Bansilal Ramnath Agarwal Charitable Trust’s
Vishwakarma Institute of Technology
(An Autonomous Institute affiliated to University of Pune)
Structure & Syllabus of
B.E. (Production Engineering)

Effective from Academic Year 2011-12

Prepared by: - Board of Studies in Industrial & Production Engineering
Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by,

Chairman – BOS                           Chairman – Academic Board
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Program Educational Objectives (PEO) for
B.E. (Production Engineering) Program

Program Educational Objectives (PEO) for
B.E. (Production Engineering) Program

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<th>PEO No.</th>
<th>Description of the Objective</th>
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<td>I</td>
<td>Preparation: To prepare students to excel in postgraduate programmes / be successful in industry / technical profession.</td>
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<td>II</td>
<td>Core Competence: To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.</td>
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<td>III</td>
<td>Breadth: To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.</td>
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<td>IV</td>
<td>Professionalism: To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context.</td>
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<td>V</td>
<td>Learning Environment: To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.</td>
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Course Objectives: Course objectives are specified in the course syllabus

2. Program and Course Outcomes,

Programme Outcomes:

a. Graduates will demonstrate basic knowledge in mathematics, science and engineering.
b. Graduate will be familiar with different manufacturing processes.
c. Graduate will be familiar with different materials used in manufacturing.
d. Graduates will demonstrate an ability to design simple mechanical components.
e. Graduates will be familiar with industry and organizational management.
f. Graduates will have the confidence to apply engineering solutions in global and societal contexts.
g. Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.
h. Graduates will demonstrate the ability to design a process that meets desired specifications and requirements.

i. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.

j. Graduates will demonstrate an ability to visualize and work on laboratory and multi-disciplinary tasks.

k. Graduates will be familiar with safety, product quality aspects and quality control.

l. Graduates will be able to communicate effectively in both verbal and written forms.

m. Graduate who can participate and succeed in competitive examinations like GATE, GRE.

**Under Graduate Program in Industrial Engineering**

p. Graduates will demonstrate the ability to identify, formulate and solve problems in materials and metal forming.

q. Graduate will be familiar with advanced trends in manufacturing.

r. Graduate will be familiar with machine design and tool design.
MODULE III
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IP21151 :: THEORY OF MACHINES

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (a,r)

Unit I
Introduction (8 Hrs)
A. Kinematic link, types of link, machine, structure, types of constrained motion, kinematic pair, classification of kinematic pairs, degrees of freedom, kinematic chain, mechanism, inversion, four bar chain and its inversion, single slider crank chain and its inversions, double slider crank chain and its inversions.
B. Steering mechanism - Ackerman steering mechanism, Davis steering mechanism, Hookes joint.

Unit II
Kinematic Analysis of Mechanisms: (Velocity & Acceleration Analysis) (8 Hrs)
A. 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 velocity method, acceleration in a slider crank mechanism, Klein’s construction
B. Approximate analytical method for velocity & acceleration of piston.

Unit III
Spur Gear (8 Hrs)
A. 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, minimum number of teeth on the pinion in order to avoid interference, minimum number of teeth on the wheel in order to avoid interference.
B. Types of Gear Trains- Simple Gear Trains, Compound Gear Trains, Reverted Gear Trains, Epicyclic Gear Trains

Unit IV
Cams and Followers

A. 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 and flat faced followers, construction of cam profile for oscillating follower.

B. Introduction to Belt drives, types of belts, types of flat belt drive.

Unit V
Governors


B. Hartung governor, pickering governor

Text Books

Reference Books
IP21153 :: DESIGN OF MACHINE ELEMENTS

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the Strength of Materials
- Develop conceptual framework of the course
- Mapping with PEOs: I, II, III (a,j,d,r)

Unit I  
Simple Stresses and Strains ; Principal Stresses and Strains  
(8 Hrs)

A. Concept of stress and strain (Linear, lateral, shear and volumetric) Hooke’s law. Poissons 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, inter-relation between elastic constants.
Elementary Treatment of Axial force diagram, stresses, strains and deformations in determinate and indeterminate, homogeneous and composite bars under concentrated loads.
Normal and Shear Stresses on any oblique plane; 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.
B. Derivations of Various Formulae, Failure Diagrams indicating Areas/Sections & Stress Levels; Graphical solution using Mohr’s circle of stresses

Unit II  
Slope and Deflection of Beams; Axially Loaded Columns  
(8 Hrs)

A. Elementary Treatment of Relation between BM and Slope. Slope and deflection of determinate beams; Derivation of formulae for slope and deflection for standard cases,
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; Safe Load on Columns.

**B. Derivations of Various Formulae, Failure Diagrams indicating Areas/Sections & Stress Levels; Double integration method (McCauley’s method)**

**Unit III**

*Shear Force and Bending Moment Diagrams; Shear stresses*

A. 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 beams, Construction of loading diagram and BMD from SFD and construction of loading diagram and SFD from BMD.


Elementary Treatment of 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.

**B. Derivations of Various Formulae, Failure Diagrams indicating Areas/Sections & Stress Levels; Bending of curved bars/beams (Winkler & Bach Theory) Stresses in ring, chain link and crane hooks.**

**Unit IV**

*Fundamentals of Machine Design; Design of Shaft, Key, and Couplings*

A. Fundamentals of machine design: Design philosophy, Engineering Materials, Brief overview of design and manufacturing

Design for Endurance; Stress Concentration, Design for dynamic loading, Low and high cycle fatigue

Design of Shaft: Stresses, strains and deformations in determinate shafts of solid and hollow homogeneous and composite circular cross section subject to twisting moment, Derivation of torsion equation

Concept of strain energy, derivation and use of expressions for deformations of axially loaded members under gradual, sudden and impact loads. Shaft and its design based on strength; -Twisting, -Bending & -Axial Load,

Design of Keys:- Introduction, Types of Keys and Design of Square, Rectangular, Gib head Sunk Keys.

Couplings Introduction, types and uses, Design for Rigid and Protected Flange Coupling

**B. Derivations of Various Formulae, Failure Diagrams indicating Areas/Sections & Stress Levels; Design of shaft for variable load and based on stiffness, Design of shaft as per A.S.M.E. Code.**
Unit V  
(8 Hrs) 
**Design of Springs, Levers, Brakes, Clutches**

**A.** Introduction to Design of Helical Springs, Types of Springs, Helical Springs in Parallel and Series, Concentric and Composite Helical Springs, Design of Helical Springs for Variable Load, Elementary Treatment of Lever Design; Design of Bell Crank Levers for Brakes & Clutch Application, 
Introduction to Brakes, Types, Design of single / double Shoe Brakes, Band Brakes, Block & Band Brakes, 
Introduction to Clutch, Types, Design of friction plate (Single and Multi plate), 

**B.** Derivations of Various Formulae, Failure Diagrams indicating Areas/Sections & Stress Levels; Energy stored in Spring, Safety Valve Lever; Energy Absorbed & Heat Dissipated by brake; Internal Expanding Brake, Centrifugal and Cone clutch.

