# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

## Course Contents (Syllabus) for

## Second Year B. Tech.
## (Mechanical Engineering)
## Sem - III to IV

## AY 2020-21

# Professional Core (Theory) Courses

| Title of the Course: **Probability and Statistics** | L | T | P | Cr |
|---|---|---|---|---|
| **Course code: 5MA201** | **2** | **0** | **0** | **2** |

**Text Books:**

1. Gupta and Kapoor, "*Fundamental of Mathematical Statistics*"
2. Vijay Rohatgi , "*An Introduction to probability and statistics*"

**References:**

1. S.Ross, "*Probability and Statistics for Engineers and Scientists*"

**Course Objectives :**

1. To understand the importance of probability and statistical tools used in engineering.
2. To get the knowledge of various types of probability distributions.
3. To understand different hypothesis and types of errors.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Identify basic elements of probability and statistics. | II | Understanding |
| CO2 | Employ use of different probability functions and distributions. | IV | Applying |
| CO3 | Use different statistical tools for hypothesis testing. | V | Evaluating |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | | | | | | | | | | | | |
| CO2 | | L | M | | L | | | | | | | | L | |
| CO3 | L | | | L | M | L | | | | | | | L | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE

**Course Contents:**

| **Module 1 Random Variable** | **4 Hrs.** |
|---|---|
| Discrete random variable, Continuous random variable, probability mass function, cumulative distribution function, bivariate discrete random variable, joint probability distribution, joint distribution function of two dimensional discrete random variable | |
| **Module 2 Probability Distribution** | **6 Hrs.** |

| | |
|---|---|
| Gaussian distribution, Exponential distribution, Uniform distribution | |
| **Module 3 Statistical Methods** | **5 Hrs.** |
| Measure of Central tendency, Measure of dispersion, Range, Quartile deviation, Mean deviation, variance, Standard deviation, Coefficient of variance, moments, Symmetry, Skewness, Kurtosis, and Types of Kurtosis | |
| **Module 4 Population and Sample** | **3 Hrs.** |
| Introduction, Types of Characteristics: Attributes and variables, Collection and Organization of data, Population and sample, Methods of sampling | |
| **Module 5 Exact Sampling Distribution** | **4 Hrs.** |
| Chi- square distribution: definition and its properties, Student t- distribution: definition and its properties | |
| **Module 6 Test of Hypothesis** | **7 Hrs.** |
| Random samples, parameter, statistic, standard error of statistic, null and alternative hypothesis, critical region, level of significance, Types of error, large sample test, Small sample test | |

**Module wise Measurable Students Learning Outcomes :**

**After the completion of the course the student should be able to:**

1. Understand meaning of different variables and probability functions.
2. Understand different types of probability distributions.
3. Use of different statistical methods.
4. Understand data collection methods, population sample.
5. Understand different sampling distribution methods.
6. Understand different hypothesis and types of errors.

| Title of the Course: Thermodynamics Course Code: 5ME201 | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Textbooks:**

1. P. K. Nag "Thermodynamics", Tata McGraw Hill Publication, 3rd Edition, 2006.
2. V. P. Vasandani and D. S. Kumar, "Heat Engineering", Metropolitan Book Company, 2nd Edition, 1975.
3. R. Yadav, "Fundamentals of Thermodynamics", Central Publication house, Allahabad, Revised 7th Edition, 2011.

**References:**

1. Cengel and Boles, "Thermodynamics an Engineering Approach", Tata McGraw-Hill publication, Revised 7th Edition 2016
2. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J. "Fundamentals of Thermodynamics", John Wiley and Sons, 6th Edition, 2003.
3. Jones, J. B. and Duggan, R. E. "Engineering Thermodynamics", Prentice-Hall of India , 2nd Edition, 1996
4. Moran, M. J. and Shapiro, H. N. "Fundamentals of Engineering Thermodynamics", John Wiley and Sons. 3rd Edition 2003.

**Course Objectives :**

1. To learn about work and heat interactions, and energy balance between system and its surroundings
2. To learn about application of I law to various energy conversion devices
3. To evaluate the changes in properties of substances in various processes
4. To understand the difference between high grade and low grade energies and II law limitations on energy conversion

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Write energy balance to systems and control volumes, in situations involving heat and work interactions | II | Understanding |
| CO2 | Evaluate changes in thermodynamic properties of substances | III | Applying |
| CO3 | Evaluate the performance of energy conversion devices and to differentiate between high grade and low grade energies. | IV | Analyzing |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | | | | | | | | | | | L | |
| CO2 | H | M | L | | | | | | | | | | L | |
| CO3 | H | M | H | | M | L | | | | | | | L | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Module 1 Fundamentals and First law of Thermodynamics**<br>Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E , Various modes of energy, Internal energy and Enthalpy | **Hrs. 8** |
| **Module 2 Properties of Pure substances**<br>Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables ; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart. | **Hrs. 6** |
| **Module 3 First law for flow steady and unsteady processes**<br>First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; numericals on of steady and unsteady flow processes, | **Hrs. 5** |
| **Module 4 Second Law of Thermodynamics**<br>Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. | **Hrs. 6** |
| **Module 5 Clausius inequality and Availability**<br>Clausius inequality; Definition of entropy S ; entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, concept of Lost work. | **Hrs. 7** |
| **Module 6 Second law analysis for a control volume and Thermodynamic cycles**<br>Second law analysis for a control volume. Exergy balance equation and Exergy analysis. Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle. | **Hrs. 6** |

**Module wise Measurable Students Learning Outcomes :**
**After the completion of the course the student should be able to:**

1.Understand the fundamental terms with their significance in thermodynamics along with introduction first law of thermodynamics.
2.Appreciate properties of pure substances through reading charts and tables.
3.Apply the first law of thermodynamics to various flow systems.
4.Interpret the need of second law of thermodynamics through studying limitations of the first law.
5.Understand the property entropy by its definition along with its evaluation for various processes.
6.Apply the second law for control volumes and explain some basic thermodynamic cycles.

| Title of the Course: Materials Engineering Course Code: 5ME202 | L | T | P | Cr |
|---|---|---|---|---|
| | 4 | 0 | 0 | 4 |

Textbooks:

1. V. Raghvan, "*Solid State Phase Transformations*", PHI Publication, 1st Edition, 1987, Reprinted 2004.
2. V. Raghvan, "*Physical Metallurgy: Principles and Practice*", PHI Publication, 3rd Edition, 2015.
3. William D. Callister, "*Fundamentals of Materials Science and Engineering*", Wiley India Pvt. Ltd, 9th Edition, 2014.
4. Donald R. Askeland, Pradeep P. Fulay,"Essentials of Materials Science & Engineering - SI Version" 4th Edition ,Cengage Learning, 2019.

References:

1. Sidney H. Avener, "*Physical Metallurgy*", Tata McGraw Hill Education Private Limited, 2nd Edition, 2017
2. George E. Dieter, "*Mechanical Metallurgy*", Tata Mc Graw Hill Publication, Si Metric Edition, 3rd Revised edition, 2013.
3. Ashok Sharma, Rajan, "*Heat Treatment: Principles & Techniques*", PHI Learning Pvt. Ltd-New Delhi, 2nd edition, 2011.

