | **No. of practical hours/week: 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Engineering mathematics, MOM, DME** | |

**COURSE OBJECTIVES:**

1. To be able to understand and handle design problems in systematic manner
2. To gain practical experience in 2D drafting and 3D modeling software systems.
3. To be able to apply CAD in real life applications.
4. 4.To be able to understand meaning and Usefulness of FEM
5. To be able to understand Various software used to solve the practical problems

| # | Contents | Hrs |
|---|---|---|
| **UNIT-1** | **STUDY OF A FEA PACKAGE AND MODELING STRESS ANALYSIS OF** | **13** |
| | a. Bars of constant cross section area, tapered cross section area and stepped bar<br>b. Trusses – (Minimum 2 exercises)<br>c. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc (Minimum 6 exercises)<br>d. Includes Theoretical problems and Introduction to meshing | |
| **UNIT-2** | **STRESS ANALYSIS OF** | **13** |
| | a) Stress analysis of a rectangular plate with a circular hole<br>b) Thermal Analysis – 1D & 2D problem with conduction and convection boundary conditions(Minimum 4 exercises)<br>c) Dynamic Analysis<br>1) Fixed – fixed beam for natural frequency determination<br>2) Bar subjected to forcing function<br>3) Fixed – fixed beam subjected to forcing function | |

**REFERENCE BOOKS:**


1. A first course in the Finite element method, Daryl L Logan, Thomason, 3rd Ed.
2. Fundaments of FEM, Hutton – McGraw Hill, 2004
3. Finite Element Analysis, George R. Buchanan, Schaum Series.


**COURSE OUTCOMES:** On completion of the course, student should be able to:
**CO1:** Do 3D/2D Modelling and assign the material properties of the models.
**CO2:** Do proper meshing of the modelled component with different meshing techniques, mesh size control and mesh quality check.
**CO3:** Assign the required boundary condition, loading condition, types of loading and solve.
**CO4:** To analyse and evaluate the results obtained after analysis.

| **MAPPING OF COs WITH Pos** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 0 | 2 |
| **CO2** | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | 0 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 2 | 0 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 0 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| SCHEME OF EXAMINATION (SEE) | | | | | |
|---|---|---|---|---|---|
| **Sl. No.** | **Particulars** | **Max. Marks** | **Break Up of Max. Marks** | | |
| | | | **Write Up** | **Conduction of experiment / Modelling Analysis** | **Expected Out Putt-Results (Different displacement, BM, Stress, Strain results. Etc. and Plotting deformation diagram, SFD,BMD, Graph if it's required)** |
| **1** | **Unit-1: Minor Experiment** (Any ONE from the list of experiments and it is purely individual Experiment) Q1 | **20** | 05 | 05 | 10 |
| **2** | **Unit-2: Major Experiment** (Any ONE **Experiment** from the list of experiments and it is a Group Experiment ) Q2 | **20** | 05 | 5 | 10 |
| **3** | Viva Voce | **10** | -- | -- | -- |
| **TOTAL MARKS** | | **50** | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : SEVENTH**

| **COURSE TITLE : PROJECT WORK PHASE- I** | | |
|---|---|---|
| **Sub Code: MEP75** | **No of Credits =0**<br>**L-T-P-SS:: 0:0:0:0** | **No. of contact hours/week : 02** |
| **Exam Duration : NA** | | **Exam Marks : NA** |

**Course objectives:**

1. To provide an amicable atmosphere for students to plan
2. To test their learned theory knowledge in an actual working situation
3. To discover the value of work and relish rewards of accomplishment
4. To ensure a professional preparation to the liberal educational goals.

| **STAGES FOR PROJECT WORK** | |
|---|---|
| Step 1 | Formulation of the problem |
| Step 2 | Exhaustive literature survey |
| Step 3 | Methodology |
| Step 4 | Time estimation for completing the project |

The Project proposal shall be submitted within 3 weeks from the start of the semester in the prescribed standard format (04 copies) to the HOD, after the certification of the concerned guide and HOD.
Minimum number of students per batch: 02 Maximum number of students per batch: 04
CIE Evaluation: Two seminars shall be conducted at the end of 6 and 10 week of the semester.