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**Text Books**

1. Timoshenko and Young – Strength of Materials, CBS Publisher

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**Reference Books**

1. U.C. Jindal, Design of Machine Elements, Pearson Education
1. Nelson Machm SS. Machine Design – Dr. Sadhu Singh
2. Mechanical Engineering Design- J.E. Shigley
IP20151: MANUFACTURING PROCESSES

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (b)

Unit I (8 Hrs)
Casting I
A. Introduction of casting process, casting manufacturing steps, applications and advantages of castings,
   Special casting Processes: Pressure and gravity Die Casting, centrifugal casting,
   continuous casting, investment casting, their typical applications, merits and limitations.
   Types of pattern and pattern design.
   Classification of molding sands, core sands, molding and core additives, Cores-
   Functions of cores, Core making, core prints, core making machines, core baking, core finishing,
   assembly & setting of cores, types of Core manufacturing, Core making machines.
B. Types of foundries, Foundry mechanization and automation, Sand preparation and sand reclamation,
   Pattern materials, types of core boxes

Unit II (8 Hrs)
Casting II
A. Types of molds: Green sand, dry sand mould, shell mold, plaster mould, CO2 moulds.
   Hand moulding equipment, mould ramming methods, steps in mould making boxes,
   forces on cores and moulds.
   Melting & Pouring of Metals - Melting Furnaces-types, Cupola, Induction- furnace construction,
   operation, zones and chemistry, Shakeout, Cleaning & finishing of castings,
   Testing and inspection of castings and casting defects, Solidification of casting,
   Progressive and directional solidification, Gating and Risering of casting
B. Moulding Methods: bench, floor, pit and Machine moulding.
Welding I
A. Gas Welding – processes and equipment used, types of flame, gas welding technique adjustment of flame, oxy Acetylene welding, gas cutting – merits, limitations and applications of above processes
Brazing, braze welding and soldering processes, merits, limitations and applications of above processes.
Arc welding processes-Carbon arc, submerged arc, tungsten inert Gas (TIG), metal inert gas (MIG), Electro slag, plasma arc & stud welding process- theory, comparison on merits, limitations and applications
B. Filler metals & fluxes used Electrodes and Fluxes used in arc welding

Unit IV
Welding II
A. Electric resistance welding - processes and equipment used, spot, seam, projection, Butt, Percussion welding, resistance tube welding, merits, limitations and applications. Laser welding, friction welding and thermitt welding, Electron beam welding. Hot & Cold Working processes, Recrystallization temperature, Rolling, Forging - Classification of forging processes-open die and closed die forging Forging equipment- Hammers and presses, construction working capacities and selection of equipment. Basic forging operations such as drawing, fullering, edging, blocking etc., Spinning, Roll forming
B. Welding defects and Remedies

Unit V
Sheet Metal Working and Processes related with Plastics and rubber
Plastics & Rubber – Moulding characteristics of raw materials, , compression, transfer injection and blow moulding, mould design – materials and construction, build factor, shrinkage
B. Moulding processes, moulding parameters, Vulcanising

Text Books
1. D.K. Singh, Manufacturing Technology, 2/e, Pearson Education
2. Foundry Technology by O.P. Khanna
3. Principles of Metal Casting by P.L. Jain
Reference Books

2. Little, Welding and Welding Technology, Tata Mc Graw Hil
3. R.S.Parmar, Welding and Welding Processes, Khanna Publication
4. Welding Technology by O.P. Kahanna
IP20153 :: MATERIAL SCIENCE

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Selection of appropriate materials for various types of products
- Mapping with PEOs: I, II, III (c,p)

Unit I  
Plastic Deformation

B. Classification of Engineering Materials. Important properties of each group & some typical applications of each group.

Unit II  
Material Testing

Non-destructive tests - Visual Inspection, Magna flux test Dye penetrant test, Sonic and Ultrasonic test, Radiography.
B. Examples of selection of NDT & mechanical testing methods for selected components like crankshafts, gears, razor blades, welded joints, steel and cast iron castings, rolled products, forged products.
Unit III  
Equilibrium diagrams and Pyrometry  
(9 Hrs)


B. Practice of numerical based on equilibrium diagrams

Unit IV  
Strengthening Mechanisms and Powder Metallurgy  
(8 Hrs)

A. Strengthening Mechanisms: Refinement of grain size, Solid solution hardening, Dispersion hardening, Age hardening, Martensitic transformation, Composite materials etc.

Powder Metallurgy: Process in brief, powder characteristics, powder manufacturing, Production of sintered structural components such as self lubricated bearing, cemented carbide tools.

B. Production of cermets, refractory metals, electrical contact materials, friction materials, Diamond impregnated tools etc

Unit V  
Methods of Surface Improvements and Corrosion Prevention  
(8 Hrs)

A. Corrosion Prevention Methods: Design and material selection, atmosphere control, electroplating, Inhibitors, Cathodic and anodic protection, Coatings etc. Surface Modification Techniques such as Electro deposition (Conventional electroplating, Electroless plating, Anodising), Diffusion coatings (Plasma nitriding, Aluminizing, Boronising, Chromizing), Vapour deposition (conventional PVD and CVD, Diamond like coating, Electron beam PVD), Thermal Spray Coatings, Ion implantation etc.

B. Corrosion prevention of some typical engineering components. Preparation of substrate for surface engineering.

Text Books
Reference Books

5. Structure and properties of materials II, Willey Eastern (P) Ltd.
IP21251 :: THEORY OF MACHINES

Credits: 01  
Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (r)

List of Contents

Term work consist of any six following exercises:

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.
7. Study of Gear Trains.
8. To draw a conjugate profile for any general shape of gear tooth.
9. To draw a cam profile for specific follower motion.
10. Determination of radius of gyration of a connecting rod using theory of compound pendulum.
11. Study of Hookes joint.
12. 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).
13. Problems solving on governor.

Text Books

IP21253 :: DESIGN OF MACHINE ELEMENTS

Credits: 01

Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: : Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the Strength of Materials
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (d,r)

List of Contents

Problem & Numerical solving and sketching figures for:
1. Simple Stresses and Strains
2. Principal Stresses and Strains
3. Slope and Deflection of Beams
4. Axially Loaded Columns
5. Shear Force and Bending Moment Diagrams; Shear stresses
6. Design for Endurance; Stress Concentration, Design for dynamic loading, Low and high cycle fatigue
7. Design of Springs
8. Design of Key, and Couplings
9. Design of Shaft
10. Design of Levers
11. Design of Brakes
12. Design of Clutches

Text Books
1. Timoshenko and Young – Strength of Materials, CBS Publisher

Reference Books
IP20351 :: MANUFACTURING PRACTICES 1

Credits: 02

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To give students ‘hands on experience’ of craftsmanship, machining, maintenance and assembly.
- To make students familiar with different Work Trades.
- To develop quality & safety consciousness amongst the students.
- To develop respect towards labour work amongst the student.
- Mapping with PEOs: I, II (b)

List of Practical
1. Turning: Introduction, functions and operations of lathe parts, lathe tools and measuring instruments, demonstration of different lathe operations, safety precautions etc.
   Practical: One job involving few lathe operations.

2. Pattern Making: Introduction, different types of patterns, necessity of draft and allowance, function and operation of wood turning lathe, safety precautions etc.
   Practical: one job of any one type of pattern.

3. Foundry: Introduction, uses of different foundry tools, sand preparation, mould preparation, metal pouring, safety precautions etc.
   Practical: One job of casting.

