Bansilal Ramnath Agarwal Charitable Trust’s

B. Tech. (Industrial Engineering)

Pattern ‘B19’
Effective from Academic Year 2019-20

Prepared by: - Board of Studies in Industrial & Production Engineering
## S.Y. B. Tech. Industrial Engineering AY 2019-20 (B19)

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| **Semester-2 (Module-IV)** |             |                                       | 14           | 12         |    |    |     |        |     |       | 22   |       |
| S1          | IE2036       | Thermal & Fluid Engineering           | 3            | 2          | 10 | 30 | 15  | 10     | 15 | 20   | 100  | 4     |
| S2          | IE2037       | Material Science                      | 3            | 2          | 10 | 30 | 15  | 10     | 15 | 20   | 100  | 4     |
| S3          | IE2038       | Casting & Joining Technologies        | 3            | 2          | 10 | 30 | 15  | 10     | 15 | 20   | 100  | 4     |
| S4          | IE2039       | Design of Machine Elements            | 3            | 2          | 10 | 30 | 15  | 10     | 15 | 20   | 100  | 4     |
| S5          | IE2186       | Engineering Design & Innovation - 2   | 1            | 2          | -- | -- | --  | --     | -- | --   | 100  | 4     |
| S6          | IE2040       | Machine Drawing & Computer Graphics   | 1            | 2          | -- | 70 | --  | 10     | -- | 20   | 100  | 2     |
| S8          | IE2088       | **GP2                                 | --           | --         | -- | -- | --  | --     | -- | --   | 0    | --    |

**(*) Audit Course evaluated in second semester**
Module III
IE2001::THEORY OF MACHINES

Credits: 04

Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1


2. Kinematic Analysis of Mechanisms: Introduction, Motion of a link, velocity of a point on a link by relative velocity method, velocity in a slider crank mechanism, introduction, acceleration diagram for a link, acceleration of a point on a link by relative acceleration method, Klein’s construction.


SECTION-2

1. Cams and Followers: Introduction, applications, types of cams and followers, terms used in radial cams, analysis of motion of follower, displacement, velocity, and acceleration diagrams for various types of follower motions: uniform velocity, SHM, uniform acceleration and retardation, cycloidal motion, construction of cam profile for roller, knife edge, flat faced followers and oscillating follower.

2. Spur Gear: Advantages and disadvantages of gear drive, classification of toothed wheel, terms used in gears, involute and cycloidal profile, condition for constant velocity ratio-law of gearing, length of path of contact, length of arc of contact, interference in involute gears.


4. Introduction to brakes and dynamometers.

List of Practicals:
1) Graphical solution of problems on velocity in mechanisms by Relative velocity method.
2) Graphical solution of problems on acceleration in mechanisms by Relative acceleration method.
3) Graphical solution of problems on velocity and acceleration in mechanisms by Kleins construction method.
4) Determination of moment of inertia of rigid body by bifilar suspension method.
5) Determination of moment of inertia of rigid body by trifilar suspension method.
6) To draw a conjugate profile for any general shape of gear tooth.

7) To draw a cam profile for specific follower motion.
8) Determination of radius of gyration of a connecting rod using theory of compound pendulum.
9) Demonstration and explanation of configuration diagram of working models based on four bar chain, single slider crank mechanism, and double slider crank mechanism for various link positions (any two models).
10) Verification of cam jump phenomenon.
11) To perform experiment on Watt Governors and to find speed, height of a Watt governor and obtaining the graph of governor speed Vs height of governor.
12) Demonstration and study of Hookes joint.

List of Projects:
1. Automatic bar feeding mechanism
2. Gear indicator for two wheelers
3. Peddling washing machine
4. Material handling system
5. Peddling pump
6. Sheet metal bend removing machine
7. Power generation using Speed breaker
8. Automated material transferring system
9. Foot step pressure electrical power generator
10. Automatic rain activated wiper
11. Cam operated expanding mandrel
12. Hydraulic forklift
13. Pedaling dress washing machine
14. Pedal controlled mobile charger cum emergency light
15. Automatic fuel tank filling system
16. Automatic speed breaking systems
17. Digital vehicle fuel level indicator
18. Automatic rain operated wiper
19. Pneumatic pick & placement robot
20. Automatic packaging and stamping systems
21. Automatic gear display
22. Automatic brake failure indicator
23. Automatic soap rapping machine.
24. Automatic bottle filling system
25. Mechanical four wheels steering
26. Speed control governor
27. Conveyor using Geneva mechanism.
28. Cam operated punching machine
29. Pantograph
30. Cam operated hammer

Text Books:

Reference Books:

Course Outcomes:
The student will be able to –
1. Classify different types of links and mechanisms used for different purposes in different machines.
2. Draw velocity and acceleration diagrams of various mechanisms.
3. Analyze different types of governor.
4. Construct cam profile for the specific follower motion.
5. Understand the mechanism of spur gear and identify the various types of gears.
6. Understand the mechanism of gear trains and distinguish between various gear trains.
7. Determine the dynamic behavior principles and operations of breaks & dynamometers.