**COURSE OUTCOMES:** On completion of the course, student should be able to:
**CO1:** Literature review on par with international journal standards
**CO2:** Literature gap determination and definition of the problem
**CO3:** Scientific Design / Numerical Analysis / Analytical model and interpret them
**CO4:** Apply tools / techniques for problem solving and prepare project work

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO3** | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **SCHEME OF EVALUATION (SEE)** | |
|---|---|
| **Sl. No.** | **Particulars** |
| 1 | Formulation of the problem |
| 2 | Relevance of the subject in the present context |
| 3 | Literature Survey |
| 4 | Problem formulation |
| 5 | Oral presentation |

## GUIDELINES FOR PREPARING PROJECT REPORT

1. Project reports should be typed neatly only on one side of the paper with 1.5 or double line spacing on an A4 size bond paper (210 x 297 mm).
2. **The margins should be:** Left – 1.25″, Right – 1″, Top and Bottom – 0.75″.
3. The total number of reports to be prepared are
   i) A copy to the department library
   ii) A copy to the concerned guide(s)
   iii) Two copies to the sponsoring agency
   iv) Candidate's copy.
4. Before taking the final printout, the approval of the **concerned guide(s) is mandatory** with suggested corrections, if any, to be incorporated.
5. For making copies dry tone Xerox is suggested. Every copy of the report must contain Inner title page (White) Outer title page with a plastic cover Certificate in the format enclosed both from the college and the organization where the project is carried out.
6. An **abstract (synopsis)** not exceeding 100 words, indicating salient features of the work. (NB: four copies of the abstract are to be submitted to the Department on the date of submission separately)
7. The organization of the report should be as follows
   i) Inner title page
   ii) Abstract or Synopsis
   iii) Acknowledgments
   iv) Table of Contents
   v) List of table & figures (optional)
   vi) Usually numbered in roman
   vii) Chapters (to be numbered in Arabic) containing Introduction-, which usually specifies the scope of work and its importance and relation to previous work and the present developments, Main body of the report divided appropriately into chapters, sections and subsections.
   viii) The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.
   ix) The chapter must be left or right justified (font size 16). Followed by the title of chapter centered (font size 18), section/subsection numbers along with their headings must be left justified with section number and its heading in font size 16 and subsection and its heading in font size 14. The body or the text of the report should have font size 12.
   x) The figures and tables must be numbered chapter wise for e.g.: Fig. 2.1 Block diagram of a serial binary adder, Table 3.1 Primitive flow table, etc.
   xi) The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.
   xii) **Reference OR Bibliography:** The references should be numbered serially in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.
   **For textbooks –** A.V. Oppenheim and R.W. Schafer, Digital Signal Processing, Englewood, N.J., Prentice Hall, 3 Edition, 1975.
   **For papers** – Devid, Insulation design to combat pollution problem, Proc of IEEE, PAS, Vol 71, Aug 1981, pp 1901-1907.

8. Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g.

$$V = IZ \text{ ……. } (3.2)$$

All equation numbers should be right justified.

9. The project report should be brief and include descriptions of work carried out by others only to the minimum extent necessary. Verbatim reproduction of material available elsewhere should be strictly avoided. Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced.

   Proper attention is to be paid not only to the technical contents but also to the organization of the report and clarity of the expression. Due care should be taken to avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project
10. Hardware projects must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix.
11. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.
12. Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run the same, etc. If the developed software uses any public domain software downloaded from some site, then the address of the site along with the module name etc. must be included on a separate sheet. It must be properly acknowledged in the acknowledgments.
13. Sponsored Projects must also satisfy the above requirements along with statement of accounts, bills for the same dully attested by the concerned guides to process further, They must also produce NOC from the concerned guide before taking the internal viva examination.
14. The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.
15. Separator sheets, used if any, between chapters, should be of thin paper

**COLOUR OF THE OUTER COVER/FRONT PAGE OF UG DISSERTATION / PROJECT REPORT - SKY BLUE**

# Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY

(An autonomous institution, Aided by Govt. of Karnataka, Affiliated to VTU)
BDA Outer Ring Road, Near Jnana Bharathi Campus, Bengaluru - 560056

Aided By Govt. of Karnataka

## Department of Mechanical Engineering

# *CERTIFICATE*

Certified that the project work - Phase I (Seventh Semester) entitled…… is carried out by the following bonafide students of Mechanical Engineering in partial fulfilment for the award of Bachelor of Engineering, B. E (Mechanical) at **Dr. Ambedkar Institute of Technology, Bangalore,** during the academic year ..... .

| Sl. No | U S N (ascending order) | Name of Student |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the project report.