Demonstrations


Text Books
2. H.P.Garg, Industrial Maintenance, Published by S.Chand Co.Ltd,1990

Reference Books

1. HMT, Production Technology,
2. Published by Tata McGraw-Hill Publishing Co.Ltd., New Delhi, 1st -1987
IP20353 :: MATERIAL SCIENCE

Credits: 02

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: I, II, III (c,p)

List of Practical
1. Tensile test on mild steel and aluminum test pieces.
2. Compression test on cast iron and brass test pieces.
3. Brinell hardness test on different materials.
4. Poldi hardness test on different materials.
5. Vickers hardness test on different materials.
6. Rockwell test on different materials with different Scales.
7. Rockwell superficial test on different materials with different Scales
8. Izod and Charpy impact tests.
9. Erichsen cupping test on minimum three different sheet metal samples.
10. Non-destructive testing - Magnaflux testing
11. Non-destructive testing - Dye penetrant test
12. Non-destructive testing - ultrasonic testing

Text Books

Reference Books
5. Structure and properties of materials II, Willey Eastern (P) Ltd.
IP24351 :: MACHINE DRAWING & GDT LAB

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Mapping with PEOs: I, II (d, r)

List of Practical

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. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT) - Cotter Joint, Knuckle Joint
8. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT)- Rigid and Flexible Coupling
9. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT)- Stop Valve
10. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT)- Non Return Valve
11. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT)- Revolving Centers
12. Assembly and Details of Machine Components based on ‘Theory of Geometrical Dimensioning & Tolerancing’ (GDT)- Machine Vice, Tool Holder
Text Books

Reference Books
1. Shah, Rana, Engineering Drawing, 2/e, Pearson Education
4. CMTI Handbook of Machine Tools
MODULE IV
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HS20104 :: MATHEMATICS FOR ENGINEERING APPLICATIONS

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
1. To make the students understand the concepts & broad principles of contents of the course
2. Develop conceptual framework of the course
3. Sensitizes the students of the importance of course in real life environment
4. Mapping with PEOs: I II (a)

Unit I
Linear Differential equations of higher order

B. System of linear differential equations, Examples on Mass Spring System. Revision: Probability and Expected value, classical, relative frequency and subjective approaches to

Unit II
Fourier and Laplace Transform

B. Application of Fourier series to physical systems that are governed by Ode’s and subjected to periodic forcing functions. Application of Laplace transform for solving system of differential equations. Revision: Regression analysis (Linear only), Correlation analysis, Karl Pearson’s correlation coefficient, Spearman’s Rank correlation coefficient

Unit III
Applications of Partial Differential equations
B. d’Alembert’s solution of partial differential equations

Unit IV (8 Hrs)
Vector Calculus
A. Vector and scalar functions & fields, Derivative, Gradient of a scalar field, Directional derivative, Divergence and curl of a vector field, vector identities, Irrotational and solenoidal vectors and potential functions, line and surface integrals, Green’s, Stoke’s and Gauss theorems and applications to Engineering Problems.
B. Applications to Fluid dynamics

Unit V (8 Hrs)
Basics Statistics
B. Application to real life problem. Revision: Concept of Random Variable & Probability Distributions, Discrete random variable and its distributions – Binomial, Poisson, Continuous random variable and its distributions - (Mean, Variance of All

Text Books

Reference Books
2. Murray R. Spiegel, Advanced Calculus, Schaum’s out line series, --------, ---------
IP20152 :: METROLOGY & MECHANICAL MEASUREMENTS

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Know fundamentals of sensors
- Suggest suitable sensor for given applications.
- Procure and install the sensor.
- Mapping with PEOs: I, II, III (a, h, j, k)

Unit I  
Introduction to Metrology  
A. Introduction to Metrology, Precision, Accuracy, Errors in Measurement, Calibration.  
Angular Measurement: Sine bar, Auto Collimator  
B. Manufacture of slip gauges, Sine Center, Uses of sine bars, angle gauges, Angle Dekkor, vernier bevel protractors

Unit II  
Limits Fits and Tolerances  
B. Optical, electrical, pneumatic Comparators.

Unit III  
Surface Finish Measurement  
A. Surface Texture, Meaning of RMS and CLA values, Tomlison’s Surface Meter  
Interferometry: Introduction, Flatness testing by interferometry  
Recent Trends in Engineering Metrology.  
B. Taylor- Hobson Surface Meter, Grades of Roughness, Specifications. NPL Flatness Interferometer. Study of Measuring Machines,
Unit IV  
(8 Hrs)

Pressure, Displacement, Velocity Measurement

A. Pressure, Displacement, Velocity Measurement, Pressure measurement—manometers, inductive transducer Measurement of displacement—mechanical method, optical method Velocity measurement—linear velocity transducer, mechanical tachometer, DC and AC tachogenerators

B. PIRANI gauge variable resistance displacement measuring transducers inductive pick up tachometer.

Unit V  
(8 Hrs)

Strain, Force, Torque Measurement


B. LVDT, Piezoelectric, Vibrating Wire type. Belt, Gear Dynamometer, Instantaneous power measurements, Alternator power measurement. Load Cells – Mechanical

Text Books

Reference Books
IP20154: METAL CUTTING, FINISHING & NCM PROCESSES

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (b)

Unit I  
Lathe and turning operations and Gear Cutting: (8 Hrs)
A. 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, Gear cutting -Forming & generation, gear cutting on milling, gear hobbing, gear shaping, gear shaving, lapping & grinding, various machines use for gear manufacturing.
B. Introduction to high speed machining

Unit II  
Shaper, planer and slotting machines & Drilling Machines and Related Operations: (8 Hrs)
A. Basic Introduction to shaping and planing operations: Definition, type of shapers and planers. Quick return mechanism, cutting speed and feeds, machining time. 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.
B. Types of drilling machines, equipment, size of drilling machine,

Unit III  
Milling Machines and operations  
A. 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.
B. Vertical milling attachment, high speed milling attachment, slotting attachment, vice

Unit IV
Grinding and Super Finishing

A. Definition, composition of grinding wheel, standard markings of grinding wheels, standard shapes of grinding wheels Dressing of grinding wheels, grinding operations(cylindrical Conical, internal, surface). Centreless grinding . Abrasive machining processes: Abrasive machining, abrasives-type, size and geometry. Grinding, grinding wheels, wheel marking, wheel selection, wheel mountings. Types of grinding machines Grinding faults. Plunge grinding,
B. Honing, lapping, super finishing, buffing, burnishing processes.

Unit V
Broaching Operations and Non-conventional machining processes

A. Definitions, types of broaching, machines cutters for broaching, materials for broach, cutting action, chip disposal, broaching speeds, application of broaching, Non-conventional machining processes: comparison with conventional machining, classification, principle, working advantages, disadvantages and applications of ECM,
B. Advantages and limitations of broaching operations

Text Books
1. “Workshop Technology : Chapman,

Reference Books
4. Manufacturing Processes. Begeman:
IP21154 :: THERMAL & FLUID ENERGY CONVERSION

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II, III (a)

Unit I
Introduction & Fluid Properties

A. 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, cavitations, Static’s of Fluid-Pressure head, Pascal’s law, continuity equation, total pressure, total Pressure on an immersed surface, Bernoulli’s equation, applications of Bernoulli’s equation, orifice meter, venturimeter, Pitot tube.

B. Measurements of fluid pressure- piezometer tubes, manometers, mechanical gauges, bourdon’s tube, diaphragm pressure gauge, dead weight pressure gauge, types of flow

Unit II
Fluid Machinery

A. Construction, working and applications of hydraulic turbines, Construction, working and applications of centrifugal pumps and reciprocating pumps.

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 and energy balance, measurement of dryness fraction of steam by throttling calorimeter.

B. Construction and working of Lancashire boiler, Babcock Wilcox boiler

Unit III
I.C. Engines.


B. Thermodynamics - zeroth, first and second law of thermodynamics, thermodynamic system and processes.

Unit IV

Air Compressors: (8 Hrs)

A. Introduction, 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, intercooling of air in a two stage reciprocating air compressors, work done by a two stage reciprocating air compressors Applications of Compressed air.