**Course Objectives :**

1. To make the students familiarize with properties of different metals and their microstructural and crystallographic relevance.
2. To describe solidification behavior of metals and its alloys and to predict their microstructure.
3. To explore different heat treatment processes, and powder metallurgy.
4. To make students to investigate various NDT methods.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Relate influence of imperfections in plastic deformation process, strengthening mechanism and show its effect over mechanical properties by conducting destructive and nondestructive tests. | II | Understanding |
| CO2 | Explain various phase transformations and classify various heat treatment processes. | II | Understanding |
| CO3 | Apply knowledge of powder metallurgy process, special grade materials in engineering applications. | III | Applying |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | | | | | | | | | | 2 | 1 |
| CO2 | | | 2 | | | | | | 2 | | | 1 | | 1 |
| CO3 | | | 2 | | | | | | | | | 1 | 2 | 1 |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Module 1** | **8 Hrs.** |
| Mechanical Behavior of Metals, Introduction to Science of metals, Properties of metals, Crystal defects, Deformation of metals, Role of dislocations in deformation, Strengthening Mechanisms, Theory behind creep. | |
| **Module 2** | **8 Hrs.** |
| Testing of Materials, Mechanical testing of materials (Destructive and Non -Destructive testing methods), Introduction to Fracture, failure case studies | |
| **Module 3** | **10 Hrs.** |
| Phase Diagram and Phase Transformations, Objectives and classification, System, phases and structural constituent of phase diagram, Iron –Carbon equilibrium diagram, Coring and dendritic segregation, Gibb's phase rule, Lever rule, Solid solutions, Eutectic, Peritectic and eutectoid system, Equilibrium diagrams for non -ferrous alloys, Experimental methods of determining phase diagrams.<br>**Phase transformations:** - Concept of solidification of metals, Solidification of pure metals, Nucleation, Growth, Growth of the new phase, Solidification of alloys, Nucleation, growth and overall transformation rates, TTT and CCT diagrams. | |
| **Module 4** | **10 Hrs.** |
| Heat Treatment Processes, Definition, Purpose and classification of heat treatment processes for various types of steels, Bainite and Martensite formation, Concept of Hardenability, Introduction and applications of various case hardening and surface hardening treatments, Precipitation Hardening, Thermo mechanical treatments. Heat treatment defects. | |
| **Module 5** | **8 Hrs.** |
| Powder Metallurgy, Introduction, Manufacturing route for – Tool materials, bearings and bushes, electrical contacts, brake pads etc. , failure of powder metallurgy components – case studies, Economic, Environmental and Social Issues in Materials Science and Engineering. | |

| Module 6 | 8 Hrs. |
|---|---|
| Application and properties of Stainless steel, Duplex stainless steels, Nickel alloys, HSLA, Maraging stainless steels, Precipitation hardenable stainless steels, Martensitic stainless steels, Carbon steels for General purpose and pressure containing parts. | |

**Module wise Measurable Students Learning Outcomes :**

student should be able to

1. Classify different metals according to their physical, chemical and mechanical properties.
2. Use NDT methods to provide support and services to nearby industries.
3. Describe solidification behavior of metals and its alloys and to predict their microstructure.
4. Evaluate metals and its alloys in order to estimate physical and mechanical properties.
5. Describe powder metallurgical processes.
6. Design heat treatment cycle of ferrous and non-ferrous metals and alloys.

| Title of the Course: Strength of Materials Course Code: 5ME203 | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**Textbooks:**

1. Beer and Johnson, *Mechanics of Materials*, McGraw Hill, 6th Edition , 2013
2. Hibbeler, R.C., *Statics and Mechanics of Materials*, Prentice-Hall, SI Edition , 2004
3. Ramamurthum, *Strength of materials,* Dhanpat Rai and Sons New Delhi, 3rd edition, 2009

**References:**

1. Den Hartog, Jacob P., *Strength of Materials*. Dover Publications Inc., 3rd Edidtion 1961
2. Timoshenko S., *Strength of Materials*,. Krieger Publishing Company, 3rd edition, 1976
3. Mott, Robert L., *Applied Strength of Materials*, Prentice-Hall, 4th edition, 2002

**Course Objectives :**

1. To make the students understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To enable the students to calculate the elastic deformation occurring in various simple geometries for different types of loading

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understand the nature of internal stresses that will develop within the components | II | Understanding |
| CO2 | Calculate the stresses in various simple components due to different loadings | III | Applying |
| CO3 | Evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading | IV | Analysing |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | H | | L | | | | | | | | | L | |
| CO2 | | H | M | L | | | | | | | | | L | |
| CO3 | | H | M | L | | | | | | | | L | L | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Module 1 Stresses and strain** | **6 Hrs.** |
| Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains, thermal stresses. True stress and true strain | |
| **Module 2 Torsion and Shear force and bending moment diagram** | **7 Hrs.** |
| Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. | |
| **Module 3 Stresses in beams** | **7 Hrs.** |
| Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads, for various commonly used sections | |
| **Module 4 Deflection of beams** | **7 Hrs.** |
| Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems | |
| **Module 5 Principal Stress** | **6 Hrs.** |
| Normal and shear stress on oblique planes, principal stresses and planes. Mohr Circle. Combined effect of bending and shear in beams. Theories of failure | |
| **Module 6 Buckling of Columns** | **6 Hrs.** |
| Euler's formula for different end connections, concept of equivalent length, eccentric loading, Rankine formula | |

**Module wise Measurable Students Learning Outcomes :**
**student should be able to**

1. Recognize basic concepts of stress, strain and their relations based on linear elasticity.
2. Calculate stresses and deformation of a torsional bar.
3. Develop shear and bending moment diagrams. Calculate bending and transverse shear stresses.
4. Analyze deflections of beam under combined loads
5. Apply concept of Mohr's circle to compute principal stresses and angles.
6. Predict stability and buckling for a slender member under an axial compressive force.

| Title of the Course: Manufacturing Processes | L | T | P | Cr |
|---|---|---|---|---|
| Course code :5ME204 | 04 | 00 | 00 | 04 |

**Textbooks:**

1.P.N.Rao, *"Manufacturing Technology- Foundry, Forming and Welding"*, Vol. I Tata McGraw-Hill, 4th edition, 2013, ISBN: 9781259062575

2. P.C.Sharma,*"A Textbook of Production Technology(Manufacturing processes)"*,S. Chand & co.,8th revised edition 2014. ISBN:8121911141

3. P. L. Jain, *"Principles of Foundry Technology"*, , Tata McGraw-Hill, New Delhi, 5th Edition,2009. ISBN: 0070151296, 9780070151291

**References:**

1. E. Paul DeGarmo, J.T. Black, Ronald A. Kosher, *"Materials and Processes in Manufacturing"*, John Wiley and Sons Ltd, 9th revised edition, 2004.ISBN:,9780471656777

2. George E. Dieter, "Mechanical Metallurgy", Tata Mc Graw Hill Publication, Si Metric Edition, 3rd Revised edition, 2013, ISBN : 9780070168930

3.Kalpakjian and Schmid, "Manufacturing processes for engineering materials", Pearson India Limited, 7th Edition-2008,ISBN: 9780132272711

**Course Objectives:**

1.To motivate and challenge students to understand and develop the processes in correlation with material properties , which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

2. To provide the students the knowledge of concepts mechanics of machining on various machine tools,rapid prototype- processing techniques.