Web site: www.nptelvideos.in
nptel.ac.in/courses/112104121
IE2002::MACHINE TOOLS & PROCESSES

Credits: 04

Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1

1. Lathe and turning operations and Gear Cutting: Lathe and its accessories, lathe specifications, lathe cutting tools, speed, feed and depth of cut, various operations on lathe (turning, boring-taper turning, threading etc.) Geometry of single point cutting tools, tool materials and their properties, coolants and lubricants, Introduction to high speed machining

2. Shaper, planer and slotting machines & Drilling Machines and Related Operations: Basic Introduction to shaping and planing operations: Definition, type of shapers and planers. Quick return mechanism, cutting speed and feeds, machining time

3. Milling Machines and operations: Various milling operations and types, accessories and standard and special equipment, Universal dividing head, angular milling attachment, standard index base, Types of indexing (direct simple, differential compound spiral, angular), size, shape and materials of milling cutters, cutting speeds, feed and depth of cut, machining time, Vertical milling attachment, high speed milling attachment, slotting attachment, vice

SECTION-2

Drilling, Gear and Thread Cutting: Types of drilling machines, equipment, size of drilling machine, Drilling operations, boring drills and reamers, cutting speeds and feeds, machining time, Thread cutting - internal and external chasers, dies, thread rolling thread milling, lapping and grinding

Gear cutting - Forming & generation, gear cutting on milling, gear hobbing, gear shaping, gear shaving, lapping & grinding, various machines use for gear manufacturing. Thread cutting & processes.


Broaching Operations and Non-conventional machining processes: Definitions, types of broaching, machines cutters for broaching, materials for broach, cutting action, chip disposal, broaching speeds, application of broaching, Advantages and limitations of broaching operations

Non-conventional machining processes: comparison with conventional machining, classification, principle, working advantages, disadvantages and applications of ECM, EDM, AJM, LBM, IBM, EBM.
List of Practicals:
1. Introduction, functions and operations of lathe parts,
2. Lathe tools and measuring instruments,
3. Demonstration of different lathe operations, such as knurling, grooving, drilling, boring, reaming, threading,
4. Safety precautions
5. One simple job involving few lathe operations.
6. One composite job involving the above mentioned operations.
7. Introduction, demonstration of milling operations such as plain milling, end milling, gear cutting
8. Demonstration on CNC lathe machine
9. Demonstration and exercise on assembly of machine parts in a group of students.
10. Introduction of Preventive and breakdown maintenance,
11. Demonstration and exercise on inspection of a machine, minor repairs and lubrication.

Text Books:
1. Chapman, Workshop Technology

Reference Books:
3. Hazra Choudhary S. K. Bose S. K., Elements of Workshop Technology: Volume I, II. Asia Publishing House:

Course Outcomes:
Students will be able to:
1. Understand basic construction and working of various Machine tools used for metal removal processes
2. Select proper work and tool holding devices, attachments and accessories of a machine tool and
3. Illustrate conventional and unconventional machining processes performed on various machines
4. Understand various tool geometries and select appropriate cutting tools to obtain required finished component
5. Define process parameters like cutting speed, feed and depth of cut and evaluate machining time for machining processes
6. Machine simple and composite job involving few lathe and milling operations
IE2003::METROLOGY AND MECHANICAL MEASUREMENTS

Credits: 04  
Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1

1. Introduction to Metrology

2. Angular Measurement
Sine bar, Auto Collimator, Sine Center, Uses of sine bars, angle gauges, Angle Dekkor, vernier bevel protractor Comparators: Uses, Types, Advantages and Disadvantages of mechanical comparators, Optical, Electrical, Pneumatic Comparators.

3. Limits, Fits and Tolerances

4. Measurement of Surface Finish and geometric parameters & Interferometry
Surface Texture, Meaning of RMS and CLA values, Grades of Roughness, Specifications, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica

SECTION-2

1. Inspection of Geometric parameters: Straightness, Flatness, Squareness Parallelism, Circularity and Rotation, measurement of run out and concentricity.

Interferometry: Introduction, Flatness testing by interferometry, NPL Flatness Interferometer.