The project report has been approved satisfying the academic requirements prescribed for the said Degree.

| | | |
|---|---|---|
| **Guide** | **Internal Examiner** | **HOD** |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : EIGHTH**

| **COURSE TITLE : COMPUTER INTEGRATED MANUFACTURING (PROFESSIONAL ELECTIVE - 6)** | | |
|---|---|---|
| **Sub Code: ME811** | **No of Credits =03 L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Manufacturing process I and II, CAD/CAM** | |

**Course Objectives:**

1. To impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models.
2. To expose students to automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems.
3. To expose students to computer aided process planning, material requirement planning, capacity planning etc.
4. To introduce the students to concepts of Additive Manufacturing, Internet of Things, and Industry 4.0 leading to Smart Factory.

| UNIT | CONTENT | Hrs. |
|---|---|---|
| **UNIT 1** | **Introduction to CIM and Automation:** (BLENDED TEACHING)<br>Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated Manufacturing, computerized elements of a CIM system, CAD/CAM and CIM.<br>Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process,<br>Numerical problems and automation strategies. | **08** |
| **UNIT 2** | **Automated Production Lines and Assembly Systems:** (BLENDED TEACHING)<br>Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with Storage buffer, fundamentals of automated assembly systems, numerical problems. | **08** |
| **UNIT 3** | **Flexible Manufacturing Systems:** (BLENDED TEACHING)<br>Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture.<br>**Line Balancing:** Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method. | **08** |
| **UNIT 4** | **Computerized Manufacture Planning and Control System:**<br>(ONLINE TEACHING)<br>Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and | **08** |

| | | |
|---|---|---|
| | benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control.<br>**Automated Assembly Systems:** Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feedback, escapement and placement.<br>**Automated Guided Vehicle System**: Introduction, types, Vehicle guidance and routing, System management. | |
| **UNIT 5** | **Additive Manufacturing Systems:** (ONLINE TEACHING)<br>Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM. Recent trends in manufacturing, Hybrid manufacturing.<br>**Future of Automated Factory:** Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems. | **07** |

**TEXT BOOKS:**

1. Automation, Production system & Computer Integrated manufacturing, M. P. Groover" 4th Edition, 2015, Pearson Learning.
2. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India.
3. CAD/CAM/CIM, Dr P Radhakrishnan, 3rd edition, New Age International Publishers, New Delhi.

**REFERENCE BOOKS**

1. "CAD/CAM" by Ibrahim Zeid, Tata McGraw Hill.
2. "Principles of Computer Integrated Manufacturing", S.Kant Vajpayee, 1999, Prentice Hall of India, New Delhi.
3. "Work Systems and the Methods, Measurement and Management of Work", Groover M. P, Pearson/Prentice Hall, Upper Saddle River, NJ, 2007.
4. "Computer Automation in Manufacturing", Boucher, T. O., Chapman & Hall, London, UK, 1996.
5. "Introduction to Robotics: Mechanics and Control", Craig, J. J., 2nd Ed., Addison-Wesley Publishing Company, Readong, MA, 1989.
6. Internet of Things (IoT): Digitize or Die: Transform your organization. Embrace the digital evolution. Rise above the competition, by Nicolas Windpassinger, Amazon.
7. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
8. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed. (2015), Ian Gibson, David W. Rosen, Brent Stucker
9. "Understanding Additive Manufacturing", Andreas Gebhardt, Hanser Publishers, 2011
10. Industry 4.0: The Industrial Internet of Things, A press, 2017, by Alasdair Gilchrist.

**COURSE OUTCOMES (COS):** On completion of this course you should be able to:

**CO1:** Able to define Automation, CIM, CAD, CAM and explain the differences between these concepts.

**CO2:** Explain the basics of automated manufacturing industries through mathematical models and analyse different types of automated flow lines.

**CO3:** Analyse the FMS, GT, AS/RS and automated flow lines to reduce down time and enhance productivity.

**CO4:** Design and development of various types of Computerized Manufacture Planning and Control System, materials handling systems, CAPP, MRP, capacity planning, shop floor control and CAQC.