3. To make the students to aware of fundamental principles of Unconventional Machining Processes.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Identify foundry operations,furnaces used in foundries,pattern materials, sand, casting processes and their defects | II | Understanding |
| CO2 | Summarise joining/additive manufacturing processes, metal forming processes and unconventional machining processes | II | Understanding |
| CO3 | Select furnaces used in foundries,Welding joints,Rapid prototyping for patterns | III | Applying |

**CO-PO Mapping :**

| PO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | | | | | | | | | | | M | L | M |
| CO2 | | | M | | | | | | H | | | | M | |
| CO3 | | | M | | | | | | L | | | | L | M |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Conventional Manufacturing processes**<br>**Module 1:**<br>Casting and Moulding Methods, Metal casting processes and equipments, Preparation of moulding sand,Types and properties moulding sand,Heat transfer and solidification, shrinkage, riser design concepts, casting defects and residual stresses,inspection and testing of castings.<br>Introduction to bulk and sheet metal forming, plastic deformation and yield criteria,Stress-Strain curve for mild steel, fundamentals of hot and cold working processes, load estimation for bulk forming (forging,rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) | **10 Hrs** |
| **Module 2 :**<br>Metal cutting: Single and multi-point cutting, Orthogonal cutting, various force components: Chip formation,Types of chips, Tool wear and tool life, Taylor's equation of tool life,Surface finish and integrity, Machinability, Machinability index,Cutting tool materials and Cutting fluids and their properties,Coating, Turning, Drilling, Milling and finishing processes,<br>Introduction to CNC machining | **10 Hrs** |
| **Module 3:**<br>Joining/fastening processes: Physics of welding,Zones of welding, brazing and soldering,materials used for soldering and brazing, design considerations in welding,Solid and liquid state joining processes, Adhesive bonding | **6 Hrs** |
| **Unconventional Machining Processes**<br>**Module 4:**<br>Introduction to Additive manufacturing: Rapid prototyping(3D Printing) and rapid tooling,Types of 3D printing,materials used for 3D printing,Applications | **8 Hrs** |
| **Module 5:**<br>Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Principles and Process Parameters,comparison and applications of these processes | **8 Hrs** |

| | |
|---|---|
| **Module 6:**<br>Electrical Discharge Machining, Principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM, Electro-chemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish.<br>Laser Beam Machining (LBM),Plasma Arc Machining PAM) and Electron Beam Machining | **10 Hrs** |

**Course Outcomes :** Upon completion of this course, students will be able to

1. Understand the basic metal casting process.
2. Describe metal forming process and the equipment/machines used.
3. Explain different metal cutting operations performed on various machine tools.
4. Identify joining processes and recognize their applications.
5. Explain basics of unconventional machining processes.
6. Classify the different conventional and unconventional manufacturing methods employed for making different products.

# Professional Core (Lab) Courses

| Title of the Course: Thermodynamics Lab Course Code: 5ME251 | L | T | P | Cr |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

**Pre-Requisite Courses: Engineering Physics, Engineering Chemistry, Basic Mechanical Engineering**

**Textbooks:**

1. P. K. Nag "*Thermodynamics*", Tata McGraw Hill Publication, 3rd Edition., 2012,
2. V. P. Vasandani and D. S. Kumar, "*Heat Engineering*", Metropolitan Book Company, 2nd Edition. 1975,
3. R. Yadav, "*Fundamentals of Thermodynamics*", Central Publication house, Allahabad, Revised 7th Edition,2011.

**References:**

1. Cengel and Boles, "*Thermodynamics an engineering Approach*", Tata McGraw-Hill publication, Revised 7th Edition,2011,
2. R. Yadav, "*Thermodynamics and heat engine*", Central Publication house Allahabad, Revised 7th Edition. 2016
3. R. Yadav, "*Steam and Gas Turbine*", Central Publication house, Allahabad, Revised 7th edition,2010

**Course Objectives :**

1. To impart the techniques to find physical properties of the oils, greases, and solid fuels used in steam generators.
2. To prepare the students for applying laws of thermodynamics to various thermodynamic devices.
3. To develop the skills of students for evaluating performance of thermodynamics systems.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Determine the properties of fluids used in various industrial systems such as Mechanical Power Production systems. | III | Applying |
| CO2 | Calculate the calorific value of a given fuel by using Bomb calorimeter. | IV | Analyzing |
| CO3 | Apply first law of thermodynamics to various cyclic systems. | V | Applying |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | | | | | | | | | | | L | |
| CO2 | H | M | L | | H | | | H | H | | H | | L | |
| CO3 | H | M | H | | M | L | | | H | | | | L | |

**Lab Assessment:**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4 Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8 Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14 Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18 Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

**Course Contents:**

| | |
|---|---|
| **Fuel testing**<br>1. Test on Grease dropping point apparatus.<br>2. Test on Redwood Viscometer.<br>3. Test on Aniline point apparatus.<br>4. Determination of flash and fire point of a lubricating oil.<br>5. A test on Bomb calorimeter.<br><br>**Thermodynamic Laws application**<br>*Students are educated to analyze following cyclic systems with conservation of mass and energy perspective.*<br>1. Vapor compression tutor.<br>2. Air conditioning Tutor.<br>3. Mini steam power plant.<br>4. Cooling Tower.<br>5. Measurement of thermal conductivity of metal rod under steady state conditions.<br>6. Reciprocating compressor unit.<br>7. Internal combustion engine setup. | **Hrs.**<br>**2**<br>**/Practical** |

| Title of the Course: Materials Engineering Laboratory<br>Course Code: 5ME252 | L | T | P | Cr |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

Textbooks:

1. V. Raghvan, "*Solid State Phase Transformations*", PHI Publication, 1st Edition, 1987, Reprinted 2004
2. V. Raghvan, "*Physical Metallurgy: Principles and Practice*", PHI Publication, 3rd Edition, 2015.
3. William D. Callister, "*Fundamentals of Materials Science and Engineering*", Wiley India Pvt. Ltd, 9th Edition, 2014.

References:

1. Sidney H. Avener, "*Physical Metallurgy*", Tata McGraw Hill Education Private Limited, 2nd Edition, 2017
2. George E. Dieter, "*Mechanical Metallurgy*", Tata Mc Graw Hill Publication, Si Metric Edition, 3rd Revised edition, 2013.
3. Ashok Sharma, Rajan, "*Heat Treatment: Principles & Techniques*", PHI Learning Pvt. Ltd-New Delhi, 2nd edition, 2011.