2. Screw & Gear Metrology

3. Computer aided and laser metrology
Co-ordinate measuring machine; applications; laser micrometer, laser interferometer, laser scanning gauge, non-contact and in- process inspection, vision system.

4. Mechanical Measurement- Transducers- Analog & digital transducers, types Pressure measurement- Mechanical & Electromechanical instruments/devices Velocity measurement—linear & angular velocity measurement Temperature Measurement – Non-
electrical, Electrical & Radiation methods (pyrometry) Strain Measurement -Strain gauge – classification (metallic, semiconductor), gauge factor, properties of gauge wire, rosettes
Force Measurement - Basic methods of force measurement, Strain gauges, LVDT Shaft power Measurement -Belt, Gear Dynamometer, Absorption Dynamometer

Any six experiments of the following:
1. Linear measurements by precision measuring instruments
2. Angular measurements by sine bar
3. Dial Gauge calibration
4. Design of limit gauge
5. Measurement of roundness using Johanson’s comparator
6. Surface finish measurement
7. Use of interferometer for study of various surfaces
8. Profile Projector for measurement of screw thread parameters and saw tooth parameter
9. Measurement of gear tooth parameters
10. Measurement of screw thread parameters using floating carriage micrometer
12. Study of Toolmakers Microscope

List of Practicals/Projects:
1. Laser based measuring systems
2. Machine vision system
3. In process gauging system
4. Image analysis for measurement
5. Case study – cordinate Measuring Machine
6. Pneumatic gauge
7. Model for solex pneumatic comparator
8. Model for electrical comparator (visual gauging head)
9. Models for
   – Force measurement
   – Torque measurement
   – Speed measurement
   – Measurement of temperature at the Furnace
   – Laser beam machining / Turning
10. Design and manufacturing of gauges for particular application
11. Calibration set up for
   – Slip gauges
   – Micrometer
   – Vernier Caliper, etc.
12. Measurement of micro components and micro features
13. Set up for measurement of
   – Roundness
   – Straightness
   – Squareness
   – Flatness
14. Remote measurement of
15. Test set up for measurement of
   - Pitch of screw thread
   - Involute profile of Gear teeth
16. Gear Roller Tester setup
17. Development of camera based systems for micro-coordinate metrology
18. Color based product sorting system using PLC
19. PLC based sorting system using metal detection
20. Pneumatic displacement gauge
21. Dimension sensing probe
22. Air Gauging
   - C Jet Air Gauge
   - E Jet Air Gauge
   - Accessories Filter Sets
23. Electronic Gauging
   - Electronic Column Gauging
   - Electronic Display Unit
   - Four Channel LCD Display Unit
   - Air Electronic Gauging
24. Air Probes
   - Air Plug Gauges
   - Air Ring Gauges
   - Air Snap Gauges
   - Special Air Probes
25. Contact Type Plug
   - Contact Type Plug for Bore Measurement
26. Multi Gauging Fixtures for
   - Con Rod Pneumatic Measurement
   - Con Rod contact type
   - Con Rod contact type for Matching Rod & Cap
   - Crank Shaft pneumatic measurement
   - Contact type snap for Crank Shaft
   - Spline Shaft measurement
   - Camshaft
   - Camshaft profile measurement
   - Cylinder Block measurement
   - Piston
   - Axle & Axle flange measurement
   - Pump body
   - Cylinder liner measurement
27. Auto Gauging Fixtures for
   - Con Rod sorting system
   - Con Rod marking and sorting system
– Crank Shaft and crank case
– Crank Shaft auto gauging with grading and marking
– Cylinder Block
– Bombshell online measurement
– Cylinder Liner

Text Books:

Reference Books:

Course Outcomes:
The student will be able to –
1. Measure length using line-graduated instruments, i.e. vernier calipers, micrometers etc.
2. Measure angle precisely using precision angular measuring instruments like vernier bevel protractor, sine bar, clinometers, angle dekkor and auto collimator.
3. Design Go and No Go gauges based on principles of limits, fits and tolerance and effectively use of comparators of various types.
4. Apply knowledge of various instruments and methods to determine geometry and surface finish and dimensions of industrial components.
5. Use effective methods of measuring screw threads and gear teeth parameters.
6. Select and measure variables using appropriate sensors and transducers.
IE2004::MECHANICS OF MATERIALS

Credits: 04  
Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1

1. Simple Stresses and Strains: Concept of stress and strain (Linear, lateral, shear and volumetric) Hooke’s law. Poisson’s ratio, modulus of elasticity, modulus of rigidity, stress-strain diagrams for ductile and brittle materials, factor of safety, working stress, generalized Hooke’s law, bulk modulus, interrelation between elastic constants. 
Elementary Treatment of Axial force diagram, stresses, strains and deformations in determinate, homogeneous and composite bars under concentrated loads. Normal and Shear Stresses on any oblique plane;