B. Construction and working of centrifugal compressor and axial Flow air compressors.

Unit V

Refrigeration and Air conditioning: (8 Hrs)

A. 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, window, central, and Industrial Air conditioning Systems.

B. Introduction to heat transfer-conduction, convection, radiation.

Text Books


Reference Books

HS20254 : MATHEMATICS FOR ENGINEERING APPLICATIONS

Credits: 01  
Teaching Scheme: - - Tutorial 1 Hr/Week

Pre requisites: : Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (a)

List of Assignments
1. Linear Differential Equation – Method of Solution
2. Application of Linear Differential Equation
3. Fourier Series
4. Fourier Transform
5. Laplace Transform
6. Inverse Laplace Transform & Its Applications
7. Vector Calculus – Vector Differentiation
8. Vector Calculus – Vector Integration
9. Statistics – Data Presentation
10. Statistics – Data Analysis

Text Books

Reference Books
IP20252 : METROLOGY & MECHANICAL MEASUREMENTS

Credits: 01  Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: : Nil

Objectives:

- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (h, j, k)

List of Contents

1. Problem solving and sketching figures for Selection of slip gauges
2. Problem solving and sketching figures for angle gauges
3. Problem on design of inspection type plug gauge
4. Problem on design of workshop type plug gauge
5. Problem on design of workshop type ring gauge
6. Problem on design of inspection type ring gauge
7. Determination of flatness or surface plate using spirit level or auto collimator
8. Study principles of electronic comparators
9. Problem on design of general type plug gauge
10. Problem on design of general type ring gauge
11. Study principles of pneumatic comparators
12. Study principles of optical comparators

Text Books

2. K.J.Hume, Engineering Metrology, Kalyani publication

Reference Books

FF No. : 654

IP20354 :: MANUFACTURING PRACTICES 2

Credits: 01  
Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To give students ‘hands on experience’ of craftsmanship, machining, maintenance and assembly.
- To make students familiar with different Work Trades.
- To develop quality & safety consciousness amongst the students.
- To develop respect towards labour work amongst the student.
- Mapping with PEOs: I, II (b, g, j)

List of Practical
1. Turning: Introduction and demonstrations of different lathe operations such as knurling, grooving, drilling, boring, reaming, threading etc., safety precautions
   Practical: One composite job involving the above mentioned operations.
2. Milling: Introduction, demonstration of milling operations such as plain milling, end milling, gear cutting etc., safety precautions
   Practical: One job.

Demonstrations
1. Demonstration on CNC lathe machine and grinding machine.

Assignment: Process sheet of machining component.

Text Books

Reference Books
IP21354 :: THERMAL & FLUID ENERGY CONVERSION LAB

Credits: 01  
Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: I, II (a)

List of Practical

1. Verification of Bernoulli’s equation
2. Determination of losses in various pipe fitting.
3. Problem on boiler to determine boiler efficiency, equivalent evaporation.
4. Study of pumps and turbines.
5. Trial on petrol engine.
6. Trial on diesel engine.
7. Study of Engine system: Air intake, exhaust, cooling, lubrication system
8. Trial on reciprocating air compressor.
9. Study of different Pressure measuring devices.
10. Study of vapour compression refrigeration system
11. Construction detail of IC engines by dismantling and assembly
12. Industrial visit

Text Books

Reference Books

IP24352 :: COMPUTER GRAPHICS LAB

Credits: 01  
Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- Mapping with PEOs: I, II (i)

List of Practical
1) Introduction & use of basic AutoCAD commands to draw basic drawing entities – Part 1
2) Introduction & use of basic AutoCAD commands to draw basic drawing entities – Part 2
3) Introduction to modifying commands (trim, extend, offset, array etc)
4) Simple 2D drafting (orthographic projections)
5) 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.)
6) 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.)
7) Introduction to basic isometric commands.
8) Isometric drafting
9) Introduction to 3D commands (extrude, polyline, etc.)
10) Introduction to 3D commands (subtract, union, etc.)
11) Simple 3D drafting of simple mechanical components
12) Complex 3D drafting

Text Books
1. Pohit/Ghosh, Machine Drawings with AutoCAD, Pearson Education

Reference Books
1. Junnarkar, Machine Drawing, 2/e, Pearson Education
3. CMTI Handbook of Machine Tools
4. Engineering drawing N.D.Bhatt, V.M.Panchal
4. Engineering Drawing N. H. Dubey-
MODULE V
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IP30151 :: METAL CUTTING & TOOL DESIGN

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If any):

Objectives:

- To make the students understand the concepts & broad principles of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (b, r)

Unit I

Tool nomenclature

A. milling cutter, broach
B. Single point cutting tool, various tool elements, Designation of cutting tools in ORS & ASA Systems, Importance of tool angles, Method of machining- orthogonal, oblique cutting, Nomenclature of drill

Unit II

Theory of metal cutting

A. Mechanics of chips formation, types of chips, determination of shear angle, chip reduction factor, velocity relationship, merchant force circle, estimation of cutting forces, Tool dynamometer. Heat generation & tool life
B. Heat generation in cutting, Functions of cutting fluid, characteristics of cutting fluid, types of cutting fluid, Tool wear, Tool life, modified Taylor’s equation, Tool dynamometers.

Unit III

Design of cutting tools

A. Tool materials, design of single point cutting tool, form tool, drill, reamer
B. Design of broach & plain milling cutter

Unit IV

Fundamentals of jig & fixtures

B. Types of Jigs & Fixtures.

Unit V  
Design of jig & fixtures  
(08 Hrs)

A. Concept of modular fixtures.
B. General guide lines & procedures for design of jig & fixtures, Bodies, bases & frame, Design of locators, Design of guiding elements, Analysis of number of clamping forces required & their magnitude

Text Books
1. P C Sharma, Production Engg., Khanna publishers.
2. M.H.A. Kempster, Introduction to Jigs and fixtures design

Reference Books
1. Tool Engg by Nagpal
2. Dolalson, Lecain and Goold, Tool design, Tata McGrawhill.
3. Hoffman, Introduction to Jigs and fixtures.
6. R. K. Jain, production technology, Khanna Publishers
7. Milton Shaw, Metal cutting principle
IP30153 :: STATISTICAL METHODS & RESEARCH METHODOLOGY

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Mathematics for Engineering Applications

Objectives:
- To make the students understand the concepts & broad principles of statistical techniques used in managerial decision making
- Sensitize the students of the importance of statistics in real life environment
- Mapping with PEOs: I, IV (a, g, i, n)

Unit I  
(08 Hrs)
Concept of random variable & probability distributions

A. Discrete random variable and its distributions – Binomial, Poisson, Hyper-geometric. Continuous random variable and its distributions - Uniform, Normal, Exponential (Mean, Variance of All Distributions)
B. Calculation of probabilities for the above probability distributions in MS EXCEL and developing probability curves

Unit II  
(08 Hrs)
Sampling Theory & Statistical Inferences

A. Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample, sampling methods, Point estimate, Interval estimate, Chebyshev’s Theorem, Sample size determination. Practical considerations in sampling and sample size
Principles of Statistical inferences – Testing hypotheses and Inferences concerning means and proportions. Sampling distributions – Test based on Normal, t-distribution, Chi-square distribution, Hypothesis Testing - Logic & Importance
B. Developing sampling distribution and its analysis for the specified data using MS EXCEL, Various methods of probability and Non-probability sampling

Unit III  
(08 Hrs)
Hypothesis Testing for Variances and ANOVA

B. Analysis of cases and numerical problems on DOE and Taguchi method using net-based study

Unit IV  
**Foundations of Research**  
(08 Hrs)

A. Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - Understanding the language of research - Concept, Construct, Definition, Variable. Research Process  
B. Designing a questionnaire for e-mail survey for the specified objective, studying cases on questionnaire design and field surveys

Unit V  
**Research Design**  
(08 Hrs)

A. Concept and Importance of Research - Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Causal relationships, Concept of Independent & Dependent variables, concomitant variable, extraneous variable, Treatment, Control group.  
Types of Data: Secondary Data - Definition, Sources, Characteristics. Primary Data - Definition, Advantages and disadvantages over secondary data, Observation method, Questionnaire Construction, Personal Interviews, Telephonic Interview, Mail Survey, Email/Internet survey.  
B. Collection and analysis of two questionnaires from real life field surveys

### Text Books

3. Krishnaswamy, Management Research Methodology – Integration of Methods & Techniques, Pearson Education

### Reference Books

4. Taguchi Methods Explained: Practical steps to robust design- Tapan Bagchi, Prentice Hall of India,1993
**IP30155 :: NUMERICAL METHODS & COMPUTER PROGRAMMING**