**Course Objectives :**

1. To demonstrate destructive and non-destructive test methods.
2. To describe solidification behavior of metals and its alloys and to predict their microstructure, and phases
3. To demonstrate methodology for metallographic sample preparation

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Examine various destructive and non-destructive testing methods | IV | Analyze |
| CO2 | Estimate effect of phases present in the microstructure over physical properties of materials. | V | Evaluate |
| CO3 | Perform metallographic sample preparation process. | VI | Create |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | H | | | | | | | | | | M | L |
| CO2 | | | M | L | | | | | | | | | | L |
| CO3 | M | | M | | | | | | | | | | M | L |

**Lab Assessment :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, | Lab Course Faculty | During Week 1 to Week 4 | 25 |

| | | | | |
|---|---|---|---|---|
| | attendance, journal | | Submission at the end of Week 5 | |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8 Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14 Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18 Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

**Course Contents:** Any ten experiments from the list

1. Tensile test as per ASTM/IS standards.
2. Hardness test
3. Charpy Impact test.
4. Demonstration tests- Ultrasonic testing, Magnetic particle test, Dye penetrant test, Spark Test, Spectro chemical analysis, Thickness measurement test, Electrical conductivity measurement test.
5. Determination of volume fraction of phases.
6. Determination of grain size of metals and alloys.
7. Determination of intergranular attack in austenitic stainless steels.
8. Determination of hardenability of a given steel component.
9. Metallography/Microstructural examination test on ferrous and non ferrous metals and alloys
10. Heat treatment of steels.
11. Creep test
12. Thermal analysis

**Module wise Outcomes**

1. At the end of the experiment 1 the students should able to perform tensile test and to calculate mechanical properties of given sample.
2. At the end of the experiment 2 the students should able to understand relation between hardness and other mechanical properties.
3. At the end of the experiment 3 the students should able to analyze ductile to brittle transition behavior.
4. At the end of the experiment 4 the students should able understand various qualitative and quantitave methods in the field of materials science and metallurgy.
5. At the end of the experiment 5 the students should able to calculate volume fraction of phases.
6. At the end of the experiment 6 the students should able to determine grain size of metals.
7. At the end of the experiment 7 the students should able to understand intergranular corrosion phenomenon.
8. At the end of the experiment 8 the students should able to calculate hardenability of steel.

| Title of the Course:Mechanical Workshop I | L | T | P | Cr |
|---|---|---|---|---|
| Course code: 5ME256 | 1 | 0 | 2 | 2 |

**Pre-Requisite Courses:**

**Textbooks:**

1.P.N.Rao, *"Manufacturing Technology- Foundry, Forming and Welding"*, Vol. I Tata McGraw-Hill, 4th edition, 2013, ISBN: 9781259062575, 1259062570

2. P.C.Sharma,*"A Textbook of Production Technology(Manufacturing processes)"*,S. Chand & co.,8th revised edition 2014. ISBN:81-219-1114-1

3. S. K. Hajra Choudhury, Nirjhar Roy S.K,*"Elements of Workshop Technology" – Vol II [Machine Tools]"*, Media Promoters and Publishers Pvt. Ltd. Mumbai, 10th edition, 2010. ISBN: 9788185099156, 8185099154

**References:**

1. George E. Dieter, *"Mechanical Metallurgy"*, McGraw Hill Book Company, Revised 3rd Indian edition, ISBN : 9780070168930, 2013
2. W.A.J. Chapman, *"Workshop Technology"*, CBS Publishing & Distributors, Delhi.*Vol.I*,5th Edition, 2001,book code: 9788123904016,

**Course Objectives:**

1. To demonstrate different wood machining processes and operate the wood working lathe machine
2. To explain various types and properties of sand
3. To perform simple turning operation on centre lathe machine

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive level | Bloom's Cognitive Descriptor |
|---|---|---|---|
| CO1 | Discuss the wood working processes and explain these machines,tooling devices and equipments | I | Remembering |
| CO2 | Demonstrate the knowledge of various sand properties of moulding sands in making of sand moulds | II | Understanding |
| CO3 | Operate metal turning lathe machine for straight turning process | III | Applying |

**CO-PO Mapping :**

| PO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | L | M | | | | | | | | | M | |
| CO2 | M | | | | | | | | | | | | M | |
| CO3 | M | | | M | | | | | | | | | | M |

**Assessment:**

**Teacher Assessment:**

| Assessment | Marks |
|---|---|
| ISE | 50 |
| ESE | 50 |

**Minimum marks for Passing 20 (ISE) + 20 (ESE)**

**Lab Course Contents:**

**1.Manufacturing Process Lab:**

**A.One Job of Pattern Making[Location : Carpentry shop/Workshop-II] (06 hrs)**

**B. Sand Testing Lab[Location: Workshop-II ](12 hrs)**

a. Preparation of sand for mould and core making with demonstration of small components
b. Tensile, Compressive and shear strength of moulding sand
c. Permeability test for moulding sand
d. Moisture content test for moulding sand
e. Hardness test (mould/core) [Green and Dry]
f. Sand Grain Size analysis (Grain Fineness No. on Sieve Shaker apparatus)

**2. a)Simple turning Job on Lathe Machine (06 hrs) [ Location:Workshop I]**

**b) Demonstration on CNC turning machine (02 Hrs)**

**3. Reports on industrial visits (min.Two) to ferrous and non ferrous foundries.**

**Module wise Measurable Students Learning Outcomes :**

Upon completion of this course, students will be able to

1. Operate Wood working Lathe.
2. Perform Sand testing Experiments and tabulate results.
3. Carrying out simple Turning operation & inspect the job.

**Course Contents for lectures**

| Lect.No. | Topics |
|---|---|
| 1 | Introduction to pattern making |
| 2 | Materials used for making patterns and their properties |
| 3 | Types of patterns and types of pattern allowances |
| 4 | Introduction to wood working lathe : Types of jobs produced , tooling arrangement |
| 5 | Sand preparation process and various machines used |
| 6 | Green Sand Moulding Properties |
| 7 | Types of Moulds |
| 8 | Introduction to Centre Lathe |
| 9 | Operations performed on lathe,safety precautions taken |
| 10 | Job holding and tool holding devices on centre lathe |
| 11 | Introduction to CNC lathe : working principle and construction |
| 12 | Types of jobs produced and various operations performed on CNC lathe |
| 13 | Elementary information related to CNC coding used and methodology |

# EVEN Semester

# Credit System and Evaluation Scheme

# Professional Core (Theory) Courses

| Title of the Course: Applied Mathematics for Mechanical Engineers<br>Course Code: 5ME221 | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

**Textbooks:**

1. *"Advanced Engineering Mathematics"*, Erwin Kreyszig, Wiley Eastern Limited Publication, 1978, 1st Edition.
2. *"A Text Book of Applied Mathematics, Vol I and II"*, P. N. and J. N. Wartikar, Vidyarthi Griha Prakashan, Pune, 2006.
3. *"Higher Engineering Maths"*, B .S. Grewal, Khanna Publication, 2005, 39th Edition

