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|---|---|---|---|---|---|
| **Course Code** | **BSC_ME401** | | | | |
| **Category** | **Basic Science Courses** | | | | |
| **Course Title** | **Laplace, Fourier and Z-Transforms** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester - 4 (Four)** |
| | **2** | **1** | **0** | **3** | |
| **Pre Requisites** | **Limits, Improper integrals, A.P and G.P series.** | | | | |

**Objectives:**

To understand various transformation techniques and their use to solve boundary value problems and various linear differential equations

| **M. No:** | **Topic** | **No. of Hrs** |
|---|---|---|
| Module 1. | Laplace transform- Laplace transform, condition for the existence of Laplace transform, Laplace transform of some elementary functions, differentiation and integration of laplace transform, laplace transform of periodic functions, shifting theorem, Laplace transforms of different functions, Heaviside's unit function, dirac delta function its Laplace transforms, Heaviside's expansion theorem . | 10 |
| Module 2. | Inverse Laplace transforms- initial and final value theorems, convolutions theorem and applications, uses of Laplace transforms in the solutions of linear differential equations. | 05 |
| Module 3. | Fourier series- Fourier series, odd and even functions, half range Fourier sine and cosine series. | 05 |
| Module 4. | Fourier transform- Finite Fourier transforms, fourier integral formula, properties of fourier transform, Fourier sine and cosine transform, convolution theorem, parseval's identity for fourier transform Fourier integral formula, applications to solutions of boundary value problems. | 10 |
| Module 5. | Z-transform- definition, linearity property, Z-transform of elementary functions, shifting theorems, initial and final value theorem, convolution theorem. | 07 |
| Module 6. | inverse Z-transform- inversion of Z-transforms, use of Z-transforms in solving difference equations . | 05 |
| | **Total number of Hours** | **42** |

**Course Outcomes:**

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

- ***Evaluate*** Laplace and Inverse Laplace transforms of various functions and related problems **(L5)**.
- ***Evaluate*** Fourier and Inverse Fourier transforms of various functions and related problems **(L5)**.
- ***Apply*** the methods of laplace and Fourier transforms in solving ODE,and PDE **(L3)**.

| **S.No:** | **Text Books** | **Author** | **Publisher** |
|---|---|---|---|
| 1. | Schaum's outlines laplace transform | M. R. Spiegel | Tata Mc-Graw Hill |
| | **References** | | |
| 1. | Advanced Engg mathematics | Erwin Kreysing | Wiley Eastern. Pub. |
| 2. | Higher Engg Mathematics | B.S. Grewal | Khanna publishers |
| 3. | Advanced Engg Mathematics | Michael D Greenberg | PHI,2001 |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME402** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Solid Mechanics-I** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester - 4 (Four)** |
| | **3** | **1** | **0** | **4** | |
| **Pre requisites** | **Statics and Dynamics** | | | | |

**Objectives:**

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

| M. No: | Topic | No. of Hrs |
|---|---|---|
| Module 1. | An introduction to stress and strain, stress-strain diagram, Poisson's ratio, multiaxial loading- generalized Hooke's law, dilatation and bulk modulus, shearing strain, deformations under axial loading, stress concentrations, plastic deformations, residual stresses, elastic constants and their relations, statically indeterminate problems, problems involving temperature change. | 16 |
| Module 2. | Transformation of plane stress, transformation equations, principal stresses and maximum shearing stress, Mohr's stress, general state of stress, three dimensional analysis of stress, transformation of plane strain, transformation equations, Mohr's circle for plane strain, three dimensional analysis of strain, measurement of strain and strain rosette. | 12 |
| Module 3. | Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends stresses and deflection of helical springs | 12 |
| Module 4. | Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, shear stresses in beams of rectangular and circular cross section, shear stresses in the webs of beams with flanges, shear centre concept and its determination for thin walled members. | 12 |
| Module 5. | Thin and thick walled pressure vessels, stresses in thick and thin cylindrical and spherical pressure vessels subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure. | 12 |
| **Total number of Hours** | | **52** |