**Credits:** 03

**Teaching Scheme:** - Theory 3 Hrs/Week

**Prerequisites (If any):**

**Objectives:**
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II (i, j)

**Unit I**
**Numerical Solution of algebraic and transcendental equations**

A. Numerical Solution of algebraic and transcendental equations by bisection method, false position method, Newton-Raphson method and Method of successive approximation. Errors and approximations: Types of errors, absolute error, relative error, algorithmic errors, truncation error, roundoff error. Error propagation

B. Revision of C or C++ syntax, Accuracy of solution by different methods

**Unit II**
**Numerical Solution of Linear Simultaneous equations**

A. Numerical Solution of Linear Simultaneous equations by Gauss elimination method, Gauss-Jordan Method, Gauss-Siedel method. Matrix inverse

B. Jacobi iteration method.

**Unit III**
**Interpolation & Curve Fitting**


B. Curve fitting of 3rd order, \( Y = aX^b \), \( Y = a.e^{bX} \).

**Unit IV**
**Numerical Integration and solution of ordinary differential equations**

A. Numerical integration by Trapezoidal rule, Simpson's 1/3rd and 3/8th rules; Weddle's rule and two point Gauss quadrature. Double integration.

methods. Simultaneous differential equation.
B. Boole’s 5 point formula for Integration, 2nd order differential equation

Unit V (08 Hrs)
Numerical solution of PDE & LPP
B. Linear Programming problems.

Text Books
1. Numerical methods by Balaguruswamy, Tata McGraw Hill

Reference Books
Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If any):

Objectives:

- To make the students understand the concepts & broad principles of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II (h, j, k)

Unit I (08 Hrs)
Introduction to Quality

B. Contribution of Quality Gurus, Juran, Crosby, Deming’s Principles of Management. Concept of TQM – Quality Circles

Unit II (08 Hrs)
Acceptance Sampling

B. Home assignment: Case on designing of sampling plan using MIL, ASQ standards.

Unit III (08 Hrs)
Statistical Process Control

B. Applications of Control Charts in Mass Production, Process Production

Unit IV
Quality Improvement Tools

A. Introduction to TQM & Quality Circles, Quality Improvement Tools: 7 QC Tools – Check Sheet, Histogram, Pareto Chart, Fishbone Diagram, Run Charts, Scatter Diagram, Process Flow Chart. 7 QM Tools – Program Decision Process Chart, Tree Diagram, Affinity Diagram, Prioritization Matrix, etc. Bench Marking
Quality Improvement Tools: Why-Why Analysis, Root Cause Analysis, Poka Yoke (Mistake Proofing)
B. Bench Marking: Types – Process, Product. Cases on application of 7 above concepts from reference books and web sources

Unit V
Six Sigma & Quality Management Systems

Introduction to TS16949: Technical Specifications, Major Components.

Text Books
1. Amitav Mitra, Fundamentals of Quality Control & Improvement, Pearson Education

Reference Books
1. J.M. Juran & F.M.Gryna , Quality Planning and Analysis.
IP30251 :: METAL CUTTING & TOOL DESIGN

Credits: 01

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites (If any):

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Mapping with PEOs: I, II (b, r)

List of Contents

A TERM-WORK containing the record of the following:

Any Eight of the following assignments:
1. Experiment on chip formation.
3. Study of influence of cutting parameters on surface roughness in turning.
5. Verification of metal cutting theories.
6. Tool life study on a single point turning tool.
7. Design & working drawing of one drilling jig.
8. Design & working drawing of one Fixture.
9. Design & working drawing of one Form tool.
10. Design & working drawing of any two of following cutting tools.
11. SPCT, Reamer, Broach, Plain milling cutter
12. Industrial visit report.
13. Research paper study & presentation on metal cutting processes.

Text Books
1. P C Sharma, Production Engg., Khanna publishers.
2. M.H.A. Kempster, Introduction to Jigs and fixtures design

Reference Books
1. Tool Engg by Nagpal
2. Dolalson, Lecain and Goold, Tool design, Tata McGrawhill.
3. Hoffman, Introduction to Jigs and fixtures.
6. R. K. Jain, production technology, Khanna Publishers
7. Milton Shaw, Metal cutting principle
IP30253 :: STATISTICAL METHODS & RESEARCH METHODOLOGY

Credits: 01

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites: : Mathematics for Engineering Applications

Objectives:
- To make the students understand the concepts & broad principles of statistical techniques used in managerial decision making
- Sensitize the students of the importance of statistics in real life environment
- Mapping with PEOs: I, IV (a, g, i, n)

List of Contents

A TERM-WORK containing the record of the following:

1) Numerical Problems on discrete probability distributions
2) Numerical Problems on continuous probability distributions
3) Numerical problems on statistical estimation
4) Determination of sample size
5) Characteristics of sampling distributions
6) Degrees of Freedom (DOF)
7) Hypothesis Testing for means
8) Hypothesis Testing for proportions
9) Hypothesis Testing for variances
10) ANOVA
11) Questionnaire Design
12) Taguchi Method of Design

Text Books

Reference Books
4. Taguchi Methods Explained: Practical steps to robust design- Tapan Bagchi, Prentice
IP30355 :: NUMERICAL METHODS & COMPUTER PROGRAMMING

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites (If any):

Objectives:
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: II (i, j)

List of Practicals
1. Assignment on Numerical Solution of algebraic equations.
2. Assignment on transcendental equations.
3. Assignment on Numerical Solution of Linear Simultaneous equations-I
4. Assignment on Numerical Solution of Linear Simultaneous equations-II
5. Assignment on Interpolation
6. Assignment on Inverse Interpolation.
7. Assignment on Curve fitting
10. Assignment on Numerical solution of partial differential equations-I
11. Assignment on Numerical solution of partial differential equations-II
12. Assignment on Linear Programming Problem.

Text Books
1. Numerical methods by Balaguruswamy, Tata McGraw Hill

Reference Books
IP30357 :: METROLOGY & QUALITY ASSURANCE

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites (If any):

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: II (h, j, k)

List of Practical

The Term work should be in the form of Journal consisting of following Two sections:

Experiments: (Any seven of the following)
1. Measurement of straightness, flatness, roundness.
7. Study and Experiment on Profile Projector.
8. Study and Experiment on any type Comparator.
10. Alignment Test on Lathe / Drilling / Milling Machine

Assignments: (Any five of the following)
1. Design of Sampling Plan
2. Design of Control Charts
3. Assignment on Process Capability
4. Case Study on 7 QC Tools
5. Case on Constructing House of Quality for any Product

Text Books
2. K.J.Hume, Engineering Metrology, Kalyani publication

Reference Books
2. J.M. Juran & F.M.Gryna , Quality Planning and Analysis.
IP37351 :: SEMINAR

Credits: 2  
Teaching Scheme: - Practical 1 Hr/Week

Objectives:
- To develop and test ability of student for self-study, presentation and communication skill
- Mapping with PEOs: IV (l, o)

Guidelines for selecting a topic
1. The topic should be the latest & related to the industrial engineering field.
2. It should not be taken directly from Syllabus.
3. Topic should be based on literature survey /a case study wherever applicable / possible, and approved by the staff- in- charge

Instruction for preparing a seminar report
1. The report should be of about 15-20 (A4 size) pages including figures and plates.
2. Use Arial 12 font with single spacing.
3. Report should be so arranged such that text matter, figures, plates, etc. will appear on right hand side only. Left hand side should be kept blank.
4. General sequence of the report material should be as follows: Title page, Certificate, Content, Abstract, Literature, Bibliography

Evaluation & Assessment Scheme
- The student will be expected to a deliver a presentation using audio-visual aids on the seminar topic. Assessment will be based on the following criteria: Report Content, Depth of Knowledge, Presentation Skills, Question-Answers, Adherence to Time

*Standard certificate Proforma will be made available by the department and the same should be used.