**CO5:** Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : EIGHTH**

| **COURSE TITLE : COMPUTATIONAL FLUID DYNAMICS (PROFESSIONAL ELECTIVE - 6)** | | |
|---|---|---|
| **Sub Code: ME812** | **No of Credits : L-T-P-SS 03:00:00:00 =03** | **No. of lecture hours/week : 03 Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Fluid dynamics, Mathematics** | |

**COURSE OBJECTIVES:**

1. To understand the fundamentals of CFD and fluid flow equations in conservation forms.
2. To understand the various methods of solving linear algebraic equations.
3. To know the discretization methods and understand how it can be used in heat conduction problems.
4. To know the equations related to convection and diffusion and understand the methods to solve these equations.
5. To understand the Navier Stokes equations and turbulent modeling.

| | **CONTENTS** | **Hrs** |
|---|---|---|
| **UNIT-1** | **INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS** (BLENDED MODE) | **07** |
| | Computational Fluid Dynamics: What, When, and Why?, CFD Applications, Experimental investigations, theoretical calculations, advantages and disadvantages of theoretical calculations, Fundamental principles of conservation, Reynolds transport theorem, Conservation of mass, Conservation of momentum, Conservation of Energy equations, Navier-Stokes equation, Time-average equations for turbulent flow, the turbulent kinetic energy equation, the general differential equations, Nature of coordinates : Independent variables, choice of coordinates, one way and two way coordinates. | |
| **UNIT-2** | **SOLUTION OF SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS** (CLASSROOM MODE) | **08** |
| | Criteria for unique solution, infinite number of solutions and no solution, Solution techniques for systems of linear algebraic equations: Elimination, Iteration and Gradient Search method, Elimination method: Forward elimination and backward substitution, Assessment of number of computations, L-U decomposition technique, Tridiagonal matrix algorithm (TDMA): Thomas algorithm Iteration methods: Jacobi's method and Gauss Siedel method, Generalized analysis of the iterative methods, Sufficient condition for convergence, Rate of convergence, Scarborough criteria of sufficient condition for convergence in Gauss Siedel Method, Illustrative examples of Jacobi's method and Gauss Siedel method. | |
| **UNIT-3** | **DISCRETISATION METHODS AND HEAT CONDUCTION** (CLASSROOM MODE) | **08** |
| | The Discretization concept, The structure of Discretization equation, Methods of deriving the Discretization equation: Taylor series formulation, variation formulation, method of Weighted residuals, Control Volume formulations. Illustrative examples, Four basic rules, Numerical problems.<br>Heat conduction: Steady one dimensional Conduction: The basic Equation, The grid Spacing, The interface conductivity, Non linearity, Source term Linearization, Boundary conditions, Unsteady one dimensional Conduction: the general Discretization equation, | |

| | | |
|---|---|---|
| | Explicit, Crank Nicolson and fully implicit schemes, Two dimensional and three dimensional situation, Over relaxation and Under relaxation Methods. Problems. | |
| **UNIT-4** | **CONVECTION AND DIFFUSION** (CLASSROOM MODE) | **08** |
| | Steady one dimensional Convection and diffusion, the primary derivation, the upwind scheme, the exact solution, The Exponential scheme, The Hybrid scheme, The power law scheme, consequences of various scheme, Discretization equation for Two dimension, details of derivation, final Discretization equation, Discretization equation for Three dimension, one way space coordinates, outflow boundary conditions, False diffusion: common and proper view of False diffusion. | |
| **UNIT-5** | **NAVIER STOKES EQUATIONS AND TURBULENT MODELLING** (ONLINE MODE) | **08** |
| | Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm,<br>Important features of turbulent flow, Vorticity transport equation, Statistical representation of turbulent flows: Homogeneous turbulence and isotropic turbulence, General Properties of turbulent quantities, Reynolds average Navier stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling, Different types of turbulence model: Eddy viscosity 2 models, Mixing length model, Turbulent kinetic energy and dissipation, The κ-ε model, Advantages and disadvantages of κ -ε model. | |

**TEXT BOOKS:**

1. **Computational Fluid Dynamics: The Basics with Applications,** John D. Anderson, Jr., McGraw-Hill International Editions, 1995.
2. **Computational Fluid Flow and Heat Transfer,** K. Muralidhar and T.Sundararajan (Editors), 2nd Edition, Narosa Publishing House, 2003.
3. **Introduction to Computational Fluid Dynamics:** H.K. Versteeg and W. Malalasekera, Pearson Education Limited, 2nd Edition, 2007.

