D Y PATIL
COLLEGE of
ENGINEERING & TECHNOLOGY
KASABA BAWADA, KOLHAPUR.
(AN AUTONOMOUS INSTITUTE)

Approved By AICTE, New Delhi, Recognised by Govt. of Maharashtra & Affiliated to Shivaji University, Kolhapur.

# D. Y. Patil College of Engineering and Technology

Kasaba Bawada, Kolhapur

## (An Autonomous Institute)

### Accredited by NAAC with 'A' Grade

# S. Y. B. Tech Programme Structure

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## Department of Mechanical Engineering

(With effect from academic year **2021-22)**

**Department of Mechanical Engineering**
**Second Year B. Tech. in Mechanical Engineering**
**Semester-III**

| Sr. No | Course Code | Course Type | Name of the Course | Teaching Scheme Per Week | | | Credits | Total Marks | Evaluation scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Lecture | Tutorial | Practical | | | Type | Max. Marks | Min. Marks for Passing | |
| 1 | 201MEL201 | BSC | Engineering Mathematics III | 3 | 1 | - | 4 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 2 | 201MEL202 | PCC | Fluid Mechanics | 3 | - | - | 3 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 3 | 201MEL203 | PCC | Kinematics Mechanism and Machines @ | 3 | - | - | 3 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 4 | 201MEL204 | PCC | Manufacturing Processes | 3 | - | - | 3 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 5 | 201MEL205 | PCC | Applied Thermodynamics | 3 | - | - | 3 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 6 | 201MEP206 | LC | Fluid Mechanics Lab | - | - | 2 | 1 | 50 | ISE | 25 | 10 | 10 |
| | | | | | | | | | ESE (POE) | 25 | 10 | 10 |
| 7 | 201MEP207 | LC | Kinematics Mechanism and Machines Lab | - | - | 2 | 1 | 25 | ISE | 25 | 10 | 10 |
| 8 | 201MEP208 | LC | Applied Thermodynamics Lab | - | - | 2 | 1 | 50 | ISE | 25 | 10 | 10 |
| | | | | | | | | | ESE (POE) | 25 | 10 | 10 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 201MEP209 | LC | Workshop Practice II Lab | - | - | 2 | 1 | 50 | ISE | 25 | 10 | 10 |
| | | | | | | | | | ESE (POE) | 25 | 10 | 10 |
| 10 | 201MEP210 | ESC | Computer Programming Lab | - | - | 2 | 1 | 25 | ISE | 25 | 10 | 10 |
| | | | **Total** | **15** | **1** | **10** | **21** | **700** | **Total Credits: 21** | | | |
| | | | | | | | | | **Total Contact Hrs.: 26** | | | |

| Course Code | Definition |
|---|---|
| BSC | Basic Science Course |
| ESC | Engineering Science Course |
| HSMC | Humanity and Social Science including Management Course |
| PCC | Professional Core Course |
| PEC | Professional Elective Course |
| OEC | Open Elective Course |
| LC | Laboratory Course |
| MC | Mandatory Course |

**Abbreviations:**

**ISE:-** In Semester Evaluation

**MSE:-**Mid semester Examination

**ESE:-**End Semester Examination

**Note:**

**1. ESE will be conducted for 100 marks and converted to 50 marks**

**2. @ Theory paper of 04 (four hour) Durations**

**Department of Mechanical Engineering**
**Second Year B. Tech. in Mechanical Engineering**
**Semester-IV**

| Sr. No | Course Code | Course Type | Name of the Course | Teaching Scheme Per Week | | | Credits | Total Marks | Evaluation scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Lecture | Tutorial | Practical | | | Type | Max. Marks | Min. Marks for Passing | |
| 11 | 201MEL211 | ESC | Machine Drawing @ | 2 | - | - | 2 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 12 | 201MEL212 | ESC | Strength of Materials | 3 | 1 | - | 4 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 13 | 201MEL213 | PCC | Fluid and Turbo Machinery | 3 | - | - | 3 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 14 | 201MEL214 | PCC | Machine Tools and Processes | 3 | - | - | 3 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 15 | 201MEL215 | PCC | Theory of Machines | 3 | - | - | 3 | 100 | ISE | 20 | 20 | 40 |
| | | | | | | | | | MSE | 30 | | |
| | | | | | | | | | ESE | 50 | 20 | |
| 16 | 201MEP216 | LC | Machine Drawing Lab | - | - | 2 | 1 | 25 | ISE | 25 | 10 | 10 |
| 17 | 201MEP217 | LC | Fluid and Turbo Machinery Lab | - | - | 2 | 1 | 50 | ISE | 25 | 10 | 10 |
| | | | | | | | | | ESE (POE) | 25 | 10 | 10 |
| 18 | 201MEP218 | LC | Theory of Machines Lab | - | - | 2 | 1 | 25 | ISE | 25 | 10 | 10 |
| 19 | 201MEP219 | ESC | Workshop Practice-III Lab | - | - | 2 | 1 | 75 | ISE | 25 | 10 | 10 |
| | | | | | | | | | ESE (POE) | 50 | 20 | 20 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 201MEP220 | LC | CAD Lab | - | - | 2 | 1 | 50 | ISE | 25 | 10 | 10 |
| | | | | | | | | | ESE (POE) | 25 | 10 | 10 |
| 21 | 201MEMC221 | MC | Environmental Studies | 2 | - | - | 0 | 50 | ESE | 50 | 20 | 20 |
| | | | **Total** | **16** | **1** | **10** | **21** | **775** | **Total Credits: 21** | | | |
| | | | | | | | | | **Total Contact Hrs.: 27** | | | |
| | | | | | | | | | | | | |

| Course Code | Definition |
|---|---|
| BSC | Basic Science Course |
| ESC | Engineering Science Course |
| HSMC | Humanity and Social Science including Management Course |
| PCC | Professional Core Course |
| PEC | Professional Elective Course |
| OEC | Open Elective Course |
| LC | Laboratory Course |
| MC | Mandatory Course |

**Abbreviations:**

**ISE:-** In Semester Evaluation

**MSE:-**Mid semester Examination

**ESE:-** End Semester Examination

**Note:**

1. **ESE will be conducted for 100 marks and converted to 50 marks**
2. **@ Theory paper of 04 (four hour) Durations**
3. **Students have to undergo 4 to 6 weeks internship Semester after IV or VI during summer vacation**

   **( Guidelines for Internship is attached below)**

**Guidelines for Internship -**

• The students are expected to undergo 4 to 6 weeks internship in Industry and work on relevant area as assigned by industry. The work done should be monitored and evaluated by the concerned Industrial expert based on report prepared by the students. The department has to assign one faculty member who has to communicate with industry and monitor the internship related work periodically.

The weightage of evaluation will be as under:-

a) Industry expert/Supervisor -70%

b) Department and faculty mentor includes preparation and submission of report to department at the beginning of subsequent semester -30%

• Internship can be availed by the students during summer vacation after the completion of Semester IV or VI.

• The credits of internship will be considered in Semester VII

• The industry expert/Supervisor is expected to assign work worth of minimum of 100 to 120 hrs. and for 4 to 6 week duration and should monitor and evaluate periodically.

• At the completion of Internship work, the student is expected to prepare report on the work done and get certified from the industry expert.

## Course Plan

| **Course Title : Engineering Mathematics - III** | |
|---|---|
| **Course Code : 201MEL201** | **Semester : III** |
| **Teaching Scheme : L-T-P : 3-1-0** | **Credits : 4** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** Quadratic Equations, Synthetic Division, Partial Fraction, Formulas of Derivatives& Integrations.

**Course Objectives:**

1. To develop mathematical skills and enhance thinking power of students.
2. To give the knowledge to the students of Applied Mathematics with an emphasis on the application of solving Mechanical Engineering problems.
3. To prepare students to formulate a mathematical model using engineering skills &interpret the solution in Mechanical Engineering and real world.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C201.1 | Make use of linear differential equation to solve the Mechanical engineering problems. |
| C201.2 | Describe the statistical data numerically by using lines of regression and curve fittings. |
| C201.3 | Apply knowledge of vector differentiation to find curl and divergence of vector fields. |
| C201.4 | Apply Laplace transforms to solve linear differential equations. |
| C201.5 | Use partial differential equation to solve the Mechanical engineering problems |
| C201.6 | Calculate Numerical Integration. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| **Course Outcomes (COs)** | **Program Outcome (POs)** | | | | | | | | | | | | **PSO** | | **BTL** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| **C201.1** | 3 | 2 | - | - | 1 | - | - | - | - | - | - | - | | | 3 |
| **C201.2** | 3 | 2 | - | - | 1 | - | - | - | - | - | - | - | | | 3 |
| **C201.3** | 3 | 2 | - | - | 1 | - | - | - | - | - | - | - | | | 3 |
| **C201.4** | 3 | 2 | - | - | 1 | - | - | - | - | - | - | - | | | 3 |
| **C201.5** | 3 | 2 | - | - | 1 | - | - | - | - | - | - | - | | | 3 |
| **C201.6** | 3 | 2 | - | - | 1 | - | - | - | - | - | - | - | | | 3 |

## Course Content

| Content | Hours |
|---|---|
| **Unit 1 : Linear Differential Equations and Its Applications**<br>Linear differential equations with constant coefficients.<br>Rules to find complementary function.<br>Methods to find particular integral (X = Sinax / Cosax, xV.)<br>Application of linear differential equations – Whirling of Shaft and Oscillation of spring. | 6 |
| **Unit 2:Regression & Curve Fitting**<br>Introduction.<br>Lines of regression of bivariate data.<br>Fitting of curves by method of least-squares.<br>Fitting of straight lines.<br>Fitting of second degree parabolic curves. | 6 |
| **Unit 3:Vector Differential Calculus**<br>Differentiation of vectors.<br>Gradient of scalar point function.<br>Divergence of vector point function<br>Curl of a vector point function.<br>Irrotational, solenoidal and scalar potential function of a vector field. | 6 |
| **Unit 4:Laplace Transformation**<br>Laplace transform of elementary functions<br>Properties of Laplace transform<br>Linearity property<br>First shifting property<br>Change of scale property<br>Multiplication by and division by t<br>Inverse Laplace transform<br>Definition and important formulae<br>Inverse Laplace transform by method of partial fraction<br>Solution of linear differential equation with constant coefficients using Laplace transform | 6 |
| **Unit 5: Partial Differential Equations and Applications**<br>Formation of partial differential equation<br>Method of separation of variables.<br>Wave equation and its solution<br>One dimensional heat flow equation<br>Solutions of Laplace equations by the Gauss – Seidel iterative method | 6 |

| | |
|---|---|
| **Unit 6: Numerical Integration**<br>Trapezoidal Rule.<br>Simpson's 1/3 rd Rule.<br>Simpson's 3/8 th Rule<br>Weddle's Rule. | 6 |

**Note –10 Tutorials should be conducted covering all units and few are based on SCILAB / MATLAB**

| Sr. No. | Title of Tutorials | Contact Hr. |
|---|---|---|
| 1 | Linear Differential Equations | 1 |
| 2 | Applications Linear Differential Equations | 1 |
| 3 | Regression & Curve Fitting | 1 |
| 4 | Vector Differential Calculus | 1 |
| 5 | Laplace Transform and its Applications | 1 |
| 6 | Inverse Laplace Transform | 1 |
| 7 | Partial differential Equation. | 1 |
| 8 | Numerical Integration | 1 |
| 9 | Fitting of first and second degree curves using SCILAB / MATLAB | 2 |
| 10 | Trapezoidal and Simpson's Rule using SCILAB / MATLAB | 2 |

**Text Book:**

1. Higher Engineering Mathematics, by B. S. Grewal (Khanna Publication, New Delhi, 40th Edition, 2007)
2. Higher Engineering Mathematics, by B.V. Ramana (Tata McGraw Hill Education Private Limited, Delhi, 1st Edition, 2007)

**Reference Books:**

1. Advance Engineering Mathematics by Erwin Kreyszig (Wiley India)
2. Numerical Methods in Engineering and Science, by Dr. B. S. Grewal (Khanna Publication, Delhi)
3. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar, Vidyarthi Griha Prakashan, Pune

## Course Plan

| **Course Title : Fluid Mechanics** | |
|---|---|
| **Course Code : 201MEL202** | **Semester : III** |
| **Teaching Scheme : L-T-P : 3-0-0** | **Credits : 3** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** Applied Physics, Applied Chemistry

**Course Description:**

This course will provide the students a basic knowledge of fluid properties, fluid statics, dynamics and fluid flow.