**Course Outcomes:**

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

- ***Recognise*** various types of loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components **(L1).**
- ***Evaluate*** the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading **(L5).**

| S.No: | Text Books | Author | Publisher |
|---|---|---|---|
| **1.** | Mechanics of Materials | Beer and Johnston | McGraw Hill, 2015 |
| | **References** | | |
| 1. | Mechanics of Materials | J.M. Gere and S.P. Timoshenko | Cengage Learning, 1997 |
| 2. | Introduction to Solid Mechanics | I.H. Shames and J.M. Pitarresi | Prentice Hall of India,1999 |
| 3. | Engineering Mechanics of Solids | Popov. E.P | Prentice Hall of India, 2004 |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME402L** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Solid Mechanics-I Lab** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **0** | **0** | **2** | **1** | |
| **Pre requisites** | - | | | | |

**Objectives:**

To understand the measurement of mechanical properties of materials. To understand the deformation behaviour of materials. To understand the kinematic and dynamic characteristics of mechanical devices

| **M. No:** | **Topic** |
|---|---|
| Module 1. | Tensile test of mild steel and aluminum bars. |
| Module 2. | Shear test on specimens of two different metals. |
| Module 3. | Charpy and Izod Impact test on a metallic specimen. |
| Module 4. | Brinnell and Rockwell hardness tests on metallic specimens. |
| Module 5. | Bending deflection test on beams. |
| Module 6. | Strain measurement using rosette strain gauge. |
| Module 7. | Torsion test on specimens of different metals for determining the angle of twist for a given torque. |
| Module 8. | Compressive test of a specimen. |
| Module 9. | Shear test on specimens of two different metals. |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME403** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Theory of Machines-I** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **3** | **1** | **0** | **4** | |
| **Pre requisites** | **Statics and Dynamics** | | | | |

**Objectives:**

To develop a solution oriented approach by in depth knowledge of Theory of Machines and to address the underlying concepts, methods and application of different machines.

| **M. No:** | **Topic** | **No. of Hrs** |
|---|---|---|
| Module 1. | Introduction, kinematic chain, planar mechanisms, lower pairs & higher pairs, degree of freedom (DOF), Kutzbach criterion and Grubler's equation, Grashof's law, inversions of simple mechanisms, quick return motion mechanisms, mechanical advantage | 06 |
| Module 2. | Instantaneous centre, Arnold Kennedy theorem, method of locating instantaneous centres in a mechanism, velocity and acceleration analysis of mechanism by graphical and analytical approach (application to simple mechanisms and their inversions). | 06 |
| Module 3 | Bearings, working and analysis of pivot, collar/ thrust & journal bearings, friction circle and friction axis of journal bearings, rolling contact bearings, friction clutches, single plate clutch and multi disc clutch, centrifugal clutch, brakes, | 13 |

| | | |
|---|---|---|
| | classification, working and analysis of simple block brake, double block brakes, long shoe brake, band brake, braking of vehicle. | |
| Module 4 | Working and analysis of different types of governors (watt, porter, Hartnell and Proell), sensitivity, stability, hunting, isochronism, effort and power of a governor, working and analysis of flywheel | 06 |
| Module 5. | Classification of cams and followers, terminology for cams, types of motion curves and their analytical expressions, graphical construction of cam profile for different types of followers, pressure angle , force analysis of cam-follower systems. | 07 |
| Module 6 | Rolling contact and positive drive, classification of gears, nomenclature, law of gearing, conjugate teeth, involute and cycloidal profile system of gear teeth, Length of path of contact, arc of contact, contact ratio, gear ratio, interference and undercutting, helical and spiral gears. | 06 |
| Module 7 | Gear trains, classification, Types, simple gear train, speed ratios, compound, reverted, epicyclic gear train, tabulation and algebraic method, compound epicyclic train. | 04 |
| Module 8 | Processional motion and angular acceleration, gyroscopic couple, reaction couple. effects on an aeroplane, naval ship. | 04 |
| **Total number of Hours** | | **52** |

**Course Outcomes:**

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

***Perform*** synthesis of mechanism by analytical and graphical method **(L2).**

***Analyze*** Influence of Inertia upon Velocity & Acceleration **(L4).**

***Demonstrate*** & perform Gravity and spring control governors evaluation **(L3)**.

***Demonstrate*** flywheel and its effect on dynamics of the system **(L3).**

***Design*** cam profile for given follower motions and ***understand*** cam Jump phenomenon, advance cam curves **(L6)**.