**REFERENCE BOOKS:**

1. **Computational Fluid Methods for Fluid Dynamics**, J.H. Ferziger and M. Peric, Springer (India) Pvt. Ltd., 3rd Edition, 2002.
2. **Introduction to Computational Fluid Dynamics**, Pradip Niyogi, S.K. Chakrabartty, M.K. Laha, Pearson Education, 2011.
3. **Numerical Heat Transfer and Fluid Flow**, Suhas V. Patankar, Hemisphere Publishing Corporation, 1980.

**e-LEARNING RESOURCES**

**Videos, Lecture notes:** http://www.nptel.ac.in

**COURSE OUTCOME (CO)**

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

**CO1:** Understand the fundamental concepts of computational fluid dynamics and explain Reynolds transport theorem.

**CO2:** Demonstrate the different methods of solving a system of linear algebraic equations.

**CO3:** Understand the concept of Discretization and its methods; Discretize the heat conduction equations and solve numerical problems.

**CO4:** Derive the one dimensional steady convection and diffusion equation; Discretize these equations using different methods.

**CO5:** Discretize the momentum equation and understand the various turbulent models.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO3** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO4** | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO5** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| QUESTION PAPER PATTERN (SEE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |
| 3. Each full question shall have maximum of 3 sub-divisions. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : EIGHTH**

| **COURSE TITLE : SMART MATERIALS (PROFESSIONAL ELECTIVE - 6)** | | |
|---|---|---|
| **Sub Code: ME813** | **No of Credits =03**<br>**L-T-P-SS::3:0:0:0** | **No. of lecture hours/week : 03**<br>**Total Number of Lecture hours : 39** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **SEE Marks : 100** |
| **Pre-requisites** | **Material science, Composite materials** | |

**COURSE OBJECTIVES:**

1. The aim of this course is to integrate research results with curriculum development for the benefit of the students in physics, materials science and engineering civil and structural engineering, mechanical and aerospace engineering, industrial and systems engineering, as well as electrical and electronic engineering.
2. The fundamentals of smart materials, device and electronics, in particular those related to the development of smart structures and products.
3. The skills, knowledge and motivation in the design, analysis and manufacturing of smart structures and products.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | **INTRODUCTION TO SMART MATERIALS (Classroom Teaching)** | **07** |
| | Characteristics of composites and ceramic materials, Smart materials and their types, dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics. | |
| **UNIT-2** | **SMART STRUCTURES (Blended Learning)** | **08** |
| | Types of smart Structures, potential feasibility of smart structures, key elements of smart structures, applications of smart structures. Piezoelectric materials, properties, piezoelectric constitutive relations, poling and coercive field, field strain relation. Hysteresis, creep and strain rate effects, inchworm linear motor. | |
| **UNIT-3** | **SENSING AND ACTUATION (Blended Learning)** | **08** |
| | Principles of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, signal processing, principals and characterization of sensors. | |
| **UNIT-4** | **SHAPE MEMORY ALLOY (Blended Learning)** | **08** |
| | Experimental Phenomenology, Shape Memory Effect, phase transformation, super elasticity, Tanaka's constitutive model, SME testing of SMA wires, vibration control through SMA, Testing of super elasticity, Applications Of SMA.<br>**ER AND MR FLUIDS**<br>Mechanisms and properties, fluid composition and behavior, The Bingham plastic and related models, pre-yield response. Post-yield flow applications in clutches, dampers and others. | |
| **UNIT-5** | **VIBRATION ABSORBERS and MEMS (Blended Learning)** | **08** |
| | **VIBRATION ABSORBERS: S**eries and parallel damped vibrations (overview), active vibration absorbers, fiber optics, physical phenomena, characteristics, sensors, fiber optics in crack detection, applications, biomimetics.<br>**MEMS:** Mechanical properties of MEMS materials, scaling of mechanical systems, fundamentals of theory, the intrinsic characteristics of MEMS, miniaturization, microelectronics integration. | |

**TEXT BOOKS:**

1. **'Analysis and Design',** A. V. Srinivasan, 'Smart Structures –Cambridge University Press, New York, 2001, (ISBN : 0521650267)
2. **'Smart Materials and Structures',** M V Gandhi and B S Thompson Chapmen & Hall, London, 1992 (ISBN : 0412370107)

**REFERENCE BOOKS:**

1. **'Smart Materials and Structures',** Banks HT, RC Smith, Y Wang, Massow S A, Paris 1996
2. **G P Gibss'Adaptive Structres',** Clark R L, W R Saunolers, Jhon Wiles and Sons, New York, 1998
3. **An introduction for scientists and Engineers',**EsicUdd, Optic Sensors :Jhon Wiley & Sons, New York, 1991 (ISBN : 0471830070).