**Course Objectives:**

1. To introduce the students about various properties of fluid and pressure measuring devices.
2. To study basic concepts of fluid statics, buoyancy, floating and submerged bodies and its applications
3. To study physical significance of fluid kinematics, fluid dynamics and its applications.
4. To understand the different form of governing equation related to fluid flow.
5. To analyze and evaluate fluid mechanics systems by applying principles of Physics, mathematics, science and engineering.
6. To develop skills in the analysis of fluid systems for lifelong learning.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C202.1 | Explain fundamentals of fluid properties, pressure measurement and fluid statics |
| C202.2 | Identify the fluid flow problem and explain the theoretical concepts of fluid statics, fluid kinematics and fluid dynamics. |
| C202.3 | Apply governing equation of fluid mechanics i.e. Continuity equation, Bernoulli's Equation and momentum equation for different fluid flow applications. |
| C202.4 | Apply momentum equation and make basic analysis of laminar flow to calculate the energy losses. |
| C202.5 | Analyze the energy losses in fluid flow systems. |
| C202.6 | Apply theory of boundary layer, Drag and lift forces in proper cases and concept of compressible flow. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C202.1** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | 2 |
| **C202.2** | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 2 |
| **C202.3** | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 3 |
| **C202.4** | 3 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | 3 |
| **C202.5** | 3 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | 4 |
| **C202.6** | 3 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | 3 |

***Note: PO5 (Justification):** In Unit No. 3 Computational Fluid Mechanics (CFD) is included which is an important tool can be used to calculate design mass-flow rates, pressure drops, heat transfer rates, fluid dynamic forces and also useful to final year students in their project work related with fluid flows.

**Course Content**

| Content | Hours |
|---|---|
| **Unit 1: Properties of Fluids and Fluid Statics**<br>**I. Properties of Fluids:** Definition of fluid, Properties of fluid with applications - Mass Density, Weight Density, Specific Volume, Specific Gravity, Viscosity, Surface Tension, Capillarity, Compressibility, vapor pressure and Mach Number, Types of fluid with examples.<br>**II. Fluid Statics:** Pascal's law and its applications, Hydrostatic law of pressure, Hydrostatic forces on the plane surfaces (Total Pressure), Centre of Pressure, Buoyancy, Stability of floating and submerged bodies, Metacenter, Metacentric Height and its application in shipping. (No Numerical Treatment on fluid Statics). | 7 |

| Content | Hours |
|---|---|
| **Unit 2: Fluid Kinematics**<br>Types of fluid flow, Continuity equation, Flow visualization, Streamline, Path line, streak line, Stream tube, Continuity equation in Cartesian coordinates in three dimensional forms. Velocity and Acceleration of fluid particles, Rotational and Irrotational flow, Stream function and velocity potential function. Eulerian and Langragian approach of<br>fluid flow | 6 |
| **Unit 3: Governing equations in Fluid Dynamics**<br>Equations of Motion ,Euler's Equation of motion, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's Theorem, Applications of Bernoulli's theorem such as Venturimeter, orifice meter and Pitot tube, Kinetic Energy correction factor, Notch, Derivation of Flow over triangular and rectangular notches only, Orifice and its classification, Introduction of CFD & its applications. | 7 |
| **Unit 4: Momentum Equation and Laminar flow**<br>**I. Momentum Equation**: Derivation of momentum equation, Applications of momentum equation, momentum correction factor, Analysis of fluid flow through pipe bends.<br>**II. Laminar Flow:** Laminar flow through circular pipes, derivation of Hagen Poiseuille's equation and Laminar flow through parallel plates, Reynolds's Transport Theorem | 7 |
| **Unit 5: Flow through Pipes**<br>Different energy losses in flow through pipe, Losses due to friction: Darcy's Welsbach equation and Chezy's equation, Minor Losses due to expansion, contraction, pipe fittings, at entrance, at exit, due to obstruction etc. Flow through Series pipe, Parallel pipe, Siphon pipes, Branching pipes and equivalent pipes, Power transmission, Hydraulic Gradient line (HGL) and Total Energy Line (TEL), Moody's Diagram. | 7 |
| **Unit 6: Boundary Layer Theory and Forces on Immersed Bodies**<br>**I. Boundary Layer Theory:** Boundary layer thickness, its characteristics, laminar and turbulent boundary layers, Displacement thickness, Momentum thickness, Energy thickness, separation, boundary layer control, Introduction to Compressible flow.<br>**Forces on Immersed Bodies:** Lift and Drag, Drag on a flat plate and on aerofoil, Types of drags, Development of lift (Magnus effect) | 6 |

**Text Book:**

1. "Fluid Mechanics", R. K. Bansal, Laxmi publications. New Delhi, 2018.
2. "Fluid mechanics and Hydraulic Machines", Modi and Seth, 22nd Edition 2018.

**Reference Books:**

1. "Fluid Mechanics", V.L. Streeter and E.B. Wylie, Tata McGraw Hill Pvt. Ltd., New Delhi, 2017.
2. "Mechanics of Fluid", Merle C. Potter, Prentis Hallof India, New Delhi, 2nd Edition.
3. "Fluid Mechanics", Fox and McDonald, John Wiley and Sons, New York, 8th Edition.
4. "Fundamentals of Fluid Mechanics", B.R. Munson, D.F. Young, T. H. Okiishi Wiley India Pvt. Ltd.
5. "Fluid Mechanics and Machinery", C.S. Ojha, , Oxford University Press.

**Course Plan**

| **Course Title : Kinematics Mechanism and Machines** | |
|---|---|
| **Course Code : 201MEL203** | **Semester : III** |
| **Teaching Scheme : L-T-P : 3-0-0** | **Credits : 3** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**@ Theory paper of 04 (four hour) duration**

**Prerequisite:** Engineering Physics, Engineering mathematics, Fundamentals of Civil Engineering (Engineering Mechanics)

**Course Description:**

Kinematics and theory of Machines may be defined as that branch of Engineering-science, which deals with concepts of mechanisms, the study of relative motion between the various parts of a machine, and forces acting on them. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine.

**Course Objectives:**

1. To describe various terminology related to kinematics of mechanism
2. To develop competency in drawing velocity and acceleration diagram for mechanisms.
3. To discuss the effect of friction bearings, screw.
4. To study the different types of cam and follower motion and its selection for engineering application.
5. To study basics of power transmission devices
6. To study the different types of governors and its characteristics and turning diagram of flywheel

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C203.1 | Understand fundamental & various terminology associated with kinematics of mechanism and machine. |
| C203.2 | Prepare velocity and acceleration diagram for a given mechanism with graphical method. |
| C203.3 | Understand laws of friction and Power loss due to friction in bearings, screw |
| C203.4 | Prepare cam profile with respect follower motion for different application |
| C203.5 | Explain need and modes of power transmission and their engineering application. |
| C203.6 | Explain the different types of governors and turning moment diagram of flywheel. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome (POs) | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| C203.1 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| C203.2 | 3 | 3 | - | 1 | - | - | - | - | - | - | - | - | 1 | - | 3 |
| C203.3 | 1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| C203.4 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 3 |
| C203.5 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| C203.6 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |

**Course Content**

| Content | Hours |
|---|---|
| **Unit 1: Fundamentals of Mechanisms**<br>Link, Kinematic pair, Kinematic chain, Mechanism, Inversions, Types of constrained motions, Grubber's criterion, Grashof‟s criterion for mobility, Kutzbach criterion, Four barchain and its inversions, Slider crank chain and its inversions, Double slider crank chain and its inversions, Hooke's joint(only theoretical treatment). | 5 |
| **Unit 2: Velocity and Acceleration Analysis in Mechanism**<br>Graphical analysis of velocity and acceleration for different mechanisms using relative velocity and acceleration method, (Simple Problems), Klein's construction for slider crank mechanism, Instantaneous centre method (Up to 6 IC) | 10 |
| **Unit 3: Friction**<br>Introduction of friction, Friction in pivot bearings, Friction circle, friction in screw. | 5 |
| **Unit 4: Cams and Followers**<br>Types of cams and followers, Terminologies used ,profiles of cam for specified motion of the follower ,spring load on the follower , Jumping of follower | 8 |
| **Unit 5: Belts and Dynamometers**<br>Introduction, Type of belts, Slip and creep of belt, Tension ratio in belts, Initial tension, Open & cross belt drive, Length of belt, Power transmitted by belt, Introduction and types of dynamometer | 6 |

| | |
|---|---|
| **Unit 6: Governors and Flywheel**<br>Types of governors, Porter and Hartnell governor, Controlling force and stability of governor, Hunting, Sensitivity, Isochronism, Governor effort and power, Insensitiveness of governors.<br>**Flywheel:** Turning moment diagrams, Fluctuation of energy, Coefficient of fluctuation, of speed, Rimmed flywheel. | 6 |

**Text Book:**

1. "Theory of Machines", Rattan S.S, Tata McGraw Hill New Delhi, 5thKindle Edition.2019
2. "Theory of Machines", V.P. Singh, Dhanpat Rai and Sons. 6th Edition

**Reference Books:**

1. "Theory of Machines and Mechanism", Shigley, McGraw Hill, New York, 4 th Edition,2014
2. "Theory of Machines", Dr. R.K. Bansal, Laxmi Publication.
3. "Theory of Machines and Mechanism", G.S. Rao and R.V. Dukipatti, New Age, Delhi.
4. "Theory of Machines", P.L.Ballany, Khanna Publication, New Delhi, 3rd Edition.

## Course Plan

| **Course Title : Manufacturing Processes** | |
|---|---|
| **Course Code : 201MEL204** | **Semester : III** |
| **Teaching Scheme : L-T-P : 3-0-0** | **Credits : 3** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** Workshop Practice –I, Engineering Chemistry.

**Course Description:**

The course is meant as an introduction towards primary manufacturing processes such as casting, forming and welding. Further apply this knowledge to select appropriate method for manufacturing specific job.

**Course Objectives:**

**To**

1. Understand basic principal of metal casting, its types and moulding techniques.
2. Study various metal joining processes and classify them according to application
3. Study various metal forming processes and their applications
4. Introduction to powder metallurgy and polymer processing

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C204.1 | Interpret basic concepts of metal casting processes and solve numerical on gating system |
| C204.2 | Describe the fundamentals of metal joining processes & classify them |
| C204.3 | Demonstrate their understanding of metal forming processes |
| C204.4 | Explain powder metallurgy and various polymer processing techniques |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| **Course Outcomes (COs)** | **Program Outcome POs** | | | | | | | | | | | | **PSO** | | **BTL** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| **C204.1** | 3 | 2 | - | - | - | - | - | - | - | - | - | 1 | 1 | - | 3 |
| **C204.2** | 2 | - | - | - | - | - | - | - | - | - | | 1 | 1 | - | 2 |
| **C204.3** | 2 | - | - | - | - | - | - | - | - | - | | 1 | 1 | - | 2 |
| **C204.4** | 2 | - | - | - | - | - | - | - | - | - | | 1 | 1 | - | 2 |

## Course Content

| Content | Hours |
|---|---|
| **Unit 1:Metal Casting**<br>Introduction to Manufacturing Processes, Classification of Manufacturing Processes, Importance of casting as manufacturing Process, advantages and disadvantages of Casting processes, Pattern, Types of patterns and cores and core boxes, materials used and selection criteria for pattern making, pattern allowances. Components of gating system, functions and importance of runners and risers, solidification control devices: chills, ceramics bricks, directional solidification. **Numerical on casting gating system**. Types of Moulding and core making sands and their properties, Green sand, shell sand CO2 sand, oil sand, Cold box process. Moulding machines and core making machines. | 9 |
| **Unit 2:Melting Practice and Special Casting Processes**<br>Types of melting furnaces-Cupola furnace, oil/gas fired furnaces, crucible furnaces, Electrical furnaces, Rotary furnaces, etc. Furnace selection criteria their applications and melting practice on different furnaces. Metal pouring equipment's, Cleaning-fettling of castings. Casting defects, their causes and remedies. Inspection of casting. Investment casting, Continuous casting, Gravity die casting, pressure die-casting, Centrifugal casting, Vacuum die casting, Squeeze casting. | 8 |
| **Unit 3:Polymer Processing**<br>Thermosetting and thermoplastic materials, their properties and applications, Introduction to blow moulding, injection moulding, extrusion, calendaring and thermo forming. | 4 |
| **Unit 4:Metal Joining Processes**<br>Welding processes:- Overview and classification of welding processes<br>Fusion welding<br>Oxy fuel gas welding Arc welding- Theory, TIG, MIG, SMAW& SAW.<br>Electric slag welding, Thermit welding,<br>Pressure welding<br>Resistance welding: Spot & Seam welding, Friction welding, Ultrasonic Welding, Brazing, Soldering &Polymer joining processes | 7 |

| | |
|---|---|
| **Unit 5: Metal Forming Processes**<br>a) Rolling: Introduction, Hot and cold rolling, Rolling Mill Classification, Defects in rolling.<br>b) Forging: Introduction, Forging Machines (board Hammer, Air and Steam, Hydraulic<br>Hammer), Open and Closed die Forging, Defects in forging.<br>c) Extrusion: Introduction, Direct, Indirect, Tube, Impact and Hydraulic Extrusion, Defects in extrusion.<br>d) Drawing: Introduction and Types of Wire, rod and pipe drawing, defects in drawing. | 10 |
| **Unit 6: Powder Processing**<br>a) Advantages, Limitations and Applications of Powder Metallurgy<br>b) Powder manufacturing types- Mechanical, Physical, Chemical and Electro-Chemical<br>c) Mixing/ Blending.<br>d) Compaction- types- Conventional, Isostatic, HERF, Powder rolling and extrusion<br>e) Sintering- Types liquid stage and solid stage sintering<br>f) Finishing operations: Sizing, Machining, Infiltration and Impregnation<br>g) Flowcharts for – Self-lubricating bearings. | 4 |