Elementary Treatment of Concept of buckling of columns. Derivation of Euler’s formula for buckling load for column with hinged ends. Concept of equivalent length for various end conditions. Limitations of Euler’s formula. Rankine’s formula 
Derivations of Various Formulae, Safe Load on Columns

3. Shear Force and Bending Moment Diagrams
Elementary Treatment of Shear force and bending moment in determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads and couples. 
Relation between SF and BM diagrams for cantilevers, simple and compound, cantilever beams, Construction of loading diagram and BMD from SFD and construction of loading diagram and SFD from BMD 
Derivations of Various Formulae, Bending of curved bars/beams (Winkler & Bach Theory) 
Stresses in ring, chain link and crane hooks

SECTION-2

1. Torsion of Shafts & Thin Cylinders: Pure Torsion – Theory of pure torsion with assumptions, Deformation in circular shaft, polar moment of inertia, elastic torsion formula, Torsional failure, 
Stresses in thin walled pressure vessels, Cylindrical pressure vessels, Spherical pressure vessels. Mohr’s circle for thin walled pressure vessels

2. Principal Stresses and Strains: Concept of principal planes; Derivation of expressions for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear, combined effect of axial force, bending and torsion. Derivations of Various Formulae; Graphical solution using Mohr’s circle of stresses
3. **Shear stresses & Deflection of Beams:** Elementary Treatment of Shear Stress: Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress, shear connection between flange and web. Deflection of beam – Derivation of equation of elastic curve. Double integration method (McCauley’s method) for simply supported beams

**List of Experiments:**
1. To study the Brinell Hardness testing machine and the Brinell hardness test
2. To study the Rockwell Hardness testing machine and perform the Rockwell hardness test
3. To study the Impact Testing machine and Perform Izod impact test
4. To study the Impact Testing machine and Perform charpy impact test
5. To study the UTM and perform the tensile test
6. To Perform compression test on UTM
7. To perform the bending test on UTM
8. To perform the shear test on UTM
9. Torsion test on mild steel rod
10. Shear Force & Bending Moment Calculations
11. Principal planes and Principal stresses
12. Buckling of columns and struts

**List of Project Areas:**
1. Models for different types of loadings of columns
2. Representation models of SFD and BMD for concentrated loaded beams
3. Representation models of SFD and BMD cantilever beam
4. Representation models of SFD and BMD for UDL beam
5. Representation models of SFD and BMD for UVL beam
6. Torsional models of shafts
7. Moment of Inertia models
8. Models of Principal planes and stresses

**Text Books:**
2. Timoshenko and Young – Strength of Materials, CBS Publisher

**Reference Books:**
1. U.C. Jindal, Design of Machine Elements, Pearson Education

**Course Outcomes:**
Students will be able to:
1. Calculate normal stress, shear stress, and deformation and applications of the analysis and design of members subjected to an axial load or direct shear
2. Analyze and design circular determinate shafts subjected to torsional loading for its shear stress distribution and angle of twist.

3. Establish the shear force and bending moment diagrams for a beam

4. Determine bending and transverse shear stress in homogeneous beam having prismatic cross section and design beam for a given bending moment and shear force.

5. Determine stress components by analytical and Mohr’s circle method, for a plane state of stress and to obtain the maximum normal and maximum shear stress along-with orientation of elements.

6. Analyze stresses developed in thin-walled pressure vessels, and to calculate resultant plane stresses in thin pressure vessels, beam and circular shafts subjected to combined loading (axial, bending, torsion)
IE2005::MATHEMATICS FOR ENGINEERING APPLICATIONS-I

Credits: 02  
Teaching Scheme: Theory 2 Hrs / Week

SECTION-1

1. Linear Differential equations of higher order
Homogeneous Linear differential equations of Second Order, Higher Order Homogeneous & Non Homogeneous Linear Differential Equations with Constant Coefficients, Solutions by undetermined coefficients and Variation of Parameters method.

2. Basics Statistics

SECTION-2

1. Laplace Transform & Inverse Laplace Transform
Introduction to Laplace Transform, conditions for existence, Transforms of elementary functions and to Inverse Laplace Transform - its properties. Method of partial fractions

2. Numerical Methods:

3. Correlation and Regression:
Correlation, coefficient of correlation, Rank correlation, Introduction to Least Squares, Examples of Nonlinear Least Squares, Solution of Inconsistent Equations, Continuous Least Square Problems.
Self Study: Flipped Classroom: - MS Excel / Matlab / R / Python

List of Practicals:
Using MS Excel / Matlab / R / Python
1. Finding Mean and Mode of available data.
2. Finding various measures of deviation.
3. Finding various measures of Kurtosis.
4. Graphical presentation of data - 1
5. Graphical presentation of data – 1
6. Data collection from primary and secondary sources.