** Bibliography should be presented in the following sequence
i) Research papers from National/International Journals, proceedings, conferences
ii) Books (starting from latest)
iii) Websites

***Two copies of report with cover page (as supplied by department) duly filled up and spiral bound to be submitted before the term end.
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IP30152 :: MATERIAL FORMING & DIE-MOULD DESIGN

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Manufacturing Processes 1 & 2

Objectives:
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (b, p, r)

Unit I  (08 Hrs)
Fundamentals of Material Forming
A. Concept of flow stress determination, Effect of temperature, strain rate, Mohrs circle for three dimensional state of stress. Theory of plasticity- Yield criteria of Von mises criteria and Tresca criteria. Classification of material forming process, Concept of workability, formability and forming diagram.
B. Engineering stress-strain and true stress-strain, Strain hardening, work done in tensile test, temperature rise in plastic deformation compression test

Unit II  (08 Hrs)
Rolling of Metals
A. Scope and importance of rolling. Types of Rolling Mills- Construction and working. Roll bite, reduction, elongation and spread. Deformation in rolling and determination forces required. Process variables, redundant deformation. Roll flattening
B. Roll camber - its effect on rolling process, mill spring. Defects in rolling. Automatic gauge control- Lubrication in rolling

Unit III  (08 Hrs)
Design of Blanking & Progressive dies
A. Shearing force, press capacity, clearances, die & punch size types of strippers, types of pilots, types of stoppers, selection of dowel pins & allen screws., center of pressure of progressive die
B. Problems on progressive and blanking die design.

Unit IV  (08 Hrs)
Design of Drawing & Bending Dies
A. Deep drawing mechanism, Design of deep drawing die: blank size, no of draws, drawing punch and die size, drawing force, press capacity and ironing.
B. Types of Bending dies, developed length calculation, bending force, spring back & methods used to overcome it, press brake.

Unit V
(08 Hrs)

Design of Forging Dies
A. Design of forging die for multi-impression die:- selection of parting line, drafts, fillet & comer radii, ribs & webs, stock size calculation, flash & gutter, design of fullering, edging, blocking, finishing impressions, trimming dies, Die block dimensions, die inserts.
B. Design of upset forging die : Up setters, stock size calculation, Rules for upset forging.

Text Books
1. Dieter, Mechanical Metallurgy

Reference Books
1. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co.
2. Surender Kumar, Principles of Metal Working.
3. ASM Metal handbook Vol: 4 forming.
4. Mechanical working of metals by J.N. Harris
5. G.W. Rowe, Principles of industrial metal working process, Edward Arnold
IP30154 :: WORK STUDY AND ERGONOMICS

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If Any):

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III, IV (f, k, n)

Unit I  
Introduction to Work Study  
(08 Hrs)

A. Historical background, Contribution of Taylor and Gilbreth, Definition and Scope of Work Study Introduction to Industrial Engineering, Historical background, Contribution of Taylor and Gilbreth, Productivity – Definition, Types, Improvement, Work Content Analysis, Definition and Scope of Work Study
B. Work study historical initiatives in India, Recent developments and applications in the country. Numerical and Cases on Productivity

Unit II  
Method Study I  
(08 Hrs)

B. Various Considerations in Select Job for Method Study. Relationship between Motion Economy and Work Simplification.

Unit III  
Method Study II  
(08 Hrs)

B. Review of Cases in Method Study
Unit IV
Predetermined Motion Time Standards
(08 Hrs)
A. Work Measurement – Time Study & Work Sampling
B. Comparison between Time Study, Work Sampling & MTM

Unit V
Ergonomics
(08 Hrs)
A. Ergonomics: Definition, Scope, Historical background, Human- machine system interfaces, Basic Ergonomics, Work Physiology, Applied Anthropometry: Definition and scope, use and principles of anthropometric data, statistical analysis, Product design and work station design using anthropometric data, Work Space design - work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design. Physical space & arrangement, principles of arrangement of components
B. Work Efficiency and Ergonomics, Effect of Light, Noise, Temperature on Human Performance

Text Books
1. ILO, “Introduction to Work study”.
3. E. Grad jean, “Fitting Task to the Man” Taylor and Francis.

Reference Books
2. R. S. Bridger, “Introduction to Ergonomics”, Taylor and Francis
5. Waldemar Karwowski, William Steven Marras, “Occupational ergonomics: design and management of work systems”, CRC Press,
IP30156 :: PRODUCTION METALLURGY

Credits: 03
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Basic Knowledge of material science

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: III (b, c, p)

Unit I (08 Hrs)
Stees
A. Introduction to Metallography, micro and macro examination, metallurgical microscope, etching. Steels: iron-iron carbide equilibrium diagram, Critical temperatures, Allotropy, cooling curve and volume changes of pure iron. Microstructure, non-equilibrium cooling of steel, widmanstatten structure, structure property relationship. Classification and applications of steels, specifications of some commonly used steels like BIS, EN, AISI, SAE.
B. Specimen preparation for micro and macro examination

Unit II (08 Hrs)
Heat treatments of Steels
B. Defects due to heat treatment, causes and remedial measure

Unit III (08 Hrs)
Surface Hardening & Isothermal Treatments
A. Carburising, heat treatment after carburising, Nitriding, Carbonitriding, Flame hardening and Induction hardening. Commercial heat treatment practice of gears of different sizes, tools, springs. Isothermal heat treatments such as austempering, patenting, isoforming, martempering, ausforming.
B. Modification of nitriding - Tuffride and Sursulf process and plasma nitriding

Unit IV
Alloy Steels & Cast Iron

B. Applications of cast irons for different components of machine tool, automobiles, pumps etc.

Unit V
Non-Ferrous Alloys: Composite Materials

A. Copper alloys - Brasses, Bronzes: Tin, Aluminium, Beryllium, Silicon Copper nickel alloys, Nickel - Silver, Aluminium and aluminium alloys. Solders, Bearing materials and their applications, Precipitation hardening alloys. High Temperature materials such as Nimonics, Super alloys, Ti-alloys etc.
Composite Materials — Various types, Production techniques, applications etc.
B. Selection of Materials and Failure Prevention: Selection factors, some case studies of common engineering components. Failure prevention through design, proper material selection.

Text Books

Reference Books
IP30158 :: INDUSTRIAL FLUID POWER

Credits: 03  Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Mathematics for Engineering Applications

Objectives:
- To make the students understand the concepts & broad principles of the contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II, III (j)

Unit I  (08 Hrs)
Introduction to Fluid Power

A. Types of hydraulic fluids - petroleum based, synthetic and water based, selection of fluids, additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, material, quick acting couplings, Fluid conditioning through filters, strainers, sources of contamination and contamination control. Heat exchangers. Accumulators : Types
Pumps: Types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic power transmission. B. Pressure drop in hoses/pipes, Power units and accessories, selection/design procedure, applications of accumulators.

Unit II  (08 Hrs)
Actuators


Unit III  (08 Hrs)
Fluid Power Control

A. Introduction to Cartridge valves. Manually operated, solenoid operated, pilot operated, direction control valves, check valve.
B. Symbols for hydraulic and pneumatic circuits. Control of fluid power: (i) Necessity of fluid control through pressure control, directional control, flow control valves. (ii) Principle of pressure control valves, direct operated and pilot operated relief valves, pressure reducing valve, sequence valve. (iii) Principle of flow control valves, pressure compensated, temperature compensated flow control valves, meter in circuit, meter out circuits, flow through restrictor. (iv) Types of directional control valves: two way two position, four way three position, four way two positions valves. Open centre, close centre, tandem centre valves

Unit IV (08 Hrs)
Industrial Circuits & System Design
A. Industrial circuits 1 - Simple reciprocating, Regenerative, Speed control(Meter in, meter out & bleed off), Sequencing, Synchronization, transverse & feed, circuit for riveting machine
Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. (Students are advised to refer manufacturer’s catalogues.)