**Text Book:**

1. P. N. Rao, "Manufacturing Technology- Foundry, Forming and Welding", Vol. I, Tata McGraw-Hill, N 3rd edition, 2009.
2. P. C. Sharma, "A Textbook of Production Technology (Manufacturing Processes)", S. Chand & Company, 2006

.**Reference Books:**

1. Material science and metallurgy for engineers", V. D. Kodgire, Everest Publishers Pune, 12th Edition.
2. P. L. Jain, "Principles of Foundry Technology", Tata McGraw-Hill, New Delhi, 2nd Edition, 2006.
3. O. P. Khanna, Foundry technology, Khanna Publishers, New Delhi.
4. Sindo Kou Welding Metallurgy, 3rd Edition Willey- Blackwell Publication.
5. ASTM Volumes on Welding, casting, forming and material selection

**Course Plan**

| **Course Title : Applied Thermodynamics** | |
|---|---|
| **Course Code : 201MEL205** | **Semester : III** |
| **Teaching Scheme : L-T-P : 3-0-0** | **Credits : 3** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** 1. Applied Physics, 2. Applied Chemistry, 3. Basic thermodynamics

**Course Description:**

This course deals with the relationship between heat, work, and systems that analyse energy processes. Laws of thermodynamics and their corollaries. Properties of pure substance and vapour power cycle. Also study of steam condenser, nozzle, Impulse and Reaction turbine

**Course Objectives:**

1. To learn the First and Second Laws of Thermodynamics to understand the factors affecting the efficiency of thermal system.
2. To explain the thermodynamic properties of pure substances using tables, charts, and ideal gas law and apply them to thermodynamic analysis of a system
3. To learn fundamental concepts of classical thermodynamics and how to use them for solving real world thermal systems and engineering problems.
4. To learn various important vapor power cycles such as Rankine and Carnot cycle.
5.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C205.1 | Conceive and relate thermodynamic problems based on their fundamental knowledge and express them in mathematical terms |
| C205.2 | Analyze a thermodynamic steam cycles and understand them in the working of boilers and condensers. |
| C205.3 | Apply knowledge of thermodynamics concepts to understand the working heat pumps, refrigerator, entropy etc. |
| C205.4 | Apply knowledge of thermodynamics concepts to solve numerical problems using steam tables. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C205.1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| **C205.2** | 3 | 2 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **C205.3** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **C205.4** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 3 |

**Note: (PO6 Justification):** Industrial visit on boiler safety and performance to achieve PO6.
(Questionnaire will be provided to students after visit to evaluate PO6)

**Course Content**

| Content | Hours |
|---|---|
| **Unit 1: Review of laws of thermodynamics**<br>Zeroth law, first law & Second law of thermodynamics, Equivalence & Corollaries of Second Law, Numerical treatment on second law. (Numerical treatment on process only). Clausius inequality, entropy as a property of system, entropy of pure substance. T-s and h-s planes, entropy<br>change in a reversible and irreversible processes, increase of entropy principle | 7 |
| **Unit 2: Properties of Pure Substances and vapour power cycle**<br>Properties of steam, use of steam table and Mollier chart, T-S diagram Carnot cycle using steam, limitations of Carnot cycle, Rankine cycle, representation on P-V, T-s and h-s planes. Thermal efficiency, specific steam consumption. Work ratio, effect of steam supply pressure and temperature, condenser pressure on the performance. (Numerical) Reheat and<br>regenerative steam power cycle | 6 |
| **Unit 3: Steam condensers**<br>Functions, elements of condensing plant, types of steam condensers, surface and jet condensers, comparison, vacuum efficiency, condenser efficiency, loss of vacuum, sources of air leakages, methods of leak detection, air extraction methods, estimation of cooling water required, (Numericals on steam condenser.) | 6 |
| **Unit 4: Steam Nozzles**<br>Functions, shapes, critical pressure ratio, Maximum discharge condition, effect of friction, design of throat and exit areas, nozzle efficiency, velocity coefficient, coefficient of discharge, Supersaturated flow, degree of under-cooling and degree of super saturation, effects of super saturation. | 6 |

| | |
|---|---|
| **Unit 5: Impulse Turbine**<br>Principles of operation, classification, impulse and reaction steam turbine, Compounding of steam turbines. Flow through impulse turbine blades, velocity diagrams, work done, efficiencies, end thrust, blade friction, influence of ratio of blade speed to steam speed on efficiency of Single and multistage turbines and its condition curve and reheat factors. Numericals | 8 |
| **Unit 6: Reaction Turbines**<br>Flow through impulse reaction blades, velocity diagram, degree of reaction, Parson's reaction turbine, and backpressure and pass out turbine. Losses in steam turbines, performance of steam turbines. Function of diaphragm, glands, turbine troubles like erosion, corrosion, vibration, fouling etc. Governing of steam turbines Reheat regenerative steam power cycles. Numericals | 7 |

**Text Book:**

1. Engineering thermodynamics by P. K. Nag. Tata McGraw Hill, New Delhi, 4th Edition
2. Thermal Engineering R. K. Rajput , Laxmi Publications 3rd Edition

**Reference Books:**

1. "Thermal Engineering", M.M Rathod, Tata McGraw Hill Education Pvt. Ltd, 1stEdition, 2010.
2. R. Yadav, Steam & Gas Turbines CPH Allahabad

**Course Plan**

| **Course Title : Fluid Mechanics Lab** | |
|---|---|
| **Course Code : 201MEP206** | **Semester : III** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | **ESE(POE) Marks : 25** |

**Course Description:** This course will provide the student with a basic understanding of fluid properties, fluid statics and dynamics, and fluid flow.

**Course Objectives:**

1. To introduce the students about various properties of fluid and pressure measuring devices.
2. To study basic concepts of fluid statics, buoyancy, floating and submerged bodies and its applications
3. To study physical significance of fluid kinematics, fluid dynamics and it‟s applications.
4. To understand the different form of governing equation related to fluid flow.
5. To analyze and evaluate fluid mechanics systems by applying principles of Physics, mathematics, science and engineering.
6. To develop skills in the analysis of fluid systems for lifelong learning.

.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C206.1 | Explain fundamentals of fluid properties, pressure measurement and fluid statics |
| C206.2 | Identify the fluid flow problem and explain the theoretical concepts of fluid statics, fluid kinematics and fluid dynamics. |
| C206.3 | Apply governing equation Bernoulli's Equation and applications of fluid momentum mechanics equation i.e. for Continuity equation, different fluid flow |
| C206.4 | Apply momentum equation and make basic analysis of laminar flow to calculate the energy losses. |
| C206.5 | Analyze the energy losses in fluid flow systems. |
| C206.6 | Apply theory of boundary layer, Drag and lift forces in proper cases and concept of compressible flow. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C206.1** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | 2 |
| **C206.2** | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 2 |
| **C206.3** | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 3 |
| **C206.4** | 3 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | 3 |
| **C206.5** | 3 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | 4 |
| **C206.6** | 3 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | 3 |

***Note: PO5 (Justification):** Experiment No. 9 Case study on Computational Fluid Mechanics (CFD) is included in which students can calculate design mass-flow rates, pressure drops, heat transfer rates, fluid dynamic forces for particular Cases and in final year students can apply their knowledge related with CFD in their project work related with fluid flows

| List of Assignments / Experiments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments / Experiments** | **Type** | **Hrs.** |
| 1 | Study and demonstration of Pressure Measuring Devices (Compulsory) | S | 2 |
| 2 | I. Theoretical assignment of Dimensional analysis which may include procedure and Numerical on Rayleigh's method<br>II. Buckingham π theorem. (Compulsory) | S | 4 |
| 3 | Flow visualization by plotting of streamlines (Heleshaw's apparatus). | S/O | 2 |
| 4 | Reynolds experiment | S/O | 2 |
| 5 | Verification of Bernoulli's equation | S/O | 2 |
| 6 | Calibration of Orifice meter | S/O | 2 |
| 7 | Calibration of venture meter | S/O | 2 |
| 8 | Calibration of notches | S/O | 2 |
| 9 | Determination of coefficient of friction in pipes of different sizes | S/O | 2 |
| 10 | Determination of minor losses in pipes-fittings | S/O | 2 |
| 11 | Case study on CFD | S/O | 2 |

***Note- Minimum 10 Experiment / Assignments should be conducted covering all units**

❖ **S-STUDY, O-OPERATIONAL**

**Text Book:**

1. "Fluid Mechanics", R. K. Bansal, Laxmi publications. New Delhi, 2018.
2. "Fluid mechanics and Hydraulic Machines", Modi and Seth, 22nd Edition 2018.

**Reference Books:**

1. "Fluid Mechanics", V.L. Streeter and E.B. Wylie, Tata McGraw Hill Pvt Ltd., New Delhi, 2017.
2. "Mechanics of Fluid", Merle C. Potter, Prentis HallofIndia, New Delhi, 2nd Edition.
3. "Fluid Mechanics", Fox and McDonald, John Wiley and Sons, New York, 8th Edition.
4. "Fundamentals of Fluid Mechanics", B.R. Munson, D.F. Young, T. H. Okiishi Wiley IndiaPvt. Ltd.
5. "Fluid Mechanics and Machinery", C.S. Ojha,, Oxford University Press.

**Course Plan**

| **Course Title : Kinematics Mechanism and Machines Lab** | |
|---|---|
| **Course Code : 201MEP207** | **Semester : III** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | |

**Course Description:**

Kinematics and theory of Machines may be defined as that branch of Engineering-science, which deals with concepts of mechanisms, the study of relative motion between the various parts of a machine, and forces acting on them. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine.

**Course Objectives:**

1. To describe various terminology related to kinematics of mechanism
2. To develop competency in drawing velocity and acceleration diagram for mechanisms.
3. To study the different types of cam and follower motion and its selection for engineering application.
4. To study basics of power transmission devices
5. To study the different types of governors and its characteristics and turning moment diagram of flywheel

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C207.1 | Understand fundamental & various terminology associated with kinematics of mechanism and machine. |
| C207.2 | Prepare velocity and acceleration diagram for a given mechanism with graphical method. |
| C207.3 | Prepare cam profile with respect follower motion for different application |
| C207.4 | Explain need and modes of power transmission and their engineering application. |
| C207.5 | Explain the different types of governors and turning moment diagram of flywheel. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| **Course Outcomes (COs) /** | **Program Outcome POs** | | | | | | | | | | | | **PSO** | | **BTL** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| **C207.1** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **C207.2** | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 1 | - | 3 |
| **C207.3** | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | - | 3 |
| **C207.4** | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **C207.5** | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |

**List of Assignments**

| Sr. No. | Name of Assignments | Type | Hrs. |
|---|---|---|---|
| 1 | An assignment on basic concepts to mechanism(demonstration of models , different mechanism) | S | 2 |
| 2 | Draw velocity problems on A3 size drawing by relative velocity method (minimum 3 problems) | D | 2 |
| 3 | Draw velocity problems on A3 size drawing by<br>I. Klein's method (minimum 2 problems for each case)<br>II. Instantaneous method (minimum 2 problems for each case) | D | 4 |
| 4 | Draw acceleration problems on A3 size drawing by relative acceleration component method (minimum 3 problems)<br>I. Basic Numerical 2-Problem on acceleration<br>II. Advance Numerical 2-Problem on acceleration | D | 4 |
| 5 | Verification of ratio of angular velocities of the shafts connected by Hooke's Joint | O | 2 |
| 6 | Experiment on cam profile and drawing of problems on cam profile on A3 size drawing sheet | O | 2 |
| 7 | Study of turning moment diagram of flywheel | S | 2 |
| 8 | An Experiment on study of governor characteristics for Porter or Hartnell governor | O | 2 |
| 9 | An experiment on study of belt drive | O | 2 |
| 10 | An experiment on study of dynamometer | O | 2 |

❖ **S-STUDY, O-OPERATIONAL D-DRAWING SHEETS**

❖ **Text Book:**

1. "Theory of Machines", Rattan S.S, Tata McGraw Hill New Delhi, 5thKindle Edition.2019
2. "Theory of Machines", V.P. Singh, DhanpatRai and Sons. 6 th Edition

**Reference Books:**

1. "Theory of Machines and Mechanism", Shigley, McGraw Hill, New York, 4 th Edition,2014
2. "Theory of Machines", Dr. R.K. Bansal, Laxmi Publication.
3. "Theory of Machines and Mechanism", G.S. Rao and R.V. Dukipatti, New Age, Delhi.
4. "Theory of Machines", P. L. Ballany, Khanna Publication, New Delhi, 3rd Edition.