List of Project areas:
1. Developing codes of numerical methods in MS Excel / Matlab / R / Python / C / C++
Text Books:

Reference Books:
3. Louis C Barrett R,

Course Outcomes:
The student will be able to –
1. Develop solutions for linear equations.
2. Interpret the various results obtained by analyzing data.
3. Understanding the Laplace Transforms.
4. Developing the insight into numerical methods useful for computing applications.
5. Analyze the relationship between variables to predict their behavior.
6. Formulate the mathematical models to predict the approximate values of variables.
Module IV
IE2036::THERMAL & FLUID ENGINEERING

Credits: 04  
Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1

Steam Generators:
Introduction, formation of a steam at a constant pressure, temperature versus total heat graph during steam formation, steam properties, boiler performance, boiler efficiency, equivalent of evaporation.

Air Compressors:
Introduction, applications of compressed air, classifications, working of single stage reciprocating air compressors, work done by a single stage reciprocating air compressors with and without clearance, multistage compression, two stage reciprocating air compressors with intercooler, construction and working of centrifugal compressor and axial flow air compressor

SECTION-2
Properties of Fluid:
Definition of fluid, Newton’s law of viscosity, classification of fluid: Newtonian & Non-Newtonian fluids, ideal & real fluids, fluid properties: viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure, types of flow, Pascal’s law, continuity equation, Bernoulli’s equation, applications of Bernoulli’s equation, orifice meter, venturimeter, pitot tube, mechanical gauges.

Fluid Machinery:
Construction, working and applications of centrifugal pumps and reciprocating pumps. Construction, working and applications of hydraulic turbines – Impulse- Pelton turbine, Reaction turbines- Francis and Kaplan turbine, draft tubes, governing of turbines.

Refrigeration and Air conditioning:
Refrigeration: Air refrigeration working on Bell Coleman cycle, Simple vapour compression cycle, vapour absorption cycle, types and properties of refrigerants, p-h and T-s diagram, Air conditioning: window, split, central, and industrial air conditioning systems.

List of Practical’s:
1. Verification of Bernoulli’s equation.
2. Trial on multi cylinder four stroke petrol engine.
3. Trial on single cylinder four stroke diesel engine.
4. Trial on reciprocating air compressor.
5. Study and demonstration on Pelton wheel.
6. Study and demonstration on Francis turbine.
7. Study and demonstration of engine systems.
8. Vapour compression refrigeration system.
9. Air conditioning system.
10. Study and demonstration of different pressure measuring devices.
11. Determination of boiler efficiency, equivalent evaporation.
12. To determine the Reynolds number and hence the type of flow either laminar or turbulent.
13. Visit to any refrigeration plant/Engine manufacturing unit/hydro power plant.
14. To demonstrate the use of Venturimeter as flow meters.
15. To determine co-efficient of discharge of Venturimeter.
16. Trial on Centrifugal pump

**List of Projects:**
1. Automatic crane system
2. Pneumatic punch
3. Pneumatic comparator- Solex
4. Automatic gear display
5. Hydraulic screw jack
6. Solar water heater
7. Pneumatic punching machine
8. Power generation using speed breaker
9. Foot step pressure electrical power generator
10. Automatic rain activated wiper
11. Hydraulic scissor jack
12. Digital fuel level indicator
13. Engine over heat indicator
14. Emergency braking system
15. Automatic brake failure indicator
17. Air conditioning using peltier plate
18. Peristaltic pump
19. Refrigeration using peltier plate
20. Syringe actuated hydraulic arm

**Text Books:**
4. R K Rajput; Thermal Engineering; 8th edition, Laxmi Publication (P) Ltd., 2010
Reference Books:

Course Outcomes:
The student will be able to –
1. Understand basic concepts of thermodynamics and analyze air standard cycles.
3. Describe and analyze various types of air compressors.
4. Understand basic concepts of fluids, classification of flows and measure fluid flow by various flow measuring devices.
5. Distinguish various types of hydraulic turbines and pumps.
6. Understand refrigeration and air conditioning principles

Web site: www.nptelvideos.in
IE2037: MATERIAL SCIENCE

Credits: 04

Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1


SECTION-2

Strengthening Mechanisms: Refinement of grain size, Solid solution hardening, Dispersion hardening, Age hardening, Martensitic transformation etc Principle, Operation and uses of various pyrometers like thermocouples, Resistance pyrometer, Disappearing filament pyrometer, Total radiation pyrometer.