**References:**

1. *"Advanced Engineering Mathematics"*, Wylie C.R., Tata McGraw Hill Publication, 1999, 8th Edition.
2. *"Advanced Engineering Mathematics"*, H. K. Dass, S. Chand & Company Ltd., 1988, 1st Edition

**Course Objectives :**

1. To develop mathematical skills and enhance thinking power of students.
2. To introduce fundamental concepts of mathematics and their applications in engineering fields

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understanding mathematical concepts in engineering field. | II | Understanding |
| CO2 | Use mathematical and computational methods to solve the problems in science and engineering field. | III | Applying |

**CO-PO Mapping :**

| PO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | | | | | | | | | | | | | |
| CO2 | M | | | | | | | | | | | | | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

| Course Contents: | |
|---|---|
| **Module 1:**<br>**Fourier Series**<br>Periodic functions, Dirichlet's conditions, Definition, Determination of Fourier coefficients(Euler's formulae), expansion of functions, even and odd functions, change of interval and functions having arbitrary period, half range Fourier sine and cosine series | **7 Hrs.** |
| | |
| **Module 2: Partial Differential Equations**<br>Four Standard forms of Partial differential equations and application to one dimensional Heat equation | **6 Hrs.** |
| | |
| **Module 3: Matrices and its Application**<br>Transpose Adjoint ,General properties, rank determinant, Jacobian ,Banded Matrix Transformation Matrices Rotation Translation, mirror scaling, concept of tensor. | **7 Hrs.** |
| | |
| **Module 4: Linear differential equation with constant coefficients**<br>Definition, complete solution, the operator D, auxiliary equation , rules for finding the complementary function, inverse operator, rules for finding the particular integrals , homogeneous linear differential equations | **6 Hrs.** |
| | |
| **Module 5: Vector Differential**<br>Concept of vector field, directional derivatives, gradient of vector field, tangent line to the curve. Velocity, acceleration, divergent and curl of vector field, conservative vector field. | **7 Hrs.** |
| | |
| **Module 6: Vector Integral**<br>Line integrals, Surface and volume integral , Greens theorem in plane, Gauss Divergence theorem, Stoke's Theorem. | **6 Hrs.** |
| | |

**Module wise Measurable Students Learning Outcomes :**
**After the completion of the course the student should be able to:**
**Module 1:**
Solve the problems of Fourier series ,expansion of function in Fourier series.
**Module 2:**
Solve differential equations and Application to Heat equation
**Module 3:**
Solve examples in transformation of Matrices as translation, rotation, scaling etc .
**Module 4:**
Solve examples in linear differential equation with constant coefficients.
**Module 5:**
Solve example and understand the problems of fluid mechanic by using vector calculus and the problems of conservation of mass.
**Module 6:**
Solve and understand the problems of surface integral , line integral
Volume integral , and understand concept of Greens theorem , Stokes 's theorem.

| Title of the Course: Fluid mechanics and Fluid Machines | L | T | P | Cr |
|---|---|---|---|---|
| Course Code: 5ME222 | 3 | 0 | 0 | 3 |

**Textbooks:**

1. S K Som, Gautam Biswas, Suman Chakraborty, "*Introduction to Fluid Mechanics and Fluid Machines*" Tata McGraw – Hill Publication. 3rd Edition 2012.
2. M. Potter, D.Wiggert "*Fluid Mechanics*" Schaum's Outline Series Mcgraw-Hill New York Second edition 2008.
3. R.K.Bansal, "*A Text book of Fluid Mechanics and Hydraulic Machines*", Laxmi Publications Pvt. Ltd. New Delhi 9th edition, 2005.

**References:**

1. Streeter, Wylie and Bedford, "*Fluid Mechanics*", Tata McGraw – Hill Publication. 9th Edition 2000.
2. Franke and White, "*Fluid Mechanics*", Tata Mcgraw-Hill New Delhi. 5th Edition 2003
3. Cengel Yunus A. And Cimbala John M. "*Fluid Mechanics and Fundamental and applications*", Tata Mcgraw-Hill New Delhi. 1st Edition 2006.

**Course Objectives :**

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Explain the basics of fluid properties, pressure measurement, fluid statics, kinematics, dynamics, and dimensional analysis. | II | Understanding |
| CO2 | Summaries the basic expressions and theory related to: fluid statics, kinematics, dynamics, dimensional analysis, boundary layer theory and its applications. | III | Applying |
| CO3 | Analyze roto dynamic machines for their performance. | IV | Analyzing |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **M** | | | | | | | | | | | **L** | |
| **CO2** | **H** | **M** | L | | | | | | | | | | **L** | |
| **CO3** | **H** | **M** | H | | M | L | | | | | | **H** | **L** | **H** |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |

| | |
|---|---|
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Module 1 Properties of Fluids**<br>Fluid Properties: viscosity, vapour pressure, compressibility, surface tension, Mach number., Pressure at a point, variation in pressure, Pascal law, and Pressure measurement by using different manometers. | **Hrs. 4** |
| **Module 2 Fluid Kinematics**<br>Different approaches to study fluid mechanics, Reynolds transport Theorem, Flow visualization, types of flow, strain rate, stream line, streak line, path lines, stream tubes, continuity equation in Cartesian coordinates in three dimensional forms, velocity and acceleration of fluid particles. Velocity potential function and stream function. | **Hrs. 7** |
| **Module 3 Momentum equation and Viscous Flows**<br>Momentum equation, Nervier Stoke equation, Development of Euler's equation, Integration of Euler's equation i.e. Bernoulli's equation, Application of Bernoulli's equation, Steady and unsteady flow through orifice. Orifice placed in pipe, Venturimeter, flow over triangular and rectangular notches, pitot tube.<br>**Viscous/Laminar flow:**<br>Plane poissullie flow and coutte flow, Laminar flow through circular pipes, Loss of head due to friction in viscous flow, Power absorbed in viscous flow.<br>**b) Turbulent flow:** Reynolds experiment, frictional losses in pipe flow, shear stress in turbulent flow, major and minor losses (Darcy's and Chezy's equation), HGL, TEL, Flow through siphon pipes, Branching pipes and equivalent pipe. | **Hrs. 7** |
| **Module 4 Dimensional analysis and Boundary layers**<br>**a) Dimensional analysis**: Dimensionally homogeneous equations, Buckingham's $\pi$ Theorem, calculation of dimensionless parameters. Similitude complete similarity, model scales<br>**b) Introduction to boundary layer theory and analysis.** | **Hrs. 7** |
| **Module 5 Rotodynamic machines**<br>Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle | **Hrs. 7** |
| **Module 6 Classification and Performance of hydro turbines.**<br>Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of | **Hrs. 7** |

| | |
|---|---|
| turbines. | |

**Module wise Measurable Students Learning Outcomes :**

**After the completion of the course the student should be able to:**

1. Explain fundamentals of fluid properties and pressure measurement.
2. Derive expressions of fluid statics and conditions of equilibrium of floating and submerged bodies,
3. Summarize characteristics of fluid motions and mass conservation equations.
4. Analyze various forces acting on fluid particles and momentum equations with different forms
5. Understand theory of rotodynamic machines.
6. Analyze rotodynamic machines for their performance.