**Course Plan**

| **Course Title : Applied Thermodynamics Lab** | |
|---|---|
| **Course Code :201MEP208** | **Semester : III** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | **ESE(POE) Marks : 25** |

**Course Description:**

This course deals with the study and demonstration of water tube and fire tube boilers, boiler mountings, accessories and steam calorimeters, condenser and cooling towers. It also focus on lubrication properties and trials are conducted on grease penetrometer and dropping point apparatus, Red wood viscometer and, aniline point apparatus, flash and fire point of a lubricating oil.

**Course Objectives:**

1. To learn the First and Second Laws of Thermodynamics to understand the factors affecting the efficiency of thermal system.
2. To explain the thermodynamic properties of pure substances using tables, charts, and ideal gas law and apply them to thermodynamic analysis of a system
3. To learn fundamental concepts of classical thermodynamics and how to use them for solving real world thermal systems and engineering problems.
4. To learn various important vapor power cycles such as Rankine and Carnot cycle.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C208.1 | Conceive and relate thermodynamic problems based on their fundamental knowledge and express them in mathematical terms. |
| C208.2 | Analyze a thermodynamic steam cycles and understand them in the working of boilers and condensers. |
| C208.3 | Apply knowledge of thermodynamics concepts to understand the working heat pumps, refrigerator, entropy etc. |
| C208.4 | Apply knowledge of thermodynamics concepts to solve numerical problems using steam tables. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| **Course Outcomes (COs)** | **Program Outcome POs** | | | | | | | | | | | | **PSO** | | **BTL** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| **C208.1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| **C208.2** | 3 | 2 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **C208.3** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **C208.4** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 3 |

| List of Assignments / Experiments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments / Experiments** | **Type** | **Hrs.** |
| 1 | I. Study and demonstration of water tube.<br>II. Study and demonstration of fire tube boilers. | S | 4 |
| 2 | I. Study and demonstration of boiler mountings.<br>II. Study and demonstration of accessories and steam calorimeters. | S | 4 |
| 3 | Study and demonstration of condenser and cooling towers. | S | 2 |
| 4 | Study Significance and relevance of lubrication properties and system. | S | 2 |
| 5 | Test on grease penetrometer and dropping point apparatus. | O | 2 |
| 6 | Test on Red wood viscometer and, aniline point apparatus. | O | 2 |
| 7 | Test on Determination of flash and fire point of a lubricating oil. | O | 2 |
| 8 | Study of steam power plant. | S | 2 |
| 9 | Boiler safety and performance checking- Industrial visit | S | 2 |
| 10. | Industrial visit to Steam Power Plant. | S | 2 |

**Note:** Industrial visit on boiler safety and performance to achieve PO6. (Questionnaire will be provided to students after visit to evaluate PO6)

❖ **S-STUDY, O-OPERATIONAL**

**Text Book:**

1. Engineering thermodynamics by P. K. Nag. Tata McGraw Hill, New Delhi, 4th Edition
2. Thermal Engineering R. K. Rajput , Laxmi Publications 3rd Edition

**Reference Books:**

1. "Thermal Engineering", M.M Rathod, Tata McGraw Hill Education Pvt. Ltd, 1stEdition, 2010.
2. R. Yadav, Steam & Gas Turbines CPH Allahabad

## Course Plan

| Course Title : Workshop Practice –II Lab | |
|---|---|
| Course Code : 201MEP209 | Semester : III |
| Teaching Scheme : L-T-P : 0-0-2 | Credits : 1 |
| Evaluation Scheme : ISE Marks :25 | ESE(POE) Marks : 25 |

**Course Description:**

Workshop (Shop floor) is the place where engineering components are fabricated and manufactured. This course has great significance to acquire knowledge and hands on practice to use various hand tools and basic operations in engineering field. This course includes demonstration and experiments based on Welding, sand testing, Pattern making, mould making, and basic machining operations.

**Course objectives:**

1. To study different sand testing parameter.
2. To develop and utilize skills in pattern making, mould making and casting.
3. To study basic machining operation on lathe and drilling machine.
4. To utilize skills in spot welding.

**Course outcomes:**

At the end of course, students will able to**,**

| | |
|---|---|
| C209.1 | Measure sand testing parameter. |
| C209.2 | Construct pattern and mould for solid casting. |
| C209.3 | Perform basic machining operation on lathe and drilling machine. |
| C209.4 | Demonstrate spot welding operation. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| C209.1 | 2 | - | - | - | - | | - | - | - | - | - | - | - | - | 3 |
| C209.2 | 2 | - | 2 | - | - | - | - | - | - | - | - | - | 1 | - | 3 |
| C209.3 | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 3 |
| C209.4 | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 3 |

| List of Job/Activity | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Job/Activity** | **Type** | **Hrs** |
| 1 | Sand testing for green sand and core sand. (Any four test)<br>• Size analysis. Grain fineness Number<br>• Moisture percentage<br>• Permeability Test | S/O | 4 |
| 2 | Sand testing for green sand and core sand. (Any four test)<br>• Green Compressive strength<br>• Clay content<br>• Mould hardness | S/O | 4 |
| 3 | Design & Preparation of Pattern for solid casting<br>• Design calculation | S/O | 2 |
| 4 | Design & Preparation of Pattern for solid casting<br>• Rough wooden solid pattern | S/O | 2 |
| 5 | Design & Preparation of Pattern for solid casting<br>• Finish solid pattern | S/O | 2 |
| 6 | Design & Preparation of Pattern for solid casting<br>• Assembly of solid pattern | S/O | 2 |
| 7 | Mould making and actual casting of aluminum component<br>• Making gating system | S/O | 2 |
| 8 | Mould making and actual casting of aluminum component<br>• Melting & casting | S/O | 2 |
| 9 | Introduction to Machining:-<br>• Job on turning, facing, chamfering on Lathe | S/O | 2 |
| 10 | Introduction to Machining:-<br>• Job on drilling and tapping on Drilling Machine | S/O | 2 |
| 11 | Job on Spot Welding | S/O | 2 |

| | | | |
|---|---|---|---|
| 12 | Industrial visit to Foundry/Rolling/ forging /Plastic Industry (at least one) | S | 2 |

***Note-**Minimum Ten experiments/assignments from the above list should be performed.

❖ **S-STUDY, O-OPERATIONAL**

Term work will consist of Job on Welding, Pattern Making, Mould making, Lathe & Drilling total (15) Marks, Journal Assessment along with internal oral 10 marks.

**Note: - The Practical's should be conducted by manufacturing processes faculty.**

**Text Book:**

1. Manufacturing Technology - Vol. 1 by P. N. Rao 2017.
2. R. Singh, Introduction to basic manufacturing Process and technology, New Age International Publication , 2007

**Reference Books:**

1. Chapman, Workshop Technology, Vol – I , The English Language Book Society, Edition 2
2. Hajra, Choudhary S. K., Elements of Workshop Technology, Vol-1, New Media Publication, 2008.
3. Hajra, Choudhary S. K., Elements of Workshop Technology, Vol-2, New Media Publication, 2010.

**Course Plan**

| **Course Title : Computer Programming Lab** | |
|---|---|
| **Course Code : 201MEP210** | **Semester : III** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | |

**Pre-requisites:** Basic Electronics and Computer Programming in 'C'

**Course Description:**

This subject exposes the learner to the various typical object oriented concepts like, classes, objects, inheritance, Operator Overloading etc. It also makes the reader realize the advantages of advanced object oriented Programming Methodology over the conventional procedural programming methodology. This course encourages students to solve real life problems by designing and developing real time application using advanced programming language.

**Course Objectives:**

1. To develop and enhance the programming skills amongst the students in general as well as application of it in the field of Mechanical Engineering
2. To introduce an object oriented programming language
3. To read and write simple Python programs
4. To develop Python programs with conditionals and loops

**Course Outcomes:**

After completion of the course, the student should be able to

| | |
|---|---|
| C210.1 | Apply their knowledge and programming skills to solve various computing problems in the field of Mechanical Engineering |
| C210.2 | Understand C++ application to solve real time problems. |
| C210.3 | Read, write, execute by hand simple Python programs |
| C210.4 | Structure simple Python programs for solving problems |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C210.1** | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | 1 | - | 3 |
| **C210.2** | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | 1 | - | 2 |
| **C210.3** | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | 1 | - | 2 |
| **C210.4** | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | 1 | - | 2 |

***Note: PO5 (Justification):** Read, write and execute the program by using any advance software like Turbo CPP, Python to achieve PO5.

**Course Content**

| **Content (Assignments will based on following contents)** |
|---|
| **Unit 1: Object-Oriented programming**<br>Introduction, Basic concepts, Benefits, object oriented Languages, Applications, Difference between procedure and Object orientated programming |
| **Unit 2: Introduction to 'C++' programming**<br>Structure of a C++ program, Creating source file, Compilation and linking processes.<br>**Tokens, Expressions:** Basic Data types, Identifier, Variables, Constants, Operators, Formatted and console I/O, cin(), cout().<br>**Functions in C++:** Introduction, main function, function prototyping, call by reference and return by reference |
| **Unit 3: Classes & Objects**<br>Introduction, structures & classes, Declaration of class, Member functions; defining the object of a class; accessing a member of a class, Array of class objects, Constructor and Destructor |
| **Unit 4: Inheritance and polymorphism**<br>Inheritance: Types of Inheritance (With examples), Polymorphism, Types of Polymorphism (with Examples). |

| |
|---|
| **Unit 5: Introduction to Python**<br>Installation and Working with Python, Understanding Python variables Python basic Operators, Understanding python blocks, Python Data Types: Declaring and using Numeric data types: int, float, complex, Using string data type and string operations |
| **Unit 6: Control Flow Statements**<br>if, if-else loops, For loop using ranges, string, Use of while loops in python, Loop manipulation using pass, continue, break and else, Programming using Python conditional and loops block, Python arrays. |

| **List of Assignments** | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments** | **Type** | **Hrs.** |
| 1 | Assignment on concept of Object-Oriented programming | S | 2 |
| 2 | Assignment on concept of basics C++ Programming | S | 2 |
| 3 | Program on Input / Output and arithmetic expressions, Hierarchy of Operators, branching and loop control statements. | O | 4 |
| 4 | Program on Classes and Objects. | O | 2 |
| 5 | Program on Array of class objects | O | 2 |
| 6 | Program using inheritance | O | 2 |
| 7 | Program using polymorphism | O | 2 |
| 8 | Program on python using Statements and Expressions | O | 4 |
| 9 | Program on python using Control Flow Statements | O | 2 |
| 10 | Program on Python Functions | O | 2 |

❖ **S-STUDY, O-OPERATIONAL**

**Text Books:**

1. Object Oriented Programming, E. Balguruswami, Tata McGraw Hill Publication.
2. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

**Reference Books:**

1. The C++ Programming Language, Brian W. Kernighan, Dennis M. Ritchie, Prentice Hall
2. Let us C++, Yashwant Kanitkar, BPB Publication.
3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
4. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent

**Useful Links**

1. http://cse.iitkgp.ac.in/~rkumar/pds-vlab/
2. http://cse18-iiith.vlabs.ac.in/
3. https://nptel.ac.in/courses/106/101/106101208/#

**Course Plan**

| **Course Title : Machine Drawing** | |
|---|---|
| **Course Code : 201MEL211** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 2-0-0** | **Credits : 2** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**@ Theory paper of 04 (four hour) Durations**

**Prerequisite:** Engineering Graphics

**Course Description:**

This course is deals with an introduction to machine drawing. Topics covered include study and use of conventions of Bureau of Indian Standards, Limits fits and tolerances, Free hand sketching of machine components, Detail and Assembly Drawing.