**COURSE OUTCOMES:** On completion of this COURSE, students should be able to:
**CO1:** Understand the physical principles underlying the behaviour of smart materials;
**CO2:** Analyze the properties of smart structures, Piezo electric materials with the applications and select suitable procedure for fabrication.
**CO3:** Understand the engineering principles in smart sensor, actuator and technologies
**CO4:** Explain the principle concepts of ER & MR Fluids and shape memory alloys with principles of working.
**CO5:** Describe the methods of controlling vibration using smart systems and fabrication methods of MEMS. Explain the principle concepts of Biomimetic, Fibre optics and actuation with principles of working.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **QUESTION PAPER PATTERN (SEE)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q. No. | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| UNIT | 1 | | 2 | | 3 | | 4 | | 5 | |
| 1. Two full questions (each of 20 Marks) are to be set from each unit. | | | | | | | | | | |
| 2. Student shall answer five full questions selecting one full question from each unit. | | | | | | | | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : EIGHTH**

| **COURSE TITLE : CONTROL ENGINEERING LABORATORY** | | |
|---|---|---|
| **Sub Code: MEL82** | **No of Credits =1**<br>**L-T-P-SS::0:2:2:0** | **No. of practical hours/week: 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 50** |
| **Pre-requisites** | **Control engineering** | |

**COURSE OBJECTIVES:**

1. To understand the basics of control system.
2. To control the heat flow rate and temperature in a tank.
3. To determine effectiveness of PID controller in heating tanks
4. To analyse the control action on the liquid levels in tanks.
5. To control the speed of DC motor.

| # | CONTENTS | Hrs |
|---|---|---|
| **UNIT-1** | Basics and heated tank | 6 |
| | 1. No control heated tank<br>2. Bump less transfer heated tank<br>3. General transfer function<br>4. Anti-windup heated tank<br>5. PID standard temperature control of heated tank<br>6. Cascade temperature control of heated tank. | |
| **UNIT-2** | Liquid level control | 6 |
| | 1. Manual level control<br>2. PID standard level control in chip tank<br>3. PID discrete General transfer function<br>4. Feed forward liquid level control in single tank.<br>5. Feed forward liquid level control in double tank. | |
| **UNIT-3** | Speed control of DC motor | 8 |
| | 1. Step test<br>2. Set point weighing<br>3. Position and step test<br>4. Speed integral control<br>5. PI implementation.<br>6. PID position implementation. | |
| **UNIT-4** | **Magnetic levitation** | 6 |
| | 1. On-off control<br>2. P- control<br>3. Transient response<br>4. PD control for desired pole placement<br>**5.** PD control for desired transient response | |

**COURSE OUTCOMES:** On completion of the course, students should be able to:

**CO1:** Evaluate thermal control action and effectiveness of PID control.
**CO2:** Plot the characteristic graphs to analyse of liquid level control.
**CO3:** Develop motors speed controls as required in industries.
**CO4:** Evaluate and optimise the magnetic levitation system.

| MAPPING OF COs WITH POs | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 0 | 1 | 1 | 1 | 2 | 1 | 0 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 2 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| SCHEME OF EXAMINATION | |
|---|---|
| One Question from Unit – 1 or 2 | 15 Marks (05 Write up +10) |
| One Question from Unit – 3 or 4 | 25 Marks (05 Write up +20) |
| Viva-Voce | 10 Marks |
| **Total** | **50 Marks** |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : EIGHTH**

| **COURSE TITLE : SEMINAR** | | |
|---|---|---|
| **Sub Code: MES83** | **No of Credits : 02** | **No. of contact hours/week : 04** |
| | | **CIE Marks: 50** |

**COURSE OBJECTIVES:**

1. To equip students for making a technical presentation based on a thorough re-search review on any contemporary area of Engineering and Management fields
2. Offering the student an opportunity to interact with faculty and peer group and to build the ability to making independent presentation.