Unit V (08 Hrs)
Pneumatics
B. (viii) Air motors- radial piston, vane, axial piston (ix) Basic pneumatic circuit, selection of components(x) Application of pneumatics in low cost Automation and in industrial automation

Text Books
1. A. Esposito – ‘Fluid Power with application’, Pearson Education

Reference Books
4. Festo’s Manual on Pneumatic Principle, applications
5. ISO – 1219, Fluid Systems and components, Graphic Symbols
IP30252 :: MATERIAL FORMING & DIE-MOULD DESIGN

Credits: 01

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites (If Any):

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Mapping with PEOs: III (b, p, r)

List of Contents

TERM-WORK containing the record of the following:

Part A: Any six of the following assignments:

1. Determination of True stress – strain & Engineering stress-strain for Mild steel
2. Formability testing of sheet metal by Ericson cupping test.
3. Forge ability test of brass by compression test.
4. Twist test of Aluminum
5. Flow line observation test on forged component
6. Tensile testing of thin wire
7. Roll pass Design for any one structural shape.
8. Determination of CCD and extrusion ratio of Extruded sections.
10. To draw a forming limit diagram
11. Research paper study and presentation on Forming process.
12. Industry visit to study any of the above forming process

Part B: Any six of the following assignments:

1. Basic sheet metal working operations and their applications
2. Types of presses and their mechanisms and its selection.
3. Types of dies and die sets and its selection
4. To determine the center of pressure for simple blanking die and progressive die.
5. To design the strip layout, % utilization and scrap development for the given component.
6. To design Punch and die for simple blank with selection of hardware, stripper & stopper
7. To design Punch and die for progressive die with selection of pilot, hardware, stripper & stopper.
8. Deep drawing die design: Blank size, no of draws, drawing force and punch and die design.
9. To determine the developed length of bend components, bending force and die
10. Forging die design for closed die forging
11. Upsetting die design for upset forging
12. Injection mould design for the given component.

Text Books
1. Dieter, Mechanical Metallurgy
3. G.W. Rowe, Principles of industrial metal working process, Edward Arnold
5. Paquin, Fundamentals of Die design,

Reference Books
1. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co.
2. Surender Kumar, Principles of Metal Working.
4. Mechanical working of metals by J.N. Harris.
5. P.H. Joshi, Press Tools, A.H. Wheeler
6. P.C. Sharma, Production Engineering, S. Chand
7. Dr. Surender Kumar, Production Enng. Design (Tool Design), Satya Prakashan
8. R.G. W. Pye, Injection Mould Design, EWP
IP30254 :: WORK STUDY & ERGONOMICS

Credits: 01  
Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites (If Any):

Objectives:
- To clearly understand the Work Study concepts
- Mapping with PEOs: III, IV (f, k, n)

List of Contents
Tutorials containing the record of the following:

Assignments :
1) Numerical on Productivity
2) Assignment on Recording Tools – Charts
3) Assignment on Recording Tools - Diagrams
4) Method Study – Bagging Exercise 1
5) Method Study – Bagging Exercise 2
6) Assignment on Time study
7) Assignment on MTM
8) Assignment on Work Sampling
9) Anthropometric data collection
10) Anthropometric data analysis
11) Assignment on Ergonomic design principles
12) Assignment on Work place design

Text Books
1. ILO, “Introduction to Work study”.
3. E. Grad jean, “Fitting Task to the Man” Taylor and Francis.

Reference Books
2. R. S. Bridger, “Introduction to Ergonomics”, Taylor and Francis

IP30356 :: PRODUCTION METALLURGY

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites (If Any):

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory
- Mapping with PEOs: III (b, c, p)

List of Practical

1. Specimen preparation for micro examination.
2. Study and drawing of microstructures of mild steel and medium carbon steel.
3. Study and drawing of microstructures of Eutectoid steel and hypereutectoid steel.
4. Study and drawing of microstructures of white and malleable cast iron.
5. Study and drawing of microstructures of grey and nodular cast iron.
7. Study and drawing of microstructures of Aluminum bronze, tin bronze and bearing metal.
8. Study and drawing of microstructures of hardened steel, tempered steel.
11. Study of change in microstructure on annealing and normalizing of tempered steel.
12. Jominy Hardenability test on steel sample

Text Books

Reference Books
5. A.S. M. Metals Hand Book Volume 4 ‘ Heat Treatment’
IP30358 :: INDUSTRIAL FLUID POWER

Credits: 01

Teaching Scheme: - Laboratory 2 Hr/Week

Prerequisites (If Any):

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II, III (j)

List of Practical
Following assignments will be covered:
1. Study of hydraulic control valves.
2. Study of hydraulic actuators
3. Study of hydraulic accumulators
4. Study of hydraulic pumps-Rotary
5. Study of hydraulic pumps-reciprocating-In line axial
6. Study of hydraulic pumps-radial
7. Study of hydraulic circuits: -, machine tools,
8. Study of hydraulic circuits-, automobile systems
9. Study of Compressed air generation and distribution systems
10. Study of Filters, Regulator and Lubricator
11. Study of Shuttle Valve/ Quick Exhaust valve/Twin pressure valve /Pneumatic Clamp
12. Demonstration of working of Pressure/Direction/ Flow control valves on trainer.

Text Books

Reference Books
4. A. Lall – ‘Oil Hydraulics’, International Literature Association
7. Festo’s Manual on Pneumatic Principle, applications
8. ISO – 1219, Fluid Systems and components, Graphic Symbols
IP37352 :: PROJECT STAGE I

Credits: 2  

Teaching Scheme: - Practical 1Hr/Week

Prerequisite : Nil

Objectives:
- To train the students to apply their engineering knowledge to real life problem solving.
- Mapping with PEOs: IV (e, f, g, i, n)

The project work could be of the following nature:
1. Manufacturing / Fabrication of a prototype machine including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
2. Improvement of existing machine / equipment / process.
3. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problems related to Productivity improvements.
6. Problems related to value engineering.
7. Problems relating to material handling system.
10. Product design and development.
11. Analysis, evaluation and experimental verification of any engineering problem encountered.
13. Quality improvements, In-process Inspection, Online gauging.
15. Time and Motion study, Job evaluation.
16. Ergonomics and safety aspects under industrial environment
17. Management Information System.
18. Market Analysis in conjunction with Production Planning and Control.

OR


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Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hitech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available benchmarks / results. Design/development and Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.

The project work shall be taken up individually or in a group consisting of not more than 4 students.

A report containing maximum 30 pages shall be submitted based on the background, need and scope of the project, project specifications, activities involved in the project and activity plan, study of literature and basic theory, and work completed (if any).

Guidelines:

- Report shall be typed or printed.
- Figures and tables shall be on separate pages and attached at respective positions.
- Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students shall be included on every certified report copy.

Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.
FF No. 653 Issue No.1, Rev No.1 dated 2/4/2011

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Total | 12 | 2 | 10 | 20
IP40151 :: MATERIALS & OPERATIONS MANAGEMENT

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject.
- Mapping with PEOs: I, III, IV (f, g, i, n, o)

Unit I

(8 Hrs)

Introduction to Materials Management:
A: Introduction to Materials Management: Functions of Materials Management – Sourcing/Procurement, Inventory, Stores, Vendor Development etc. Organization of Materials Management Function. Inventories – Objectives of an Inventory Control, Classification and Costs of Inventories: Types, Objective of holding inventories, Different types of Inventories, Costs Associated with Inventory - Carrying cost, Procurement cost. EOQ - Concept, Assumptions of EOQ Model, Practical Constraints – Numerical Analysis, Quantity Discounts. Symptoms of Poor Inventory management, Selective Inventory Control: Concept of Selective Inventory Control, ABC analysis
B: Selective Inventory Control Techniques. VED analysis, HML analysis, SDE analysis, SOS analysis, FSN analysis, GOLF analysis. EMQ Model - Carrying cost, Setup cost. EOQ Special Considerations – Spares, Bought-outs, etc.