| Title of the Course: Metal Forming | Course Code: 5ME223 | L | T | P | Cr |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Textbooks:**

1. George E. Dieter Jr., 'Mechanical Metallurgy', Mc-Graw Hill, Third Edition, 1989
2. SeropeKalpakjian, Steven R. Schmid, 'Manufacturing Engineering and Technology', Pearson (Prentice Hall), Fifth Edition, 2005
3. B. L. Juneja, 'Fundamentals of Metal Forming Processes', New Age International (P) Limited, Publishers, First Edition, 2007

**References:**

1. Schuler GmbH, 'Metal Forming Handbook', Springer, Fifth Edition, 1998
2. Heinz Tschaetsch, 'Metal Forming Practise, Processes, Machines, Tools', Springer, Seventh Edition, 2005
3. V. N. Danchenko, 'Metal Forming', Ministry of Education and Science of Ukraine, National Metallurgy Academy of Ukraine, First Edition, 2007

**Course Objectives :**

1. To familiarize students with various Bulk and Sheet Metal forming processes
2. To introduce students with various machine tools and their peculiars used for Metal Forming
3. To train the students to identify main variables of Metal Forming processes and to judge their effect on as formed product
4. To instil deformation pattern, residual stresses and various defects encountered during Metal Forming

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Summarize the various metal forming processes, necessary machine tools and main process-variables | II | Understand |
| CO2 | Illustrate the deformation patterns and benefits of metal forming Processes | III | Apply |
| CO3 | Investigate the defects and residual stresses of metal forming processes | IV | Analyse |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | | | | | | | | | | | | | |
| CO2 | M | | | | | | | | | | | | | |
| CO3 | | L | | | | | | | | | | | L | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1** | **Hrs.** |
|---|---|
| Classification of Metal Forming Processes, General Mechanics of Metal Forming, Ideal Work for Plastic Deformation and Deformation Efficiency, Friction in Metal Forming, Causes for Residual Stresses in Metal Forming, Basic Equations Methods of Solutions for Metal-Forming Analysis. | **6 Hrs.** |
| **Module 2** | |
| Major Forging Operations, Main variables, Deformation and Metal Flow, Benefits by Economic Aspects and Work piece properties, Die Design, Defects, Residual Stresses, Case studies | **7 Hrs.** |
| **Module 3** | |
| Geometrical relationships in rolling mill, Main Variables in rolling, Forward Slip, Backward Slip, Neutral Point, Raw material natural entry to deformation zone, Roll camber, Deformation and Metal Flow, Defects, Residual Stresses, Benefits, Ring Rolling and Thread Rolling, Case studies | **6 Hrs.** |
| **Module 4** | |
| Classification of Extrusion Processes, Die Materials and Die Design, Main Variables, Ugine – Sejournet Process, Deformation and Metal Flow, Defects, Residual Stresses, Benefits, Case Studies | **7 Hrs.** |
| **Module 5** | |
| Wire and Rod Drawing Process, Tube Drawing Processes, Tube Sinking, Tube Drawing with stationary and moving Mandrel, Main Variables, Die Design, Defects, Residual Stresses in Wire, Rod and Tube Drawing, Drawing benefits over extrusion, Case studies. | **6 Hrs.** |
| **Module 6** | |
| Classification of Sheet Metal Forming Processes, Formability Tests, Forming Methods, Shearing and Blanking, Bending and Springback, Stretch Forming and Stretch Wrap Forming, Spinning, Deep Drawing and Redrawing, Ironing and Sinking, Defects in formed parts, Brief description of Explosive Forming, Case studies | **7 Hrs.** |

**Module wise Measurable Students Learning Outcomes :**

**After the completion of the course the student should be able to:**

1. Summarize the Metal Forming Processes and know their general mechanics
2. Summarize various forging operations, main variables and benefits. Investigate deformation pattern, residual stresses, die design and defects.
3. Illustrate geometrical parameters of rolling mill, and main variables.
Inspect deformation pattern and metal flow, residual stresses, benefits and defects
4. Discuss types of extrusion processes. Describe die design, main variables, deformation pattern, residual stresses, benefits and defects
5. Investigate Wire, Rod and Tube Drawing processes, main variables, deformation pattern, residual stresses, die design, benefits and defects
6. Investigate the Formability Test and its importance. Distinguish various sheet metal operations, and defects in sheet metal forming

| Title of the Course: Kinematics and Theory of Machines | L | T | P | Cr |
|---|---|---|---|---|
| Course Code: 5ME224 | 3 | 0 | 0 | 3 |

**Textbooks:**

1. Ratan S.S, *"Theory of Machines"*, Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2. Sadhu Singh, *"Theory of Machines"*, Pearson Education, 2nd Edition, 2009
3. H. G. Phakatkar, *"Theory of Machines I"*, Nirali Publication, 5th Edition 2009.

**References:**

1. Thomas Bevan, *"Theory of Machines"*, CBS Publishers, New Delhi, 1st Edition, 2010.
2. J. E. Shigley, *"Theory of Machines and Mechanism"*, , McGraw Hill, New York. 4th Edition, 2011
3. G.S. Rao and R.V. Dukipatti, *"Theory of Machines and Mechanism"*, New Age International Publications Ltd. New Delhi. 2011

**Course Objectives :**

1. To make the students understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To make the students understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To enable the students to design linkage mechanisms and cam systems to generate specified output motion
4. To ma eth students understand the kinematics of gear trains

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Identify mechanism that should be used according to application and find degrees of freedom of different mechanisms. | II | Understanding |
| CO2 | Analyse various linkage mechanisms for optimal functioning | IV | Analyse |
| CO3 | Develop various linkage mechanism for different applications | V | Evaluate |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | H | | L | | | | | | | | | L | |
| CO2 | | H | | L | | | | | | | | | L | |
| CO3 | | | H | | | L | | | | | | | L | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |

| ESE | 50 |
|---|---|

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1** | **7 Hrs.** |
|---|---|
| Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms | |
| **Module 2** | **8 Hrs.** |
| Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity acceleration analysis, instantaneous centers, velocity and acceleration analysis using loop closure equations, Coincident points- Coriolis component of acceleration | |
| **Module 3** | **7 Hrs.** |
| Introduction to linkage synthesis three position graphical synthesis for motion and path generation kinematic analysis of simple mechanisms slider crank mechanism dynamics | |
| **Module 4** | **7 Hrs.** |
| Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers | |
| **Module 5** | **6 Hrs.** |
| Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics | |
| **Module 6** | **5 Hrs.** |
| Surface contacts- sliding and rolling friction- friction drives, belt and rope drives bearings and lubrication, friction clutches and brakes | |

**Module wise Measurable Students Learning Outcomes :**

**student should be able to**

1. Identify mechanism that should be used according to application and find degrees of freedom of different mechanisms.
2. Analyze the given mechanism for its velocity and acceleration
3. Synthesize Slider crank mechanism and Four bar mechanism for given input positions
4. Understand basics of cams and develop cam profile
5. Understand principle of gear drives

6. Understand concept of friction and its applications

| Title of the Course: Instrumentation & Control Course Code: 5ME225 | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | 1 | 0 | 4 |

**Textbooks:**

1. Ernest O. Doeblin, "Measurement Systems: Application and Design", Tata McGraw- Hill, 5th Edition, 2004.
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th Edition, 2010.
3. Kumar D S, "Mechanical Measurements and Control", Metropolitan publication, 4th Edition, 2006.