| **STAGES OF SUBJECT SEMINAR** |
|---|
| Identification of seminar topic related to area of interest in the field of advanced mechanical engineering. |
| Literature survey on the selected topics and collection of research papers. |
| Final seminar shall be presented during 8 /9 week of the semester in the department before the Departmental Evaluation Committee constituted by HOD. |
| The seminar marks are to be awarded by the committee. |
| Students shall submit the seminar report in the prescribed standard format. |

**COURSE OUTCOMES:** On completion of the course, student should be able to:

**CO1:** Conduct literature survey on a current topic based on peer reviewed literature and identify research gap in the literature

**CO2:** Develop methodologies to resolve the identified problem(s)

**CO3:** Develop presentation slides / report arranging the material coherently and discuss the topic with clarity and confidence.

**CO4:** Summarize the presentation, submit the report and identify scope for further work.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

| **SCHEME OF EVALUATION** | | | | |
|---|---|---|---|---|
| | | **MARKS ALLOTED** | | |
| **PARTICULARS** | **MAX MARKS** | **EXAMINER 1** | **EXAMINER 2** | **AVERAGE** |
| Report | **20** | | | |
| Relevance of topic with the programme | **10** | | | |
| Oral presentation | **10** | | | |
| Viva Voce | **10** | | | |
| **TOTAL** | **50** | | | |

**ADMISSION YEAR : 2017-18 ACADEMIC YEAR: 2020-21**
**SEMESTER : EIGHTH**

| **COURSE TITLE : PROJECT WORK PHASE – II** | | |
|---|---|---|
| **Sub Code: MEP84** | **No of Credits : 12** | **No. of contact hours/week : 02** |
| **Exam Duration : 3 hours** | **CIE Marks: 50** | **Exam Marks : 100** |

**COURSE OBJECTIVES:**

1. To provide an opportunity and atmosphere in which students may test theory learned in the classroom in an actual working situation and discover the value of work and the rewards of accomplishment
2. To insure a natural transition to the higher level of professional preparation as a complement to the liberal education goals of the Institution.

| **STAGES OF PROJECT WORK** |
|---|
| Identification of project topic related to area of interest in the field of advanced or current mechanical engineering |
| Literature survey based on the identified topic |
| Define / formulate the problem and the methodology |
| Design and fabricate or analysis based on type of problem |
| Results, conclusions, scope for further work |
| References. |
| Oral presentation of the project at the end of $6^{th}$ and $10^{th}$ week of a semester |

**OUTCOMES:** On completion of the course, student should be able to:
**CO1:** Perform literature review on par with international journal standards.
**CO2:** Identify literature gap and define the problem.
**CO3:** Design experiments scientifically / perform numerical analysis / develop analytical models and interpret the results and apply advanced tools / techniques for solving the problem.
**CO4:** Prepare quality document of project work.

| **MAPPING OF COs WITH POs** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 |
| **CO2** | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 1 |
| **Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0 | | | | | | | | | | | | |

**CIE EVALUATION**: Two presentations shall be conducted at the end of $6^{th}$ and $10^{th}$ week of the semester. The Project Report shall be submitted in the prescribed standard format (04 copies) to the HOD, after the certification of the concerned guide and HOD.

| SCHEME OF EVALUATION (CIE) | | | | |
|---|---|---|---|---|
| | | MARKS ALLOTED | | |
| **PARTICULARS** | **MAX MARKS** | **EXAMINER 1** | **EXAMINER 2** | **AVERAGE** |
| Relevance of topic with the programme | **10** | | | |
| Oral presentation | **30** | | | |
| Viva Voce | **10** | | | |
| **TOTAL** | **50** | | | |

| SCHEME OF EVALUATION (SEE) | | |
|---|---|---|
| **Sl. No.** | **Particulars** | **Max. Marks** |
| 1 | Relevance of the subject in the present context | **10** |
| 2 | Literature Survey | **10** |
| 3 | Problem formulation | **10** |
| 4 | Experimental observation / theoretical modelling | **10** |
| 5 | Results – Presentation & Discussion | **10** |
| 6 | Conclusions and scope for future work | **10** |
| 7 | Overall presentation of the Thesis/Oral presentation | **40** |
| | **Total Marks** | **100** |