**Course Objectives:**

1. **To make** the student familiar with Indian Standards for drawing.
2. **To develop** students to apply knowledge of different limits, fits and tolerances on assembly drawings
3. To **develop** students to apply knowledge of Geometrical Tolerances and surface roughness.
4. **To make** the student acquainted with standard machine parts and sub-assemblies readily available in market.
5. **To provide** sound knowledge of detailed drawing procedure.
6. **To provide** sound knowledge of assembly procedure.

**Course Outcomes (COs):** At the end of the course the student should able to:

| | |
|---|---|
| C211.1 | Recall Bureau of Indian Standards drawing conventions in drawings. |
| C211.2 | Generalize limits, fits and tolerances on assembly drawings. |
| C211.3 | Acquaint standard machine parts and sub-assemblies readily available in market. |
| C211.4 | Produce sketches of standard machine components, detail and assembly drawing. |
| C211.5 | Produce sketches of standard machine components with detailed drawing including tolerance. |
| C211.6 | Produce assembly drawing from given standard machine components. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| **Course Outcomes (COs)** | **Program Outcome POs** | | | | | | | | | | | | **PSO** | | **BTL** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| **C211.1** | 2 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 1 |
| **C211.2** | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 2 |
| **C211.3** | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **C211.4** | - | - | 2 | - | - | - | - | - | - | 1 | - | - | - | - | 3 |
| **C211.5** | - | - | 3 | - | - | - | - | - | - | 1 | - | - | 2 | - | 3 |
| **C211.6** | - | - | 3 | - | - | - | - | - | - | 1 | - | - | 2 | - | 3 |

## Course Content

| Content | Hours |
|---|---|
| **Unit 1:Study and use of B.I.S. (Bureau of Indian Standards) Conventions**<br>Significance and importance of BIS Conventions. Drawing sheet sizes and layout recommended by BIS. Conventions for Engineering Materials. Spur, helical and bevel gears. Worm and worm wheel. Rack and pinion. Type of helical coil, disc and leaf springs. Internal and external threads. Square on shaft. Splined shaft, diamond knurling, type of sections. BIS methods of linear and angular dimensioning. Symbolic representation of welds as per BIS. First angle method of projection is recommended by BIS. | 3 |
| **Unit 2: Limits fits and tolerances**<br>Significance of limit systems, terminology, types of fits, Recommendations and selections, Dimensional Tolerances, IT grades and fundamental deviation details, Hole-base and shaft - base system of tolerances, Values related to various manufacturing process. Maximum material condition and Minimum material principles. | 4 |
| **Unit 3: Geometrical Tolerances and surface roughness**<br>Geometric Tolerances, Nomenclature, Rules, Symbols, form and position, Representation of geometric tolerances on drawing. Giving Tolerances for individual dimensions on a detail drawing. Roughness Grades, Representation of Machining symbol along with surface roughness value, Study of industrial drawing based on geometrical and dimensional tolerance. Relation between surface finish, IT Grades & Manufacturing processes. | 6 |
| **Unit 4: Free hand sketching of machine components**<br>Flat and V-belt pulleys. Speed cone pulley. Standard pipe fittings. Various types of riveted joints, Knuckle joint, Muff coupling, Protected and unprotected flanged coupling, Universal coupling, Solid and bush bearing, Plummer block, Foot step bearing, fast and loose pulley. Types of keys. | 3 |
| **Unit 5: Detailed Drawing**<br>**A) Introduction of Fasteners –** Types of Nuts, Bolts, Washers, Split Pin, and Dowel pins, Rings.<br>**B) Detailed Drawing –**<br>Machine tool parts: Tool post. Tailstock, Machine vice. Chucks etc.<br>Engine parts: Stuffing box, Crosshead assembly. Piston & connecting rod etc. Miscellaneous parts: Valve assembly, Screw jack. Jigs & fixture, Pipe vice etc. Detailed drawing selected should include different types of sections. | 6 |

| | |
|---|---|
| **Unit 6: Assembly Drawing**<br>Machine tool parts: Tool post. Tailstock, Machine vice. Chucks etc.<br>Engine parts: Stuffing box, Crosshead assembly. Piston & connecting rod etc.<br>Miscellaneous parts: Valve assembly, Screw jack. Jigs & fixture, Pipe vice etc. Assembly selected should include different types of sections.<br>Study of assembled drawing for actual Industrial components. | 6 |

**Text Book:**

1. P. S. Gill, "Machine Drawing", S.K. Kataria and Sons, 2002.
2. N. D. Bhatt, "Machine Drawing", Charotor Publication House, 2001.

**Reference Books:**

1. P.S.G. Hand Book. P.S.G. College
2. I.S.:SP46 Engineering drawing practice for schools and colleges BIS Publication.
3. I.S.:696 Code of practice for general engineering drawings. BIS Publication.
4. I.S.:2709 Guide for selection of fits. BIS Publication.

**Course Plan**

| **Course Title : Strength of Materials** | |
|---|---|
| **Course Code : 201MEL212** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 3-1-0** | **Credits : 4** |
| **valuation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** Engineering Mechanics

**Course Description:**

This subject deals with concepts of stress and strain, their importance in engineering applications which is useful while studying kinematics of machines, dynamics of machines and design of mechanical elements.

**Course Objectives:**

1. To gain knowledge of different types of stresses, strains and deformation induced in mechanical components due to external loads.
2. To study shear force and bending moment distribution for different types of loads and support conditions.
3. To study the distribution of Bending & Shear stresses in mechanical elements.
4. To study the analytical and graphical method to solve the problems in principal planes and stresses.
5. To study the effect of component dimensions and shape on stresses and deformations.
6. To study the buckling, and strain energy effect in mechanical elements.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C212.1 | Explain the concepts of Stress, Strain and deformation in mechanical components. |
| C212.2 | Understand the concept of Torsion in shafts and Draw shear force and bending moment diagrams for various types of beams subjected to various loads and support conditions. |
| C212.3 | Compute bending and shear stresses in mechanical components. |
| C212.4 | Determine plane stress, principal stress, maximum shear stress and their orientations using analytical method and Mohr's circle. |
| C212.5 | Calculate the Slope and deflection in beams. |
| C212.6 | Describe buckling in columns and strain energy in beams subject to various types of loading. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| **Course Outcomes COs** | **Program Outcome POs** | | | | | | | | | | | | **PSO** | | **BTL** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| **C212.1** | 3 | 1 | - | - | - | - | - | - | 2 | - | - | - | - | 2 | 2 |
| **C212.2** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **C212.3** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **C212.4** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **C212.5** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **C212.6** | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |

## Course Content

| Content | Hours |
|---|---|
| **Unit 1: Stresses and Strains**<br>Concept of Stress (Normal & Shear Stress) and Strain (Linear, Lateral, Shear and Volumetric), True Stress Strain Curve, Hooke's Law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus, Inter-relationship between elastic constants, Factor of safety, Thermal Stress, deformation in varying sections, composite sections and principle of superposition. | 6 |
| **Unit 2: Torsion, Shear force and Bending moment diagrams**<br>**I. Torsion:** Introduction to Torsion, Basic assumptions, Torsion formula, Hollow and solid circular shafts, Polar moment of Inertia, Power transmitted and replacement of shafts.<br>**II. Shear Force and Bending Moment Diagrams:** Concept and definition of shear force and bending moment in determinate beams (Simply supported, cantilever and overhanging) due to concentrated, UDL,UVL and Couple | 8 |
| **Unit 3: Stresses in Beams**<br>**I. Bending Stresses:** Symmetric pure bending of beams, Flexure formula, moment of resistance of cross-sections, Determination of bending stress in rectangular ,circular, L, I and T sections **II. Shear Stresses:** Distribution of shear stresses in beams of various commonly used sections such as circular. I, T, and angles | 7 |
| **Unit 4: Principal Stresses**<br>Normal and shear stresses on any oblique planes, Concept of Principal planes, Expression for Principal stresses and maximum shear stress, Positions of principal planes and planes of maximum shear, Graphical solutions using Mohr"s circle of stresses, Theories of failure. | 8 |
| **Unit 5: Deflection of Beams**<br>Concept and definition, Slope and deflection by Double integration method and Areamoment method (Simply Supported Beam and Cantilever.) and conjugate beam method | 6 |
| **Unit 6: Columns and Energy methods**<br>**I. Columns:** Euler's formula for different end connections, Concept of equivalent length, Rankine formula.<br>**II. Energy Methods:** Concept of strain energy, Resilience, Proof resilience, Modulus of Resilience, derivation for deformation of axially loaded members under gradual, sudden and impact loads (including Numerical). | 5 |

| List of Assignments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments** | **Type** | **Hrs.** |
| 1 | Tensile Test of Mild Steel | O | 1 |
| 2 | Compression Test on Aluminum Column | O | 1 |
| 3 | Stresses and strains | S | 1 |
| 4 | Torsion (Problems based on industrial applications) | S | 1 |
| 5 | Shear force diagram & bending moment diagram | S | 2 |
| 6 | Bending stresses and shear stresses in beams. | S | 1 |
| 7 | Principal stresses (both analytical and graphical). | S | 2 |
| 8 | Deflection of beams | S | 1 |
| 9 | Columns | S | 1 |
| 10 | Strain Energy | S | 1 |

❖ **S-STUDY, O-OPERATIONAL**

**Text Book:**

1. "Strength of Materials", S. Ramamruthum, Dhanpat Rai and Sons, New Delhi.
2. "Strength of Materials", R. K. Bansal, Laxmi Publication, 4th Edition.

**Reference Books:**

1. "Strength of Materials", Beer and Johnson, CBS Publication.
2. "Strength of Materials", G.H. Rider, MacMillan India Ltd.
3. "Strength of Materials", Nag and Chanda, Willey India Publication.
4. "Advanced Mechanics of Materials", Boresi, Willey India Publication.
5. "Strength of Materials", Den Hartong, McGraw Hill Publication.
6. "Mechanical analysis and design", H. Burr and John Cheatam, PHI, New Delhi

## Course Plan

| **Course Title : Fluid and Turbo Machinery** | |
|---|---|
| **Course Code : 201MEL213** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 3-0-0** | **Credits : 3** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** Fluid Mechanics, Applied Thermodynamics.

**Course Description:**

This course is deals with the study of working principles of water turbines & its velocity triangles, design parameters related to Turbines. Similarly understand the concept of Centrifugal pumps, selection of centrifugal pumps, and use of pumps for various engineering application. Understand the working principles & concept Compressors, selection of Compressors for various engineering application. And study the working of Gas Turbines and Jet engine and know its various configurations he knowledge of these devices is necessary in all types of power plants.

**Course Objectives:**

1. To understand the working principles of Impulse and Reaction water turbines also to study its velocity triangles & design parameters related to Turbines
2. To understand the concept of Centrifugal pumps and its construction. To understand NPSH terms related to centrifugal pumps. To understand selection of centrifugal pumps for various Engineering application.
3. To understand the concept, working principles of Compressors. To understand various parameters related to Compressors. And understand selection of Compressors for various engineering application.
4. To understand the working of Gas Turbines and Jet engine and know its various configurations. To determine the efficiencies of gas turbines

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| **C213.1** | Understand & Apply working principle of Rotodyanamic machines |
| **C213.2** | Understand & Apply working principle of Centrifugal Pump |
| **C213.3** | Understand & Apply working principle of Compressors |
| **C213.4** | Understand & Apply working principle of Gas Turbines |
| **C213.5** | Analyze the machines to evaluate the performance |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C213.1** | 3 | 2 | 2 | - | - | - | - | - | 2 | - | - | - | - | 2 | 3 |
| **C213.2** | 3 | 2 | 2 | | - | - | - | - | 2 | - | - | - | - | 2 | 3 |
| **C213.3** | 3 | 2 | 2 | - | - | - | - | - | 2 | - | - | - | - | 2 | 3 |
| **C213.4** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **C213.5** | 3 | 2 | 2 | - | - | - | - | - | 2 | - | - | - | - | 2 | 3 |

***Note: PO9 (Justification):** Group of four students collectively take readings, observations, calculations on instrument from Fluid & Turbo Machinery Lab so that we can consider it as an indivisible and team work.