***Understand*** fundamentals of gear theory **(L2)**.

***Perform*** force analysis of Spur, Helical, Bevel, Worm gear **(L3)**.

***Demonstrate*** & perform gyroscope evaluation **(L3)**.

| **S.No:** | **Text Books** | **Author** | **Publisher** |
|---|---|---|---|
| **1.** | Theory of Mechanisms and Machines | Amitabha Ghosh and Ashok Kumar Mallik | EWP, 2007 |
| | **References** | | |
| 1. | Theory of Machines | Shigley | McGraw Hill, 1995 |
| 2. | Theory of Machines | Bevan | C.B.S Publication, 1997 |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME403L** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Theory of Machines-I Lab** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **0** | **0** | **2** | **1** | |
| **Pre requisites** | - | | | | |

| **M. No:** | **Topic** |
|---|---|
| Module 1 | Study of kinematic pairs. |
| Module 2. | Study slider crank motion, reciprocating engine mechanism, Inversion of four bar chain, oscillating cylinder mechanism and whitworth quick return mechanism. |

| | |
|---|---|
| Module 3 | Study the working of various models of brakes. |
| Module 4. | Study the working of various models of clutch. |
| Module 5. | Study the characteristics of a Watt Governor, Proell Governor, Porter Governor and Hartnell Governor. |
| Module 6. | Study characteristics of various types of cams and followers. |
| Module 7 | Determine the velocity of precession of a given motorized gyroscope. |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME404** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Manufacturing Technology-II** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **2** | **1** | **0** | **3** | |
| **Pre requisites** | | | | | |

**Objectives:**

To emphasize the importance of manufacturing sciences in day-to-day life, and to study the basic manufacturing processes and tools. To study the basics of metal machining and mechanics of metal machining and different cutting tool materials & geometry of cutting tools.

| **M. No:** | **Topic** | **No. of Hrs** |
|---|---|---|
| Module 1. | Metal cutting- tool materials, tool geometry and nomenclature in *ASA, ORS* and *NRS,* cutting fluids, single and multipoint cutting operations, production of gears and screw threads, grinding and finishing processes, specification of grinding wheels, honing, lapping, tool-workpiece interaction (Merchant circle diagram). | 12 |
| Module 2. | Machine tools- primary and secondary drives, guideway and slideways, structure. Introduction to *NC, CNC* and *DNC* machining and part programming. | 10 |
| Module 3. | Non-conventional machining methods: process capabilities and limitations of *AJM*, *USM, WJM, ECM, ECG, EDM, EBM* and *LBM* processes. | 08 |
| Module 4. | Joining processes- conventional welding processes, heat affected zone, testing of welded joints, solid state welding processes, weld defects, brazing and soldering, process selection, adhesive bonding, mechanical fastening processes, inspection of welding joints. | 08 |
| Module 5. | Process variables, metrology- limits, fits and tolerances, hole basis and shaft basis system, Taylor's principles of gauge design. | 04 |
| **Total number of Hours** | | **42** |

**Course Outcomes:**

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

- ***Understand*** the basic concept of machining, tool geometry, mechanism of chip formation, and the factors affecting the machining process **(L1).**
- ***Select*** cutting fluids, tool materials and coatings to control tool wear and temperature **(L1).**
- ***Understand*** the mechanics of grinding, economy of machining and grinding, advanced technology of machining and grinding **(L1).**
- ***Understand*** basic concepts of NC, CNC and DNC machining and part programming **(L2).**
- ***Explain*** and analyse the conventional machining processes **(L3).**
- ***Analyse*** the welding process behaviour for fusion and solid state welding techniques **(L4)**