## GUIDELINES FOR PREPARING PROJECT REPORT

8. Project reports should be typed neatly only on one side of the paper with 1.5 or double line spacing on an A4 size bond paper (210 x 297 mm).
9. **The margins should be:** Left – 1.25″, Right – 1″, Top and Bottom – 0.75″.
10. The total number of reports to be prepared are
    v) A copy to the department library
    vi) A copy to the concerned guide(s)
    vii) Two copies to the sponsoring agency
    viii) Candidate's copy.
11. Before taking the final printout, the approval of the **concerned guide(s) is mandatory** with suggested corrections, if any, to be incorporated.
12. For making copies dry tone Xerox is suggested. Every copy of the report must contain Inner title page (White) Outer title page with a plastic cover Certificate in the format enclosed both from the college and the organization where the project is carried out.
13. An **abstract (synopsis)** not exceeding 100 words, indicating salient features of the work. (NB: four copies of the abstract are to be submitted to the Department on the date of submission separately)
14. The organization of the report should be as follows
    xiii) Inner title page
    xiv) Abstract or Synopsis
    xv) Acknowledgments
    xvi) Table of Contents
    xvii) List of table & figures (optional)
    xviii) Usually numbered in roman

xix) Chapters (to be numbered in Arabic) containing Introduction-, which usually specifies the scope of work and its importance and relation to previous work and the present developments, Main body of the report divided appropriately into chapters, sections and subsections.

xx) The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.

xxi) The chapter must be left or right justified (font size 16). Followed by the title of chapter centered (font size 18), section/subsection numbers along with their headings must be left justified with section number and its heading in font size 16 and subsection and its heading in font size 14. The body or the text of the report should have font size 12.

xxii) The figures and tables must be numbered chapter wise for e.g.: Fig. 2.1 Block diagram of a serial binary adder, Table 3.1 Primitive flow table, etc.

xxiii) The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.

xxiv) **Reference OR Bibliography:** The references should be numbered serially in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.

**For textbooks –** A.V. Oppenheim and R.W. Schafer, Digital Signal Processing, Englewood, N.J., Prentice Hall, 3 Edition, 1975.

**For papers** – Devid, Insulation design to combat pollution problem, Proc of IEEE, PAS, Vol 71, Aug 1981, pp 1901-1907.

9. Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g.

$$V = IZ \text{ ……. } (3.2)$$

All equation numbers should be right justified.

16. The project report should be brief and include descriptions of work carried out by others only to the minimum extent necessary. Verbatim reproduction of material available elsewhere should be strictly avoided. Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced.

    Proper attention is to be paid not only to the technical contents but also to the organization of the report and clarity of the expression. Due care should be taken to avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project

17. Hardware projects must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix.
18. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.
19. Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run the same, etc. If the developed software uses any public domain software downloaded from some site, then the address of the site along with the module name etc. must be

included on a separate sheet. It must be properly acknowledged in the acknowledgments.

20. Sponsored Projects must also satisfy the above requirements along with statement of accounts, bills for the same dully attested by the concerned guides to process further, They must also produce NOC from the concerned guide before taking the internal viva examination.
21. The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.
22. Separator sheets, used if any, between chapters, should be of thin paper

**COLOUR OF THE OUTER COVER/FRONT PAGE OF UG DISSERTATION / PROJECT REPORT - SKY BLUE**

# Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY

(An autonomous institution, Aided by Govt. of Karnataka, Affiliated to VTU)
BDA Outer Ring Road, Near Jnana Bharathi Campus, Bengaluru - 560056

Aided By Govt. of Karnataka

## Department of Mechanical Engineering

# *CERTIFICATE*

Certified that the project work - Phase II (Eighth Semester) entitled…… is carried out by the following bonafide students of Mechanical Engineering in partial fulfilment for the award of Bachelor of Engineering, B. E (Mechanical) at **Dr. Ambedkar Institute of Technology, Bangalore,** during the academic year ..... .

| Sl. No | U S N (ascending order) | Name of Student |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the project report.

The project report has been approved satisfying the academic requirements prescribed for the said Degree.

| | | |
|---|---|---|
| **Guide** | **HOD** | **Principal** |

**External Viva:**

| Sl. No | Name of the examiner | Signature with date |
|---|---|---|
| 1 | | |
| 2 | | |