**Course Content**

| Content | Hours |
|---|---|
| **Unit 1: Impulse Water Turbines**<br>Euler's equation for work done in Rotodyanamic Machines classification of water turbines, Pelton wheel, its construction and working, velocity triangles, types. Pelton wheel design (bucket dimensions, Number of buckets, Jet diameter, Wheel diameter, Jet ratio, Speed ratio, Number of jets), Calculation of efficiency, Power, Discharge etc. Governing of Pelton wheel. Study and demonstration of Model & Testing, Unit quantities of Impulse Water turbine | 7 |
| **Unit 2: Reaction Water Turbines**<br>Principle of operation, Construction and working of Francis and Kaplan Turbine, Draft tube, Cavitation calculation of various efficiencies, Power, Discharge, Blade angles, Runner dimensions etc. Governing of Francis and Kaplan turbine. Draft tube-types and analysis. Study and demonstration of Model & Testing, Unit quantities of Reaction Water turbine | 7 |
| **Unit 3: Centrifugal Pumps**<br>Working principles, Construction, Types, Various heads, Multistage pumps, Velocity triangles, Minimum starting speed, Cavitation, Net positive suction head (NPSH). Efficiencies, Discharge, Blade angles, Head, Power required, Impeller dimensions etc. selection of manufacturing pump for different engineering application using manufacturing catalogue. Study and demonstration of Model & Testing, Unit quantities of pump | 6 |

| | |
|---|---|
| **Unit 4: Reciprocating Air Compressors**<br>Application of compressed air, classification of compressor, Reciprocating compressors, construction , Work input, Necessity of cooling , Isothermal efficiency, Heat rejected, Effect of clearance volume, Volumetric efficiency, Necessity of multistage, construction, Optimum intermediate pressure for minimum work required, After cooler. Calculation for capacity of compressor for different application | 8 |
| **Unit 5: Rotodyanamic Air Compressors**<br>Centrifugal compressor, velocity diagram. Theory of operation, losses, Adiabatic efficiency, Effect of compressibility, Diffuser, Prewhirl, Pressure coefficient, Slip factor, performance. Surging, Chocking, Stalling, Performance, Comparison with centrifugal. Introduction to Axial flow compressors, Roots blower and vane blower (Descriptive treatment) | 7 |
| **Unit 6: Gas Turbines**<br>Working principles, Applications, Open, Closed cycle and their comparison. Cycle modified to Regeneration, Reheat, and Intercooling performance. Calculation of gas turbine work ratio, Efficiency etc. Types of fuels for gas Turbine Introduction to Jet engine | 5 |

**Text Book:**

1. "Turbo machines", S.M. Yahya , Tata Mc Graw Hill , 2005
2. "Fans, compressor and turbine", S. M. Yahya, Tata Mc Graw Hill , 2005

**Reference Books:**

1. "Hydraulic Machines", V.P. Vasantdani, Khanna Publishers, 1996.
2. "Fluid flow machines", N.S. Govindrao, Tata McGraw-Hill, 1983.
3. "Steam and gas Turbines", R. Yadav, Central Publishing House, Allahabad, 6th Edition1997
4. "Fluid mechanics and hydraulic machines", Modi and Seth, Standard Book House, 2004
5. "Thermal Engineering", R K Rajput, Laxmi Publication.

## Course Plan

| **Course Title : Machine Tools and Processes** | |
|---|---|
| **Course Code : 201MEL214** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 3-0-0** | **Credits : 3** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** Basic Mechanical Engineering, Manufacturing Processes.

**Course Description:**

The Subject Machine tools and Processes is focused on the study of introduction to various types of metal cutting processes and machine tools. It includes the study of general purpose machine tools such as center lathe, capstan lathe, turret lathe, drilling, milling, planning- shaping machines along with their accessories and attachments. It also includes study of single point and multi-point cuttings tools along with thread and gear manufacturing process. Non-conventional machining processes along with the CNC Technology and tooling's are included.

This course intends to bring the competency in the students to identify and select a proper machine tools, proper cutting tools, types of operations, and use of accessories and attachments on the machine tools.

**Course Objectives:**

1. To introduce students to various metal removal processes and the machine tools.
2. To study tool geometry of single and multipoint cutting tools.
3. To provide students with knowledge of different types of Thread and Gear Manufacturing processes.
4. To make students aware of fundamental principles of Non-Conventional Machining and CNC technology.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C214.1 | Identify and explain the function of the basic components of machine tools and its accessories |
| C214.2 | Identify parameters of single and multipoint cutting tools. |
| C214.3 | To acquire the knowledge and demonstrate thread and gear manufacturing operations. |
| C214.4 | Understand and be in position to appreciate the merits of non –conventional machining and CNC technology and its applications in industries. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C214.1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 2 |
| **C214.2** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 2 |
| **C214.3** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | 3 |
| **C214.4** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |

**Course Content**

| Content | Hours |
|---|---|
| **Unit 1: Machine Tools for Metal Cutting I**<br>a) **Lathe**: Introduction, Working principle, types, specifications, principle parts, accessories, attachments, and various lathe operations, Calculations of Change gears for thread cutting.<br>b) **Capstan, turret lathe**: Principle parts, Working, Turret indexing mechanism, bar feeding mechanism, Comparison with centre lathe.<br>c) **Drilling & Boring Machines:** Classification of drilling machines, Construction And working of radial drilling machine, Various accessories and various operations. Introduction to boring machines, Types of boring machine, different operations. | 12 |
| **Unit 2: Machine Tools for Metal Cutting II**<br>a) **Shaping & Planning Machine:** Construction & working of shaper and Planer machine, Comparison between planer and shaper machine.<br>b) **Milling Machine:** Types- Horizontal, Vertical milling machines, Milling cutters, construction and working of column and knee type, milling operations, simple and compound indexing. | 7 |
| **Unit 3: Tool Geometry**<br>Tool geometry parts, angles and types of single point cutting tools, tool geometry of single point cutting tools, geometry of multipoint cutting tools –drills, milling cutters, reamers. | 4 |
| **Unit 4: Gear Manufacturing and Thread Manufacturing processes**<br>a) **Gear Manufacturing Processes:** Study of various processes like gear shaping, gear hobbling, Gear finishing processes –Gear shaving, Gear burnishing and gear rolling.<br>b)**Thread Manufacturing Processes:** Study of various processes like thread casting, thread chasing, thread rolling, die threading and tapping, thread milling, thread grinding. | 8 |

| | |
|---|---|
| **Unit 5: Nonconventional Machining**<br>Fundamental principle, machining unit, tool material, advantages, limitations and applications of Abrasive Jet Machining, Electrical Discharge machining, Electro- Chemical machining, Laser beam machining, Ultrasonic machining, Water jet machining. | 4 |
| **Unit 6: CNC technology and Tooling**<br>Introduction, construction and working of CNC, DNC and machining centre. CNC axes and drives. Automatic tool Changer (ATC) and Automatic Pallet Changer (APC).New trends in tool materials, turning tool geometry, tool inserts (coated and uncoated),Tool presetting etc. | 5 |

**Text Book:**

1. "A Text Book of Production Technology (Manufacturing Processes)", P.C. Sharma, S. Chand and Company Pvt. Ltd, New Delhi.7th Edition, 2010.
2. "Workshop Technology vol. II", B.S. Raghuvanshi, Dhanpat Rai Publications Pvt. Ltd, New Delhi.10th Edition, 2000

**Reference Books**:

1. "Machine Tools and Manufacturing Technology", Steve F. Krar, Mario Rapisarda, Albert F.
2. HMT Hand book- Production Technology Roy A. & Linberg- "Processes and materials of manufacturing", Prentice Hall of India Delhi.
3. Campbell J.S.: Principles of manufacturing Materials and Processes, McGraw-Hill, New York.
4. "Production technology", R. K. Jain, Khanna Publishers, Delhi, 15th Edition, 2000.
5. "Workshop Technology vol. II", W. A. J. Chapman, Viva Books Pvt. Ltd, New Delhi, 1st Edition, 2001.
6. "Elements of Workshop Technology vol.I& II", S.K. Hajra Choudhury and A.K. Hajra Choudhury , Media promoters and Publishers Pvt. Ltd, New Delhi, 13thEdition,2012.
7. "A Textbook of Manufacturing Technology (Manufacturing Processes)", R.K. Rajput, Laxmi Publications Pvt. Ltd, New Delhi. Edition, 2007

**Useful Links**

1. https://nptel.ac.in/course.html
2. https://nptel.ac.in/courses/112/107/112107219/
3. https://nptel.ac.in/courses/112/104/112104195/
4. https://nptel.ac.in/courses/112/105/112105127/
5. https://nptel.ac.in/courses/112/105/112105211/
6. https://nptel.ac.in/courses/112/105/112105212/

**Course Plan**

| **Course Title : Theory of Machines** | |
|---|---|
| **Course Code : 201MEL215** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 3-0-0** | **Credits : 3** |
| **Evaluation Scheme : ISE + MSE Marks : 20 + 30** | **ESE Marks : 50** |

**Prerequisite:** Engineering Physics, Engineering mathematics, Fundamentals of Civil Engineering (Engineering Mechanics)

**Course Description:**

This course is deals with an introduction to gear geometry, types of gear teeth profile and phenomena of interference. Other topics covered include types of gear trains, Inertia forces and torques in mechanisms, balancing of rotary and reciprocating masses along with multi-cylinder in- line engines radial and V- engines, effect of gyroscopic couple in machinery, Free and forced vibrations of one-degree of freedom systems with and without viscous damping.

**Course Objectives:**

**1 .To describe** basic gear geometry, gear profile and theory of gearing
**2. To study** the various types of gear trains used for transmission of motion and power.
**3 .To study** the gyroscopic effects on vehicles, aero plane, ship, four wheeler and two wheeler
**4. To study** the problems on velocity and acceleration of slider crank mechanism analytically.
**5. To study** static and dynamic balancing of rotary and reciprocating masses
**6. To study** basic concepts of vibration analysis

**Course Outcomes (COs):**

At the end of the course the student should able to:

| | |
|---|---|
| C215.1 | **Understand** various terminology associated with gear. |
| C215.2 | **Identify** various terminology related to gear train. |
| C215.3 | **Understand** the gyroscopic effects on vehicles, aeroplane, ship, four wheeler and two wheeler. |
| C215.4 | **Solve** the problems on velocity and acceleration of slider crank mechanism analytically. |
| C215.5 | **Understand** the static and dynamic balancing of rotary and reciprocating masses. |
| C215.6 | **Apply** the basic concepts of vibration analysis. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| C215.1 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 2 |
| C215.2 | 2 | 2 | - | | - | - | - | - | - | - | - | - | 1 | - | 2 |
| C215.3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| C215.4 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| C215.5 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| C215.6 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |

**Course Content**

| Content | Hours |
|---|---|
| **Unit 1:Toothed Gearing**<br>Geometry of motion, Gear geometry, Types of gear profile- Involute & cycloid, Theory of Spur gear, Interference in Involute tooth gears and methods for its prevention, Path of contact, Contact ratio. | 7 |
| **Unit 2: Gear Trains**<br>Types of Gear trains - Simple, Compound, Reverted, Epicyclic gear train, Tabular method for finding the speeds of elements in epicyclic gear train, Torque in epicyclic gear train, Differential gear box(theoretical gearing). | 7 |
| **Unit 3:Gyroscope**<br>Gyroscopic couple, spinning and precessional Motion, Gyroscopic couple and its effect on i) Aero plane ii) Ship iii) Four-Wheeler iv) Two –Wheeler. | 6 |
| **Unit 4:Static and dynamic Force analysis of Mechanisms**<br>Velocity and acceleration of slider crank mechanism by analytical method, Inertia force and torque, D'Alembert's principle, Dynamically equivalent system, force analysis of reciprocating engine mechanism and four bar chain mechanism. | 6 |
| **Unit 5:Balancing**<br>Static and dynamic balancing of rotary and reciprocating masses, primary and secondary forces and couples. direct and reverse cranks, balancing of single cylinder, multi cylinder, in-line and radial engines for four wheeler | 7 |

| | |
|---|---|
| **Unit 6:Mechanical Vibration**<br>Basic concepts and definitions, types of vibrations, equivalent springs, equation of motion, types of damping, SDOF free vibrations with and without damping, logarithmic decrement. SDOF forced vibrations with and without damping, magnification factor, frequency response curves, vibration isolation and transmissibility | 7 |

**Text Book:**

1. "Theory of Machines", Rattan S.S, Tata McGraw Hill New Delhi, 5th Kindle Edition.2019
2. "Mechanical Vibrations „by Grover G.K., Nemchand Publications

**Reference Books:**

1. "Mechanisms and Dynamics of Machinery", Hamilton H Mabie and Charles F Reinholtz, (1987) Fourth Edition, John-Wiley and Sons, Inc., New York.
2. "Theory of Vibration with applications", William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan, (2004) Fifth Edition, Pearson Education Publishers.
3. "Theory of Machines and Mechanism", Shigley, McGraw Hill, New York, 4thEdition,2014
4. "Theory of Machines", P.L.Ballany, Khanna Publication, New Delhi, 3rd Edition.