**References:**

1. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V , "Mechanical Measurements", Pearson Education India, 6th Edition, 2007.
2. Gregory K. McMillan, "Process/Industrial Instruments and Controls Handbook", McGraw-Hill: New York, 5th Edition, 1999.
3. Holman J.P., "Experimental Methods for Engineers", Tata McGraw-Hill., 7th Edition, 2004.
4. Williams Bolton, "Instrumentation and control", Elsevier Limited, 2nd Edition, 2015.
5. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes Publishers, 1st Edition, 2000.

**Course Objectives :**

1. To provide a basic knowledge about measurement systems and their components.
2. To introduce various sensors used for measurement of mechanical quantities.
3. To teach system stability and control.
4. To show integration the measurement systems with the process for process monitoring and control.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Select the suitable instrumentation systems for monitoring and control of Industrial processes. | V | Evaluate |
| CO2 | Measure mechanical quantities using instruments, their accuracy & range, and use the techniques for controlling devices automatically. | V | Evaluate |
| CO3 | Analyze system and its mathematical model for standard input responses. | IV | Analyze |

**CO-PO Mapping :**

| PO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | | M | | | | | | | | | | M | |
| CO2 | H | M | H | | | | | | | | | | M | |
| CO3 | H | | H | | | | | | | | | | H | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |

| | |
|---|---|
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1** | **6 Hrs.** |
|---|---|
| Significance of mechanical measurements, Classification of measuring instruments, Generalized measurement system, Types of inputs: Desired, interfering and modifying inputs. Static characteristics: Static calibration, Linearity, Static sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. Errors in measurement: Types of errors, Effect of component errors, Probable errors. | |
| **Module 2** | **7 Hrs.** |
| Displacement Measurement: Potentiometer, LVDT, Capacitance Types, Digital transducers, Nozzle flapper transducer. Measurement of Angular Velocity: Analog and Digital tachometers, Stroboscopic Methods. Acceleration Measurement: Theory of accelerometer and vibrometers Strain Measurement : Theory of strain gauges, gauge factor, Temperature compensation, Bridge circuit, Strain gauge based load cells and torque sensors | |
| **Module 3** | **7 Hrs.** |
| Pressure Measurement: Elastic pressure transducers, High pressure measurements, Bridge man gauge. Vacuum measurement Flow Measurement: Ultrasonic flowmeter, Magnetic flow meter, Rotameter. Temperature Measurement: Resistance thermometers, Thermistors and Thermocouples, Pyrometers. Sensitivity analysis of sensor. | |
| **Module 4** | **6 Hrs.** |
| Introduction to control systems. Classification of control system. Open loop and closed loop systems. Mathematical modelling of control systems, Concept of transfer function, Block diagram algebra. | |
| **Module 5** | **7 Hrs.** |
| Time Domain specifications. Step response of second order system. Steady-state error, Error coefficients, Steady state analysis of different type of systems using step, ramp and parabolic inputs. | |
| **Module 6** | **7 Hrs.** |
| Introduction to concepts of stability, The Routh criteria for stability, Experimental determination of frequency response, Stability analysis using Root locus, Bode plot and Nyquist Plots, State space modeling, Process control systems, ON-OFF control, P-I-D Control. | |

**Module wise Measurable Students Learning Outcomes :**
**After the completion of the course the student should be able to:**

1. Explain the use and principles of measuring devices and error measurements.
2. Demonstrate the working of various measuring instruments of displacements, strain, velocity, vibration measurement.
3. Discuss the working of various measuring devices for pressure, flow, temperature.
4. Construct a simple mathematical model for physical systems.

5. Analyze control system under different time domain.
6. Identify the suitable techniques for analyzing the response time and stability of the control systems.

# Professional Core (Lab) Courses

| Title of the Course: Fluid Mechaics and Fluid Machines Laboratory | L | T | P | Cr |
|---|---|---|---|---|
| Course Code: 5ME272 | 0 | 0 | 2 | 1 |

**Textbooks:**

1. Modi and Seth," *Fluid mechanics and hydraulic machines*", Standard book house, third edition 2012.
2. N.S. Govindrao, "*Fluid flow machines*", Tata Mc Hill, Second edition 1983.
3. Jagdish Lal, "*Fluid and Turbo machines*", New Age publisher, Second edition 1982.
4. S K Som, Gautam Biswas, Suman Chakraborty, "*Introduction to Fluid Mechanics and Fluid Machines*" Tata McGraw – Hill Publication. 3rd Edition, 2012.

**References:**

1. P.L. Balleny, "*Thermal Engg.*", Khanna pub. New delhi, third edition, 2002.
2. Cohen and Rogers, "*Gas turbines and Compressor*", Pearson Ed, second edition, 1996.
3. R. Yadav, "*Thermodynamics and Heat Engines – Vol-II*",CPH Allahabad , third edition 1999.

**Course Objectives:**

1. To introduce the students about basic principles and laws through conducting experiments in laboratory.
2. To enable the students to analyze the fluid turbo machines.
3. To develop skills in the evaluation of fluid turbo machines.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understand basic principles and laws and conduct the experiments for validation. | I | Understanding |
| CO2 | Investigate the performance parameters of fluid turbo machines. | IV | Analyzing |
| CO3 | Interpret the performance of fluid turbo machines. | V | Evaluating |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | | | | | | | | H | | | L | |
| CO2 | H | M | L | | | | H | | H | | | | L | H |
| CO3 | H | M | H | | M | L | | | | H | | H | L | H |

**Lab Assessments :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4 Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8 Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14 Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18 Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

**Course Contents:**

STUDY and demonstration.