- ***Understand*** the basics of limits, fits and tolerances in manufacturing **(L5).**

| S.No: | Text Books | Author | Publisher |
|---|---|---|---|
| 1. | Manufacturing Science | Amitabha Ghosh, Asok Kumar Mallik | East-west press pvt ltd |
| 2. | Manufacturing Technology. | P N Rao. | Tata McGraw-Hill Publishing Co. Ltd., New Delhi. |
| | **References** | | |
| 1. | Manufacturing Engineering and Technology. | S Kalpakjian. | Addison-Wesley (India). |
| 2. | Materials and Processes in Manufacturing. | E P DeGarmo, J T Black and R Kosher. | Macmillan International. |
| 3. | Fundamentals of Manufacturing Processes. | G K Lal and S K Choudhary. | Narosa Publishing House, New Delhi. |
| 4. | Non conventional Machining. | P K Mishra. | Narosa Publishing House, New Delhi. |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME404L** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Manufacturing Technology-II Lab** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **0** | **0** | **2** | **1** | |
| **Pre requisites** | | | | | |

**Objectives:**

To impart hands-on practical exposure on manufacturing processes and equipment. To study and practice the various machining operations that can be performed in lathe and equip students with the practical knowledge required in the manufacturing/production companies.To understand the arc welding, gas welding and resistance welding equipment for the fabrication of welded joints.

| M. No: | Topic |
|---|---|
| Module 1. | Performing step turning and taper turning on a lathe machine. |
| Module 2. | Performing drilling and boring operations on a lathe machine. |
| Module 3. | Performing external thread cutting on a lathe machine. |
| Module 4. | Study of a surface grinding machine performing surface grinding on washers. |
| Module 5. | Setting of oxy-acetylene welding equipment and setting of flame. |
| Module 6. | Setting up an arc welding machine and accessories, and striking an arc. |
| Module 7. | Deposit straight line bead on MS plate in flat position. |
| Module 8. | Testing of weld joints by visual inspection. |
| Module 9. | Carry out dye penetrant test on welded joints. |
| Module 10. | Use of sine bars and slip gauges for angle measurement. |
| Module 11 | Use of bevel protector and dial gauges. |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME405** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Applied Thermodynamics** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **2** | **1** | **0** | **3** | |
| **Pre requisites** | **Basic Engineering Thermodynamics** | | | | |

**Objectives:**

To provide an overview of the application of thermodynamic principles to the design and optimization of Thermal Engineering Systems.

| **M. No:** | **Topic** | **No. of Hrs** |
|---|---|---|
| Module 1. | Combustion- combustion analysis, air requirement, air/fuel ratio, standard heat of reaction,heat of formation. | 05 |
| Module 2. | Boilers- steam generators-classification, working of fire-tube and water-tube Boilers, boiler mountings and accessories. | 07 |
| Module 3. | Vapour power cycles- carnot vapour power cycle,rankine cycle, modified rankine cycle, working of steam power plant, binary vapour cycle. | 08 |
| Module 4. | Nozzles- flow through nozzle, variation of velocity, area and specific volume, choked flow, nozzle efficiency, off design operation of nozzle, super saturated flow. | 07 |
| Module 5. | Steam turbines- classification of steam turbine, compounding of impulse turbine, velocity diagrams, reaction turbine, degree of reaction, work output, governing of turbine. | 08 |
| Module 6. | Condensers- type of condensers, air leakage, condenser performance parameters | 05 |
| | **Total number of Hours** | **42** |

**Course Outcomes:**

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

- ***Define*** air/fuel ratio and **calculate** stoichiometric air/fuel ratio for different fuels **(L1)**.
- ***Define*** steam boilers and **classify** the boilers based on circulation,position,tube,method of firing,pressure **(L1)**.
- ***Understand*** the different boiler mountings and accessories **(L1)**.
- ***Analyse*** the different vapour power cycles **(L4)**.
- ***Compare*** the work ratio,efficiency,SSC, net work output for different vapour power cycles **(L5)**.
- ***Explain*** the operation of steam turbines **(L2)**.
- ***Analyze*** the energy conversion in various thermal devices such as nozzles,condensers,steam turbines **(L4)**.
- ***Understand*** the working of steam condensers and classify the condenser based on working **(L1)**.