Corrosion Prevention Methods: Preparation of substrate for surface engineering. Design and material selection, atmosphere control, Inhibitors, Cathodic and anodic protection, Coatings etc Methods of surface improvement --- Electroplating, Surface Modification Techniques such as Electro deposition (Conventional electroplating, Electro less plating, Anodising, Diffusion coatings like Plasma nitriding, Aluminizing, Boronising, Chromizing, Vapour deposition conventional PVD and CVD, Diamond like coating, Electron beam PVD, Thermal Spray Coatings, Ion implantation etc.
List of Practicals:
1. Non destructive tests.
2. Brinell hardness test on different materials.
4. Rockwell hardness test on different materials.
5. Poldi hardness test on different materials.
6. Erichsen cupping test on different sheet metal specimens.
7. Impact test on steel and Aluminium.
8. Tension test on Mild Steel and Aluminium.
10. Micro hardness test.
11. Tension test of polymeric materials.

List of Project areas:
1. Evaluation of tensile properties of ferrous materials.
2. Evaluation of tensile properties of non ferrous materials.
3. Sorting of materials on the basis of hardness.
6. Evaluation of effect of cold work on hardness.
7. Evaluation of effect of cold work on Impact strength.
8. Evaluation of effect of cold work on tensile properties.
9. Study & calibration of thermocouple.
10. Case depth measurement of surface hardened components.
11. Identification of defects by using Non destructive testing methods.
12. Model making of different crystal structures.

Text Books:
1. Dr. V. D. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House, Pune.

Reference Books:
Course Outcomes:
The student will be able to –
1. Correlate crystal structures, crystallographic directions and planes, Plastic deformation mechanisms, cold & hot working changes in properties & with mechanical, physical, electrical & thermal properties.
2. Apply and integrate knowledge of properties and performance to solve materials selection and design problems.
3. Apply and integrate knowledge of equilibrium diagram
4. Apply and integrate knowledge of strengthening mechanisms & Pyrometry
5. Apply and integrate knowledge of Powder Metallurgy & Composite materials
6. Apply and integrate knowledge of apply and integrate knowledge of various surface modification techniques.
IE2038::CASTING & JOINING TECHNOLOGY

Credits: 04  
Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1

1. **Foundry Industry**: Introduction of Casting as a manufacturing process, Classification of casting processes, applications and advantages and limitations of casting process, Classification of foundries based on different criteria, Major activities in foundry Foundry process flowchart and different layouts of foundry.

2. **Patterns and Molds**: Introduction to different ferrous and non-ferrous cast alloys and their applications, Patterns: Pattern materials, allowances, types of pattern, pattern design, Pattern color codes. Types of molding sand, properties of molding sands sand mold, molding sand materials, composition of molding sand Green and dry sand molding process, hand molding and machine molding, ramming methods, CO2 molding process.

3. **Core & Core making**: Core sands, core sand composition, Functions of cores, types of cores and core boxes. Core making procedure, core prints, chaplets, Shell molding and core making, forces on cores and molds.

4. **Melting practices**: Melting of Metals, Types of melting furnaces, Cupola, induction melting furnaces, Arc melting furnace, Oil and gas fired furnaces construction and working, Charge calculation for cast Iron Importance and methods of inoculation in cast irons,. Ladles Types, Use, Lining materials. Fettling and cleaning of castings

5. **Casting Materials**: Composition, physical properties and applications of ferrous and non-ferrous materials for castings: Grey cast iron, S.G. iron, White cast iron, Malleable cast iron, Aluminum alloys, Copper alloys, Magnesium, Titanium alloys. Degassing and modification treatments in aluminum, copper and magnesium alloy castings.

6. **Methoding of casting and special casting techniques**: Gating and Risering: Components of gating system, functions and importance, design parameters of gating. Gating ratio, pressurized and un-pressurized gating systems. Risers, functions and modulus. Directional solidification, use importance of chills and ceramic bricks. Yield of castings. Numerical treatment to be given to design of and gating system and riser design., Defects, inspection and testing of castings.

7. **Special casting Processes**: Gravity die casting, high Pressure die casting and low pressure die Casting, Centrifugal casting process;, Continuous casting process, Investment casting, Lost foam casting process their typical applications, merits and limitations.

8. **Pollution and safety in foundry**: Possible hazards in foundries, Safety measures, Safety devices Types and sources of pollution in foundries, Measures for pollution control.