**Course Plan**

| **Course Title : Machine Drawing Lab** | |
|---|---|
| **Course Code : 201MEP216** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | |

**Course Description**

This course is deals with an introduction to machine drawing. Topics covered include study and use of conventions of Bureau of Indian Standards, Limits fits and tolerances, Free hand sketching of machine components, Detail and Assembly Drawing.

**Course Objectives**

1. To make the student familiar with Indian Standards for drawing.
2. To develop students to apply knowledge of different limits, fits and tolerances on assembly drawings
3. To develop students to apply knowledge of Geometrical Tolerances and surface roughness.
4. To make the student acquainted with standard machine parts and sub-assemblies readily available in market.
5. To provide sound knowledge of detailed drawing procedure.
6. To provide sound knowledge of assembly procedure.

**Course Outcomes (COs)**

At the end of the course the student should

| | |
|---|---|
| C216.1 | Recall Bureau of Indian Standards drawing conventions in drawings. |
| C216.2 | Generalize limits, fits and tolerances on assembly drawings. |
| C216.3 | Acquaint standard machine parts and sub-assemblies readily available in market. |
| C216.4 | Produce sketches of standard machine components, detail and assembly drawing. |
| C216.5 | Produce sketches of standard machine components with detailed drawing including tolerance. |
| C216.6 | Produce assembly drawing from given standard machine components. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| C216.1 | 2 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 1 |
| C216.2 | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 2 |
| C216.3 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| C216.4 | - | - | 2 | - | - | - | - | - | - | 1 | - | - | - | - | 3 |
| C216.5 | - | - | 3 | - | - | - | - | - | - | 1 | - | - | 2 | - | 3 |
| C216.6 | - | - | 3 | - | - | - | - | - | - | 1 | - | - | 2 | - | 3 |

| List of Assignments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments** | **Type** | **Hrs.** |
| 1 | BIS Convention sheet. | D | 2 |
| 2 | Free hand Sketching of various machine Components. | D | 2 |
| 3 | To draw details (with all manufacturing Tolerance) from given assembly- Sheet 1 | D | 2 |
| 4 | To draw details (with all manufacturing Tolerance) from given assembly- Sheet 2 | D | 2 |
| 5 | To complete detailed drawing (with all fits) from given detailed drawing- Sheet 1 | D | 2 |
| 6 | To complete detailed drawing (with all fits) from given detailed drawing- Sheet 2 | D | 2 |
| 7 | To draw standard machine components with detailed drawing including tolerance - Sheet 1 | D | 2 |
| 8 | To draw standard machine components with detailed drawing including tolerance - Sheet 2 | D | 2 |
| 9 | To draw assembly drawing from given standard machine components- Sheet 1 | D | 4 |
| 10 | To draw assembly drawing from given standard machine components- Sheet 2 | D | 4 |

❖ **S-STUDY, O-OPERATIONAL, D-DRAWING SHEET**

**Text Book:**

1. P. S. Gill, "Machine Drawing", S.K. Kataria and Sons, 2002.
2. N. D. Bhatt, "Machine Drawing", Charotor Publication House, 2001.

**Reference Books:**

1. P.S.G. Hand Book. P.S.G. College
2. I.S.:SP46 Engineering drawing practice for schools and colleges BIS Publication.
3. I.S.:696 Code of practice for general engineering drawings. BIS Publication.
4. I.S.:2709 Guide for selection of fits. BIS Publication.

## Course Plan

| **Course Title : Fluid and Turbo Machinery Lab** | |
|---|---|
| **Course Code : 201MEP217** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | **ESE(POE)Marks :25** |

**Prerequisite:** Fluid Mechanics, Applied Thermodynamics.

**Course Description:**

This course is deals with the study of working principles of water turbines & its velocity triangles, design parameters related to Turbines. Similarly understand the concept of Centrifugal pumps, selection of centrifugal pumps, and use of pumps for various engineering application. Understand the working principles & concept Compressors, selection of Compressors for various engineering application. And study the working of Gas Turbines and Jet engine and know its various configurations he knowledge of these devices is necessary in all types of power plants

**Course Objectives:**

1. To understand the working principles of Impulse and Reaction water turbines also to study its velocity triangles & design parameters related to Turbines
2. To understand the concept of Centrifugal pumps and its construction. To understand NPSH terms related to centrifugal pumps. To understand selection of centrifugal pumps for various Engineering application.
3. To understand the working principles & concept of Compressors. To understand various parameters related to Compressors. And understand selection of Compressors for various engineering application.
4. To understand the working of Gas Turbines and Jet engine and know its various configurations. To determine the efficiencies of gas turbines

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C217.1 | Understand & Apply working principle of Rotodyanamic machines |
| C217.2 | Understand & Apply working principle of Centrifugal Pump |
| C217.3 | Understand & Apply working principle of Compressors |
| C217.4 | Understand & Apply working principle of Gas Turbines |
| C217.5 | Analyze the machines to evaluate the performance |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C217.1** | 3 | 2 | 2 | - | - | - | - | - | 2 | - | - | - | - | 2 | 3 |
| **C217.2** | 3 | 2 | 2 | | - | - | - | - | 2 | - | - | - | - | 2 | 3 |
| **C217.3** | 3 | 2 | 2 | - | - | - | - | - | 2 | - | - | - | - | 2 | 3 |
| **C217.4** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **C217.5** | 3 | 2 | 2 | - | - | - | - | - | 2 | - | - | - | - | 2 | 3 |

***Note: PO9 (Justification):** Group of four students collectively take readings, observations, calculations on instrument from Fluid & Turbo Machinery Lab so that we can consider it as an indivisible and team work.

| List of Assignments / Experiments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments / Experiments** | **Type** | **Hrs.** |
| 1 | Trial on Pelton wheel with characteristics curve | O | 2 |
| 2 | Study of Francis turbine with characteristics curve | S | 2 |
| 3 | Study of Kaplan turbine with characteristics curve | S | 2 |
| 4 | Study of various types of pumps | S | 2 |
| 5 | I. Trial on Centrifugal pump with characteristics curve.<br>II. Selection of on Centrifugal pump for application like boiler, feed pump, multistage in building and other application. Using manufacturing catalogue | O | 4 |
| 6 | I. Trial on reciprocating compressor.<br>II. calculation of compressor for various application like service station, spray painting, and dentist | O | 4 |
| 7 | Trial on Gear Pump | O | 2 |
| 8 | Study of hydraulic devices- Intensifier, Accumulator, Hydraulic jacks, Press, Crane. Hydraulic ram. | S | 2 |
| 9 | Study of other types of pumps- Reciprocating pump, Gear pump, Jet pump, Submersible Pump, Air lift pump | S | 2 |
| 10 | Industrial visit to Pump/Turbine Manufacturing Industry or Hydro Power | S | 2 |

❖ **S-STUDY, O-OPERATIONAL**

**Text Book:**

1. "Turbo machines", S.M. Yahya , Tata Mc Graw Hill , 2005
2. "Fans, compressor and turbine", S. M. Yahya, Tata Mc Graw Hill , 2005

**Reference Books:**

1. "Hydraulic Machines", V.P. Vasantdani, Khanna Publishers, 1996.
2. "Fluid flow machines", N.S. Govindrao, Tata McGraw-Hill, 1983.
3. "Steam and gas Turbines", R. Yadav, Central Publishing House, Allahabad, 6th Edition1997
4. "Fluid mechanics and hydraulic machines", Modi and Seth, Standard Book House, 2004
5. "Thermal Engineering", R K Rajput, Laxmi Publication.

## Course Plan

| **Course Title : Theory of Machines Lab** | |
|---|---|
| **Course Code : 201MEP218** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | |

**Course Description:**

This course is deals with an introduction to gear geometry, types of gear teeth profile and phenomena of interference. Other topics covered include types of gear trains, Inertia forces and torques in mechanisms, balancing of rotary and reciprocating masses along with multi-cylinder in-line engines radial and V- engines, effect of gyroscopic couple in machinery, Free and forced vibrations of one-degree of freedom systems with and without viscous damping.

**Course Objectives:**

1. **To describe** basic gear geometry, gear profile and theory of gearing
2. **To study** the various types of gear trains used for transmission of motion and power.
3. **To study** the gyroscopic effects on vehicles, aero plane , ship, four wheeler and two wheeler
4. **To study** the problems on velocity and acceleration of slider crank mechanism analytically.
5. **To study** static and dynamic balancing of rotary and reciprocating masses
6. **To study** basic concepts of vibration analysis

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C218.1 | Draw gear tooth profile using rack and cutter method. |
| C218.2 | Identify types of Gear trains. |
| C218.3 | Explain the concepts of gyroscope on vehicles, aeroplane, ship, two and four wheeler. |
| C218.4 | Evaluate Static and Dynamic force on slider crank mechanism. |
| C218.5 | Apply balancing principles to the Reciprocating and Rotary masses. |
| C218.6 | Understand the fundamental concepts of vibrations. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C218.1** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 3 |
| **C218.2** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **C218.3** | 2 | 2 | - | 2 | - | - | - | - | - | - | - | - | - | - | 2 |
| **C218.4** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **C218.5** | 2 | 2 | - | - | | - | - | - | - | - | - | - | - | - | 3 |
| **C218.6** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 |

| List of Assignments/Experiments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments/Experiments** | **Type** | **Hrs.** |
| 1 | Generation of involute profile using rack cutter method. | O | 2 |
| 2 | Experiment on Torque Measurement in epicyclical Gear Train. | O | 2 |
| 3 | Experiment on Gyroscope | O | 2 |
| 4 | Determination of M.I. using bifilar suspension system. | O | 2 |
| 5 | Determination of M.I. using trifilar suspension system. | O | 2 |
| 6 | Experiment on Balancing of rotary masses (Static and Dynamic). | O | 4 |
| 7 | Problems on balancing of reciprocating masses. (Minimum 3) | S | 4 |
| 8 | Determination of M.I. of connecting rod by Compound pendulum method. | O | 2 |
| 9 | Computer aided force analysis of any one of following<br>a. Slider crank mechanism<br>b. Four bar mechanism | O | 2 |
| 10 | Study and experiment on Vibration measurement | S | 2 |

❖ **S-STUDY, O-OPERATIONAL**

**Text Book:**

1. "Theory of Machines", Rattan S.S, Tata McGraw Hill New Delhi, 5th Kindle Edition.2019
2. "Mechanical Vibrations „by Grover G.K., Nemchand Publications

**Reference Books:**

1. "Mechanisms and Dynamics of Machinery", Hamilton H Mabie and Charles F Reinholtz, (1987) Fourth Edition, John-Wiley and Sons, Inc., New York.
2. "Theory of Vibration with applications", William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan, (2004) Fifth Edition, Pearson Education Publishers.
3. "Theory of Machines and Mechanism", Shigley, McGraw Hill, New York, 4thEdition,2014
4. "Theory of Machines", P.L.Ballany, Khanna Publication, New Delhi, 3rd Edition.

**Course Plan**

| **Course Title : Workshop Practice-III Lab** | |
|---|---|
| **Course Code : 201MEP219** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | **ESE (POE) Marks : 50** |

**Prerequisite:** Engineering Graphics, Basic Mechanical Engineering

**Course Description:**

The course Workshop practice III is focused on the study of various types of metal cutting processes and machine tools. It includes the study of general purpose machine tools such as center lathe, drilling, milling machines along with their accessories and attachments.

This course intends to bring the competency in the students to identify and select and use proper machine tools, proper cutting tools, types of operations, and use of accessories and attachments on the machine tools.