| **S.No:** | **Text Books** | **Author** | **Publisher** |
|---|---|---|---|
| 1. | Applied Thermodynamics for Engineering Technologist. | T. D. Eastop & McConkey | Pearson Education |
| | **References** | | |
| 1. | Engineering Thermodynamics | P K Nag | Mc Graw Hill |
| 2. | Fundamentals of Engineering Thermodynamics | Moran M J and H N Shapiro | Wiley |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME405L** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Applied Thermodynamics Lab** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **0** | **0** | **2** | **1** | |
| **Pre requisites** | **Basic Engineering Thermodynamics** | | | | |

**Objectives:**

To identify various boiler mountings and accessories and to to find power output & efficiency of a steam turbine.

| M. No: | Topic |
|---|---|
| Module 1. | Study the working of different Boilers. |
| Module 2. | Calculation of heat balance sheet of a boiler. |
| Module 3. | Calculation of dryness fraction of steam. |
| Module 4. | To study the working of impulse and reaction steam turbines. |
| Module 5. | To study various types of steam condenser. |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME406** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Measurement and Instrumentation** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester- 4 (Four)** |
| | **2** | **1** | **0** | **3** | |
| **Pre requisites** | **Engineering Physics, Laplace Transform, Basic electronics** | | | | |

**Objectives:**

To introduce the basics of measurements and different error analysis methods. To understand concepts of various electrical and electronic measuring instruments.

| M. No: | Topic | No. of Hrs |
|---|---|---|
| Module 1. | Definitions, significance, fundamental methods of measurement, generalized measurement system, types of input quantities, standards, calibration, classification of instruments, errors, methods of correction, generalized performance characteristics, static characteristics, static calibration, dynamic characteristics, zero and first order instruments, time constant, second-order instruments, transient response characteristics. | 10 |
| Module 2. | Transducer elements, motion and vibration measurements, force measurement-balance principle of force measurement, hydraulic and pneumatic load cell, elastic force devices. | 9 |
| Module 3. | Torque and power measurement- dynamometer (absorption, driving and transmission type). | 4 |
| Module 4. | Pressure measurement- Instruments for high, mid and low pressure measurement, dead weight and null type, elastic element gauges, differential pressure cell, high pressure measurement, Low pressure measurement, Pirani gauges & Mcleod pressure gauge. | 7 |

| | | |
|---|---|---|
| Module 5. | Flow Measurement: orifice meters, Venturimeter, Pitot tube, flow nozzle, variable area meters, rotameter, design and accuracy, positive displacement flow meter, turbine flow meter, electromagnetic flow meter, ultrasonic flow meters | 6 |
| Module 6. | Temperature measurement: non electrical and electrical methods of temperature measurement, radiation methods | 6 |
| **Total number of Hours** | | **42** |

**Course Outcomes:**

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

- ***Explain*** the working of different electromechanical indicating instruments **(L2)**
- ***Define*** the static and dynamic characteristics of measurement systems.
- ***Define*** the different transducers.
- ***Understand*** the functioning and use of temperature measuring instruments.
- ***Analyze*** the instrumentation for displacement, strain, velocity, force, toque, power, pressure.

| **S.No:** | **Text Books** | **Author** | **Publisher** |
|---|---|---|---|
| | Instrumentation, Measurements & Analysis | Nakra B.C. | Tata McGrawHill, N.Delhi |
| | **References** | | |
| | Mechanical Measurements | Beckwith, B | Pearson Education Int. |
| | Measurement systems | Doeblin, E.O | McGraw Hill |

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|---|---|---|---|---|---|
| **Course Code** | **PCC_ME406L** | | | | |
| **Category** | **Professional Core Course** | | | | |
| **Course Title** | **Measurement and Instrumentation Lab** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | **Semester - 4 (Four)** |
| | **0** | **0** | **2** | **1** | |
| **Pre requisites** | | | | | |

**Objectives:**

To measure different input quantities using various types of transducers. and to make use of different flow measuring devices.

| **M. No:** | **Topic** |
|---|---|
| Module 1. | To measure displacement using *LVDT*. |
| Module 2. | Measurement of strain using strain gauge. |
| Module 3. | To study characteristics of various temperature measuring instruments like thermocouple, thermistor and *RTD*. |
| Module 4. | To measure flow rate using different flow measurement devices. |
| Module 5. | To study the working of Bourdon pressure gauge and to check the calibration of the gauge in a deadweight pressure gauge calibration set up. |