SECTION-2

2. **Gas welding**: types of flames, Gas welding Techniques, filler material and fluxes, Gas welding equipments, advantages and applications, Gas cutting: merits, limitations and applications of above processes.


4. **Electric Arc welding processes**: Power source, types of electrodes, coding of electrodes, Carbon arc, submerged arc, tungsten inert Gas (TIG), metal inert gas (MIG), electro slag welding process, plasma arc welding process - theory, comparison on merits, limitations and applications.


**List of Practical:**
1. Preparation of green sand with additives.
2. To determine compatibility of Green sand Mould.
3. Permeability testing of green sand.
4. Grain size distribution and estimation of AFS no of system sand and silica sand.
5. To measure green compressive strength of sand.
6. To measure green shear strength of sand.
8. Core hardness test of Shell sand or Oil sand core.
10. Pattern and Core box design
11. Preparation of pattern and green sand mould for simple gear blank.
12. Demonstration of neutral, oxidizing and carburizing flames of gas welding & Equipment set up.
13. Demonstration of arc welding and its set up.
15. Industry visit to any Foundry: Visit report on plant layout, operation

**List of Project areas: (Any one project)**
1. Optimization of soldering gap for soldering metal sheets
2. Optimization of brazing of steel sheets.
3. Design and manufacture of permanent mould.
5 Design of cope, drag pattern and core box, gating ratio and casting yield for Cover casing casting.
6 Case study of Aluminum casting manufactured by high pressure dies casting process. (Die design, Metal composition, Process parameters, gating system & Rejection analysis).
7 Case study of Grey Cast Iron casting manufactured by sand casting process. (Die design, Metal composition, Process parameters, gating system & Rejection analysis, casting with gating system)
8 Case study of S.G. Iron casting manufactured by sand casting process. (Die design, Metal composition, Process parameters, gating system & Rejection analysis, casting with gating system)
9 Inoculation and modification of grey Cast iron properties. (Mechanical & Microstructures)
10 Optimization of sand properties for Green sand moulding of silica sand.
11 Manufacturing of Cu-Zn-Al casting plate by permanent mould process
12 Manufacturing of Cu-Al-Mn casting plate by permanent mould process
13 Mechanical and metallurgical Characterization of welded samples.
14 Design and fabrication of structures of any working product/mechanism/facility in the institute/for society.

**Text Books:**

2. P.L. Jain; Principles of Metal casting; Tata McGraw Hill
3. O.P. Khanna; Foundry Technology; Khanna Publisher
4. O.P. Khanna; Welding Technology; Khanna Publisher

**Reference Books:**

1. T. V. Ramana Rao; Metal Casting: Principles & Practice; New Age International Pvt. Ltd.
2. P. C. Mukharjee; Fundamentals of Metal Casting; Oxford & IBH Publishing Co.
3. Heine, Loper, Rosenthal; Principles of Metal Casting; Tata McGraw Hill.
5. Dr. R.S. Parmar; Welding Processes and Technology; Khanna Publisher.

**Course Outcomes:**

The student will be able to –

1. Select and design and perform different pattern and mould making to manufacture castings.
2. Understand and apply different methods of core making and melting techniques.
3. Design gating system and select appropriate casting method for manufacturing castings with optimum cost and quality.
4. Apply fundamentals of gas welding, soldering and brazing techniques for joining of appropriate material and job.
5. Understand and apply electric arc and resistance welding and nonconventional techniques.
6. Test and analyze weld quality by mechanical properties and micro structural analysis.
IE2039::DESIGN OF MACHINE ELEMENTS

Credits: 04

Teaching Scheme: Theory 3 Hrs / Week & Lab/Project 2 Hrs/Week

SECTION-1


SECTION-2

1. Rolling Contact Bearings: Types, Static and Dynamic load Capacity, Stribeck’s Equation, Concept of equivalent load, Load life Relationship, Selection of bearing from Manufacturer’s Catalogue, Design forbearing for variable loads and Speeds, Bearings with Probability of Survival other than90%. Lubrication and Mounting of bearings, oil Seals and packing used for bearings.

2. Design of Threaded, Welded Joints and Power Screw: Design of Power Screw - Types, materials used, thread forms and their applications; types of stresses induced, overhauling and self-locking properties, design of nuts. Design of bolted joints subjected to transverse and eccentric loads. Design of welded joints for various loading conditions


List of Practicals:

1. Design of shaft.
2. Design and sheet drawing of coupling
3. Design of spur gear
4. Design under variable load
5. Design of flywheel  
6. Design of bearings  
7. Design of threaded joint  
8. Design of welded joint  
9. Design of power screw  
10. Design and sheet drawing of screw jack assembly  
11. Design of spring  
12. Design of helical gear

**List of Project areas:**

Students will perform projects of following designs for material selection, design calculations, assembly and detail drawing.