**Course Objectives:**

1) To impart basic knowledge of Machine layout, installation of Machine Tools, selection of Tools.
2) To understand Lathe Machine, Drilling Machine, Milling Machine.
3) To study machining operations and prepare Job with its process sheet on Lathe machine.
4) To study basics of CNC and VMC Machine

**Course Outcomes (COs):**

At the end of the course the student should be able to:

| | |
|---|---|
| C219.1 | Understand Machine layout, method of Machine Tool installation, selection of Tools for various machining operation. |
| C219.2 | Understand Construction, Mechanism and Application of Lathe Machine, Drilling Machine, and Milling Machine. |
| C219.3 | Demonstrate effect of variables such as speed, feed and depth of cut on machining process and produce Job with plain turning, taper turning, external threading and knurling operation along with its process sheet. |
| C219.4 | Understand basics of CNC and VMC Machine along with simple program using G & M codes. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| C219.1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 2 |
| C219.2 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 2 |
| C219.3 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | 6 |
| C219.4 | 3 | 2 | - | - | 3 | - | - | - | - | - | - | - | 1 | - | 3 |

**Course Content**

| List of Practical's &Assignments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Practical's &Assignments** | **Type** | **Hrs.** |
| 1 | Machine layout, existing machine specifications, Installation procedure of Machine Tools | S | 2 |
| 2 | Selection of tools for metal cutting based on work piece materials | S | 2 |
| 3 | Study of Construction, Mechanism and Application of Lathe Machine | S | 2 |
| 4 | Study of Construction, Mechanism and Application of Drilling Machine | S | 2 |
| 5 | Study of Construction, Mechanism and Application of Milling Machine | S | 2 |
| 6 | Study and construction of Shaper and Planer Machine | S | 1 |
| 7 | Study and construction of Grinding Machine | S | 1 |
| 8 | One Job of MS material plain turning, Taper turning, External threading, knurling operation, with its process sheet. | O | 8 |
| 9 | Introduction to CNC (Construction working theoretical treatment only)<br>Introduction to VMC Machine (Construction working theoretical treatment only) | S | 4 |

| | | | |
|---|---|---|---|
| 10 | Industrial visit to study gear manufacturing processes or thread manufacturing Processes | - | - |

❖ **S-STUDY, O-OPERATIONAL**

**Note:**

1. **The load of Workshop Practice III will be allotted to the Teaching Faculty.**
2. **Assessment of Journal based on above Term Work and Industrial Visit Report.**
3. **Term work will consist of Job Carrying 15 Marks, Journal Assessment along with internal oral 10 marks.**
4. **Practical Examination is on basis of Job done (50 Marks)**

**Text Book:**

1. "A Textbook of Production Technology (Manufacturing Processes)", P.C. Sharma, S. Chand and Company Pvt. Ltd, New Delhi.7$^{th}$Edition, 2010.
2. "Workshop Technology vol. II", B.S. Raghuvanshi, Dhanapat Rai Publications Pvt. Ltd, New Delhi.10th Edition, 2000

**Reference Books:**

1. "Machine Tools and Manufacturing Technology", Steve F. Krar, Mario Rapisarda, Albert F.
2. HMT Hand book- Production Technology Roy A. & Linberg- "Processes and materials of manufacturing", Prentice Hall of India Delhi.
3. Campbell J.S.: Principles of manufacturing Materials and Processes, McGraw-Hill, New York.

**Course Plan**

| **Course Title : CAD Lab** | |
|---|---|
| **Course Code : 201MEP220** | **Semester : IV** |
| **Teaching Scheme : L-T-P : 0-0-2** | **Credits : 1** |
| **Evaluation Scheme : ISE Marks : 25** | **ESE(POE) Marks :25** |

**Pre-requisites:** Engineering Graphics, Fundamentals of drawings

**Course Description:**

Computer Aided Drafting is aimed at providing basic understanding of the fundamentals of Computer Aided Drafting with industrial drafting practices to make them fit in industries. This course enables students to create 2D, Isometric, Detail Assembly, Bill of material and drafting of any mechanical components.

**Course Objectives:**

1. Enable them to use computer aided drafting tools for the generation of drawing.
2. To develop an ability to create 2-D drawings with appropriate dimensional and geometrical constraints by using CAD tool.
3. To create Isometric drawings by using CAD tool.
4. To create assembly and details of simple machine components with industrial approach by using CAD tool.

**Course Outcomes:**

At the end of the course student should be able to:

| | |
|---|---|
| C220.1 | Understand modern engineering tools used for engineering drawing. |
| C220.2 | Prepare 2-D drawings with appropriate dimensional and geometrical constraints by using CAD tool. |
| C220.3 | Prepare isometric projection by using CAD tool. |
| C220.4 | Prepare assembly and detail of simple machine components by using CAD tool. |

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes (COs) | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **C220.1** | 3 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | 2 |
| **C220.2** | 3 | - | - | - | 3 | - | - | - | - | 2 | - | - | - | - | 3 |
| **C220.3** | 3 | - | - | - | 3 | - | - | - | - | 2 | - | - | - | - | 3 |
| **C220.4** | 3 | - | - | - | 3 | - | - | - | - | 2 | - | - | - | - | 3 |

*In CAD lab CAD software is use act as modern tool for draw the drawing and drafting.

**Course Content**

| **Content (Assignments will based on following contents)** |
|---|
| **Unit 1: Introduction to CAD**<br>Introduction to CAD software, Standard Toolbars, Menus, Tabs, navigational tools and Basic, Editing, Modify & Viewing commands to draw 2D objects, Co-ordinate system and planes, Apply Dimensions, Lettering, and annotations as per BIS conventions. |
| **Unit .2: Introduction Isometric Drawings**<br>Introduction to Isometric, Isometric scale, Isometric projections and Isometric views / drawings. Circles in isometric view. Isometric views of simple solids and objects. |
| **Unit .3: Use of layers**<br>Use of layers in 2D drawing, Annotation and Layers toolbars any advance CAD Software |
| **Unit 4: Geometric Dimensioning and Tolerancing**<br>Geometric Dimensioning and Tolerance for 2-D Objects: Straightness, Flatness, perpendicularity, Angularity, Roundness, Concentricity, Cylindricity, Run out, Profile, Parallelism etc. Entering limits, fits, tolerances surface finish symbols and Machining Symbols on drawings. |
| **Unit 5: Detail Drawings**<br>Preparing detail drawings in 2D. Entering limits, fits, tolerances and surface finish symbols on detail drawings. |
| **Unit 6: Assembly Drawings**<br>Preparing assembly drawings in 2D. Preparing of bill of material (BOM). Maximum no. of parts to be limited to twelve only. Entering limits, fits, tolerances and surface finish symbols on assembly drawings. |

| List of Assignments | | | |
|---|---|---|---|
| **Sr. No.** | **Name of Assignments** | **Type** | **Hrs.** |
| 1 | Computer Aided Drafting of simple components and print out of the same on A4 size sheet –Object 1 | D | 4 |
| 2 | Computer Aided Drafting of simple components and print out of the same on A4 size sheet – Object 2 | D | 2 |
| 3 | Isometric drawing of simple components and plotting its 2-D views. Print out of the same on A4 size sheet– Object 1 | D | 2 |
| 4 | Isometric drawing of simple components and plotting its 2-D views. Print out of the same on A4 size sheet– Object 2 | D | 2 |
| 5 | Drawing Details with limit, fit, tolerances & Bill of material of assembly containing 6-8 major components. Print out of the same on A4 size sheet – Object 1 | D | 2 |
| 6 | Drawing Details with limit, fit, tolerances & Bill of material of assembly containing 6-8 major components. Print out of the same on A4 size sheet – Object 2 | D | 2 |
| 7 | Drawing Details with limit, fit, tolerances & Bill of material of assembly containing 6-8 major components. Print out of the same on A4 size sheet – Object 3 | D | 2 |
| 8 | Drawing Assembly with limit, fit, tolerances & Bill of material of assembly containing 6-8 major components. Print out of the same on A4 size sheet – Object 1 | D | 2 |
| 9 | Drawing Assembly with limit, fit, tolerances & Bill of material of assembly containing 6-8 major components. Print out of the same on A4 size sheet – Object 2 | D | 4 |
| 10 | Case Study | S/D | 2 |

❖ **S-STUDY, O-OPERATIONAL, D-DRAWING SHEET**

***Note:**

Latest drafting software like Auto cad and any advance software are to be used.

**Case Study**: Students have to visit any mechanical industry and study one industrial drawing and prepare report.

**Text Book:**

1. Ajeet Sing, "Working with AutoCAD 2000", Tata McGraw Hill.
2. N. D. Bhatt, "Machine Drawing", Charotor Publication House, Bombay, 46th Edition.

**Reference Books:**

1. "Auto cad 2014 for Engineers and Designers", Sham Tickoo, New Delhi, 2014.
2. "Auto Cad 2014", Ellen Finkelsten, Wiley India Manuals and Tutorials.

3. K. L. Narayana, "Machine Drawing", New Age Publication
4. K. Venugopal, "Engineering Drawing and Graphics", New Age Publication
5. R. K. Dhawan, "A text book of Engineering Drawing", S. Chand and Co.
6. W. J. Luzadder, "Fundamentals of Engineering Drawing", Prentice Hall of India.
7. N. B. Shaha and B. C. Rana, "Engineering Drawing", Pearson Education, 2nd Edition.

**Course Plan**

| **Course Title: Environmental Studies** | |
|---|---|
| **Course Code: 201MEMC221** | **Semester: IV** |
| **Teaching Scheme: L-T-P : 2-0-0** | **Credits: Non Credit** |
| **Evaluation Scheme: ISE + MSE Marks : - Nil** | **ESE Marks: 50** |

**Prerequisite:** Understanding of Environmental Education course.

**Course Description:**

Environmental Studies course enhance a student's knowledge in a variety of currently relevant topics related to environmental awareness and pollution. The course aims to identify environmental problems, come-up with suitable solutions and create awareness for a hygienic and eco-friendly environmental.

**Course Objectives:**

1 Recognize the structure and functions of ecosystems with their importance.

2 Understand the environmental and social problems with global concern.

3 Understand the importance of environmental management for its protection.

4 Acquire problem solving skills through visits to different locations, identifying the environmental problems, proposing the solution models and exhibiting to the society and government authorities.

**Course Outcomes (COs):**

**At the end of successful completion of course, the students will be able to**

| | |
|---|---|
| C221.1 | Understand the importance of ecosystem and biodiversity in view of its conservation. |
| C221.2 | Understand the concept of hazardous waste and to promote healthier environment. |
| C221.3 | Explain the importance of environmental management through pollution control boards. |
| C221.4 | Propose solutions for problems related with environmental well beings through location visits and model exhibitions. |

**:**

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

| Course Outcomes COs | Program Outcome POs | | | | | | | | | | | | PSO | | BTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO 2 | |
| C221.1 | - | - | - | - | - | 1 | 3 | 2 | - | - | - | - | - | - | 2 |
| C221.2 | - | - | - | - | - | 1 | 2 | - | - | - | - | - | - | - | 2 |
| C221.3 | - | - | - | - | - | 1 | 3 | - | 1 | 1 | - | - | - | - | 2 |
| C221.4 | - | - | - | - | - | 2 | 3 | 1 | 1 | 1 | - | - | - | - | 3 |

| Course Content | Hours |
|---|---|
| **Unit 1.Ecology and Biodiversity**<br>Definition, types, importance and examples of ecology, types of community relationships: Symbiosis, predation and competition. Ecosystem: structure and functions, biotic and abiotic components, energy flows, ecological succession, food chain, food web & ecological pyramid, types of ecosystems, degradation of ecosystems and its impact. Biodiversity hotspots: Western ghats, eastern Himalayas, threats to biodiversity and conservation of biodiversity, environmental ethics. | 8 |
| **Unit 2.Environment and Health**<br>Air Pollution, water pollution. E-waste, waste minimization technology, Plastic waste, Population growth of the world and reduced health content of the environment, energy crisis, bio fuels, Occupational health hazards, Concept of Carbon footprint. | 7 |
| **Unit 3.Environmental Management**<br>Role of Central Pollution Control Board (CPCB) and Maharashtra Pollution Control Board (MPCB) in environmental protection of India. Concept of sustainability, ISO Certification. | 5 |
| **Unit 4.Field Work**<br>Visit to a local area for documentation of environmental assets-River/forest/grassland/hill/mountain<br>OR<br>Visit to a local polluted site-Urban/Rural/Industrial/Agricultural<br>OR<br>Study of common plants, insects, birds<br>OR<br>Study of simple ecosystems- Ponds, Lakes, Rivers, Hill slopes, etc. | 5 |

**Text Books:**

1. Trivedi R.K. and P.K Goel, Introduction to Air Pollution, Tech-science Publications.
2. Mhaskar A.K, Matter Hazardous, Techno-Science Publication**.**

**Reference Books:**

1. Bharucha, Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad 380013, India
2. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
3. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I & II, Environmental Media.
4. Miller T. G. Jr., Environmental Science, Wadsworth Publications Co.
5. Sharma B.K., Environmental Chemistry, Gokel Publ. House, Meerut.