1. Study of similarity principles.

**Experiments and Trials. ( All are compulsory)**

1. Experiment on impact of Jet.
2. Experiment on Prandtl type pitot type apparatus.
3. Verification of Bernoulli's Equation.
4. Calibration of Venturi meter and Orifice meter.
5. Determination of Minor losses in pipe fittings.
6. Determination of loss of friction in series of pipes.
7. Trial on Pelton Turbine.
8. Trial on Kaplan Turbine.
9. Trial on Francis Turbine.
10. Trial on Centrifugal Pump.
11. Trial on Multistage pump.
12. Trial on series and parallel pump.

| Title of the Course: Metal Forming and Manufacturing Lab<br>Course Code: 5ME273 | L | T | P | Cr |
|---|---|---|---|---|
| | 0 | 0 | 2 | 1 |

**Textbooks:**

1. P.N.Rao, *"Manufacturing Technology- Foundry, Forming and Welding"*, Vol. I Tata McGraw-Hill, 3rd edition, 2009.
2. P.C.Sharma, *"A Textbook of Production Technology(Manufacturing processes)"*,S. Chand & co,2006.
3. P.H.Joshi,*"Press Tools-Design and Construction"* ,S.Chand & Company Ltd.,2010, ISBN:81-219-2938-5

**References:**

1. W.A.J. Chapman , *"Workshop Technology"– Vol I, II & III,* CBS Publ.& Dist.N.Delhi
2. G.C.Sen, A.Bhattacharya, *"Principle of Machine Tools"*, New Central book agency, Kolkata
3. HMT, *"Production Technology"*, Tata McGraw-Hill Pub. Ltd.,N.Delhi
4. Edward G.Hoffmann ,"Jigs and Fixtures Design ", 5th Indian Edition, Delmar CENGAGE Learning, N.Delhi.

**Course Objectives :**

1. To Demonstrate different wood machining processes and operate the wood working lathe machine.
2. To Evaluate various types and properties of sand.
3. To Perform simple turning operation on centre lathe machine.
4. To Understanding of importance of Jigs and Fixtures design in mass production.
5. To acquire the knowledge of press tools working and their design aspects.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Defining the wood working as well as the handle the machine, tooling devices and equipment's. | II | Understanding |
| CO2 | Apply the knowledge of various Sand properties of moulding sand. | III | Applying |
| CO3 | Describe the working of Die-Punch set, Metal Strip layout, 3D Printing and Non-Conventional Processes. | III | Applying |

**CO-PO Mapping :**

| PO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | | | | M | | | | | L | | L | M | |
| CO2 | | | M | | | | | | | | | | | |
| CO3 | | | | | H | | | | | L | | | | |

**Lab Assessment:**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab work, submission and Attendance | Lab Course Faculty | During Week 1 to Week 4<br>Submission at the end of Week 5 | 25 |
| LA2 | Lab work, submission and Attendance | Lab Course Faculty | During Week 5 to Week 8<br>Submission at the end of Week 9 | 25 |

| | | | | |
|---|---|---|---|---|
| LA3 | Lab work, submission and Attendance | Lab Course Faculty | During Week 10 to Week 14<br>Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Test Performance and Oral Presentation | Lab Course faculty | During Week 15 to Week 18<br>Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

**Course Contents:**

1. Manufacturing Process Lab
   A. Carpentry shop: one Job of Pattern Making (04 hrs)
   B. Sand Testing Lab (08 hrs)
      a. Preparation of sand for mould and core making with demonstration of small components
      b. Tensile, Compressive and shear strength of moulding sand
      c. Permeability test for moulding sand
      d. Moisture content test for moulding sand
      e. Hardness test (mould/core)
      f. Sand Grain Size analysis (Grain Fineness No. on Sieve Shaker apparatus)
2. Simple turning Job (04 hrs)
3. Study of various types of Press Tools and design of Sheet Metal Die Set [on drawing sheet] or design of strip layout for die punch assembly. (04 hrs)
4. Study and Demonstration of 3D Printing process. (02 hrs)
5. Study and demonstration of various Non-Conventional Machining Processes. (04 hrs)

| Title of the Course: Kinematics and Theory of Machines Lab | L | T | P | Cr |
|---|---|---|---|---|
| Course Code: 5ME274 | 0 | 0 | 2 | 1 |

**Textbooks:**

1. Ratan S.S, *"Theory of Machines"*, Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2. V. B. Bhandari, *"Design of Machine Elements"*, Tata McGraw Hill, 3rd Edition, 2011
3. Sadhu Singh, *"Theory of Machines"*, Pearson Education, 2nd Edition, 2009

**References:**

1. Thomas Bevan, *"Theory of Machines"*, CBS Publishers, New Delhi, 1st Edition, 2010.
2. J. F. Shigley, *"Mechanical Engineering Design"*, , McGraw Hill, New York. 4th Edition, 2011

**Course Objectives :**

1. To develop skills of generation of gear tooth and cam profiles.
2. To prepare the students to perform the analysis of gear drives and mechanisms.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Apply principles of kinematics to plot velocity and acceleration diagrams of mechanisms. | III | Applying |
| CO2 | Investigate gear trains for various power transmission systems. | IV | Analyzing |
| CO3 | Evaluate various types of gears and belt drives. | V | Evaluating |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | | H | | | | | | | | | | L | |
| CO2 | | L | | H | L | | | | | | | | L | |
| CO3 | | | H | | L | | | | L | | | | L | |

**Lab Assessments :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4 Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8 Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14 Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18 Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

**Course Contents:**

**Term Work contains following:-**

1. To plot displacement, velocity and acceleration curves for two types of cam follower systems.
2. To verify angular displacement ratio of shafts connected by Hooke's joint
3. To find out Coriolis component of acceleration.
4. To develop computer program for velocity and acceleration analysis of four bar chain and single slider crank mechanism.
5. To generate involute gear tooth profile.
6. To solve problems on epicyclic gear train by tabular method.
7. To determine moment of inertia by Bi-filler suspension, Tri-filler suspension or compound pendulum method.
8. To study different mechanisms and analyse them with respect to links, joints, Degrees of freedoms.
9. To analyse gear trains in lathe, drilling, milling machine etc
10. To study any one automobile gearbox.

| Title of the Course: Presentation and Report Writing<br>Course Code 5ME276 | L | T | P | Cr |
|---|---|---|---|---|
| | 1 | | | 1 |

**Textbooks:**

As per topic chosen by student.

**References:**

As per topic chosen by student.

**Course Objectives :**

1. To review and increase student's understanding of the specific topics.
2. To read, summarise and review research articles and gain an understanding of a new field, in the absence of a textbook.
3. To judge the value of different contributions and identify promising new directions.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Review and increase their understanding of the specific topics. | II | Understanding |
| CO2 | Read research papers critically and efficiently. | II | Understanding |
| CO3 | Summarize and review the topics in absence of textbooks. | III | Applying |

**CO-PO Mapping :**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO-1 | PSO-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | | | | | | | | | | | M | |
| CO2 | M | M | L | | L | | | L | L | | | | M | |
| CO3 | M | M | L | | M | L | | | M | | | | L | |

**Assessments :**

In semester Evaluation -100 Marks

| Assessment | Marks |
|---|---|
| ISE | 100 |

**Course Contents:**

| | |
|---|---|
| Based on any recent subject student should choose the topic for report writing and presentation. (Subcomponents: Introduction, Literature review, modelling (if any), case study, applications, advantages, disadvantages, future scope and conclusions etc.) | **1 Hrs./ week** |

**Module wise Measurable Students Learning Outcomes :**

**After the completion of the course the student should be able to:**

1. Student will be able to learn about new technology areas from literature available in various engineering areas.