1. Design and drawing of Two stage Gear box used for any industrial applications
2. Design and drawing of Three stage Gear box used for any industrial applications
3. Design and drawing of shaft subjected under static and dynamic loads.
4. Design and drawing of rigid flange coupling for any industrial application
5. Design and drawing of flexible flange coupling for any industrial application.
6. Design and drawing of levers used in industry
7. Design and drawing of helical spring for any industrial application
8. Design and drawing of break in any automobile
9. Design and analysis of spring used in two wheeler
10. Design and drawing of spur gear used for any industrial applications
11. Design and drawing of screw jack assembly used in daily life.
12. Design and drawing of threaded joint used in real life application

**Text Books:**

7. PSG Design data Book

**Reference Books:**

1. P. Kannaiah, *Design of Machine Elements* Scitech Publication,
Course Outcomes:
The student will be able to –
1. Analyze the stress and strain mechanical components such as shaft, keys and couplings and design the same for various industrial applications.
2. Design spur and helical gears for various applications.
3. Select different types of rolling contact bearings from manufacturer’s catalogue for various industrial applications.
4. Analyze the stress and strain in power screw and design the same for various industrial applications.
5. Analyze the stress and strain in threaded and welded joints and design the same for various industrial applications.
6. Design mechanical components for fluctuating and reversible loading conditions.
PR2040::MACHINE DRAWING & COMPUTER GRAPHICS

Credits: 02  Teaching Scheme: Theory 1 Hrs/Wk & Lab 2 Hrs/Wk

Study of B.I.S. Conventions
Significance and importance of BIS Conventions, Conventional representation of engineering materials, BIS conventions for machine parts and joints, BIS methods for dimensioning

Sketching of Machine Component
Sketches of threaded joints, Various types of rivets and riveted joints, Various types of keys, Socket and spigot (Cotter joint), Knuckle (pin) joint, Coupling and types of couplings, Bearings and its types, Plummer block (pedestal bearing), Belts and Pulleys, pipe joints.

Limits, Fits and Tolerances
Significance of system of limits and fits. Definitions, Types, Recommendations and selections, Tolerances of form and position, surface finish symbols as per BIS, Selection and entering of all these symbols with reference to details and assembly drawings, Tolerancing an individual dimensions of details drawing.

Details and Assembly Drawing
To prepare detail drawings from given assembly drawing. To prepare assembly drawing from given drawing of details. Such as: -Machine tool parts: Tool post, Tailstock, Machine vice, Chucks etc. -Engine parts: Stuffing box, Crosshead assembly, Piston and connecting rod, etc. -Miscellaneous parts: Valve assembly, Screw jack, Jigs and fixtures, Pipe vice etc. Assembly selected should include different types of sections.

Computer Graphics using Auto CAD
Introduction & use of basic AutoCAD commands to draw basic drawing entities, Introduction to modifying commands (trim, extend, offset, array etc), Complex 2D drafting – Part 1 (Assembly and details of any one of Machine Components Cotter Joint, Knuckle Joint, Flange Joint, Rigid and Flexible Coupling, Stop Valve, Non Return Valve, Revolving Centers, Machine Vice, Tool Holder.) Introduction to basic isometric commands & Isometric drafting Introduction to 3D commands (extrude, polyline, etc.) Simple 3D drafting of simple mechanical components.
One assembly and Complex 3D drawing for each student as a project

List of Practicals:
Following practicals to be done using Auto CAD software
1. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Screw Threads, Tapped Holes, Holes on Circular Pitch, Countersunk and Counter-bores,
2. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Bearing, Splined Shafts, Tapers, Chamfers, Knurling, Keys
3. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Springs, Gears, Welded Joints, Structural Sections
4. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Types of Screws
5. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Bolts and Nuts
6. Sketches of Conventional Representation of Machine Components as per ‘IS Code SP 46’ of Nut Locking Arrangements
7. 2 assembly drawings for each student as a project.

Text Books:


Reference Books:


Course Outcomes:–
The student will be able to –
1. Identify the national and international standards pertaining to machine drawing.
2. Apply limits, fits, tolerances and various manufacturing drawing symbols to assemblies and details drawings.
3. Illustrate various machine components through assembly and detail drawings.
4. Analyze and draw the 2D and 3D views using AutoCAD
5. Prepare part and assembly drawing along with Bill of Material using AutoCAD
6. Communicate and present ideas through drawing using AutoCAD