Unit II

(8 Hrs)

Replenishment Systems:
A: Replenishment Systems: Introduction, Concept of lead time and its effects on Inventory, Components of Lead Time - Internal and External. Variability in demand and lead time. Safety Stock Evaluation and ways to minimize lead time, Different types of replenishment systems like Fixed order quantity system, Fixed order interval system, Combination of fixed order interval and quantity system, Two Bin System. Probabilistic Replenishment System
B: Case Study in Inventory Control & Replenishment Systems

Unit III

(8 Hrs)

Material Requirement Planning (MRP I)
A: Material Requirement Planning (MRP I): Inputs to MRP – MPS, BOM – Types of BOM, BOM Explosion, Inventory Transaction Files, MRP Processing (Logic) – Time Phased Operation Plan, Numerical on BOM Explosion Netting Requirements, Outputs of
MRP. Procurement Management: Procurement Procedure, Documents in Procurement, Import Procedure – Documents, Vendor Selection, Vendor Development, Vendor Rating

B: MRP II: Manufacturing Resource Planning, Types of Buying, Methods of Buying, Legal Aspects of Buying,

Unit IV

Types of Production Systems
B: Scheduling Tools: Gantt Charts, Machine Load Charts, Documentation - Production Work Order. Johnsons Algorithm - Sequencing n jobs on m machines

Unit V

Demand Forecasting:
B: Holts Model, Winters Model, Box-Jenkins Method

Text Books
1. Inventory management by L.C. Jhamb, Everest Publishing House

Reference Books
1. Material Management by Dobler Burt
2. Inventory management, Silver and Peterson, John Willey and sons
Credits: 03  

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- Introduce students to basic concepts in FEM, various elements used and steps in FEM
- Make students to understand problem formulation and solution by FEM for Single degree, Double degree of freedom problem and Axi-symmetric field problems
- Make students to understand mathematical computation when using higher order elements
- Introduce the students to few case studies for FEM analysis.
- Mapping with PEOs: II, III (b, j)

Unit I
A: Introduction to FEA, Basic Steps in FEM, Integral formulation for Numerical Solution-Variational method, Collocation method, Galerkin’s method. Stress and strain relations,
B: plane stress and plain strain, Potential energy method.

Unit II
B: Application of the above equation for Problems like, Beam Analysis, temperature distribution analysis, Voltage distribution analysis, etc.

Unit III
A: Two dimensional elements- Linear triangular and Bilinear Rectangular elements, Shape function for the same. Local co-ordinate system, significance of natural co-ordinate system, Natural co-ordinate systems for Linear element, Linear Triangular element.
B: Bilinear Rectangular elements

Unit IV
A: Introduction to Basic Transformations - Translation, Rotation, Scaling, Reflection, Homogenous Coordinate system, Concatenated Transformation, Mapping of Geometric
Models, Inverse Transformations. Projections - Orthographic, Isometric.

B:-- Oblique, Perspective.

Unit V (8 Hrs)

B: Introduction to different volume modelling techniques - Constructive Solid Geometry, Boundary Representation, Pure Primitive instancing, Spatial Occupancy Enumeration, Feature Based Modelling

Text Books

Reference Books
IP40155:: POWDER METALLURGY

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: III (b, c, h)

Unit I  (8Hrs)
Powder Production
B. Historical development, Basic principles of Powder Metallurgy

Unit II  (8 Hrs)
Compaction
A. Fundamentals of compaction, presses used, selection of presses, Automation and Handling of powder, tool clearances, Die design principles, wear reclamation, Die and punch materials selection and heat treatment, surface treatment properties, compact density variations, effect of blending powders, lubricants and lubrication in process. Pressure less powder shaping.
B. Improvement of press tool life

Unit III  (8 Hrs)
Sintering
A. Principle, time temperature effects, Theories of sintering mechanism. Sintering methods, sintering furnaces-characteristics and selection. Dimensional and property changes after sintering, Rapid sintering processes, impregnation. Liquid phase sintering, Activated sintering.
B. Sintering atmosphere and its impact on process performance

**Unit IV**

**Special P.M. Processes & Secondary Operations**

A. Secondary operations like sizing, coining, Oil impregnation, heat treatments, Steam treatment. Special PM processes like Hot Compaction, Iso static pressing, Hot Iso static compaction merits, demerits and typical applications. Powder metal products with polymer blends, Powder roll compaction. P.M. Forging, Powder Extrusion, Injection molding, Spray deposition forming

B. Comparison between various special PM processes.

**Unit V**

**Powder Metallurgy Applications & Economics**

A. Production details of common PM structural parts like gears, levers, ratchets, etc. lamp filament and filament support, refractory metal components, electrical contact material, Cemented Carbide tools and wear parts, brakes and clutch lining material, porous bearings and filters, catalytic components etc. Advantages and limitations of powder metallurgy. Production of nano composites.

B. Economics, Quality assurance, Manufacturing Competitiveness due to conservation of energy, Materials, Operations, Durability, rigidity, near net – shape, surface finish and machining.

**Text Books**


**Reference Books**

IP40157:: HUMAN FACTORS ENGINEERING

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: IV (f, i, k, n)

Unit I
Introduction to Human Factors  (8 Hrs)

A. Human criteria’s, human physical activities, features of the human body, Measures of physiological functions such as: energy expenditure, gross body activity, local muscular activity, work load, work efficiency, work and rest. Type of movements of body members. manual material handling (MMH)

B. Performance criteria for physical activity such as: Strength & endurance, speed of movements, accuracy of movements

Unit II
Applied Anthropometry and Work Space  (8 Hrs)

A: Introduction to anthropometry, use & principles of anthropometry data, work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design. Design and Displays: Information input & processing, visual displays of static & dynamic information. Auditory, textual & olfactory displays, general location of controls & displays within workspace, concept of visibility

B: Physical space & arrangement, principles of arrangement of component, Functions of controls, types of controls, factors in control design, design of specific hand operated controls, foot controls and special control devices.

Unit III
Working Conditions  (8 Hrs)
Illumination: Color systems, energy consideration,
Atmospheric conditions: Measurement of thermal variables, wet-bulb globe temperature, Botsball, heat stress index, heat index, wind chill index,


Unit IV  
Energy Expenditure  
A. Muscle mechanism, BMR, Heart Rate variations, Oxygen consumption, Rest allowances, Rate of energy expenditure, Manual Material Handling Capacity determination 
B. Effect of environmental conditions and work design on Energy Expenditure

Unit V  
Ergonomics and Work Organization  
A. Human factors applications in system design, characteristics of system design, human factors data for interface design, ergonomic safety & health management 
B. Case studies of ergonomically designed product.

Text Books
2. E. Grad jean, “Fitting Task to the Man” Taylor and Francis.

Reference Books
1. ILO, “Introduction to Work study”.
3. R. S. Bridger, “Introduction to Ergonomics”, Taylor and Francis  
IP40159 :: LOGISTICS & SUPPLY CHAIN MANAGEMENT

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: IV (f, o)

Unit I

(8 Hrs)

Logistics Management


B: Modes of Transportation – Rail, Road, Pipelines, Water Air – Advantages & Disadvantages

Unit II

(8 Hrs)

Warehouse Management:


B: Stores Documentation – Bin Cards, Stores Ledger. WMS Systems in Practice

Unit III

(8 Hrs)

Concept of SCM

A: Supply Chain: Concept, Objective. Decision Phases in Supply Chain. Process View

B: Importance of Supply Chain, Examples of Supply Chain

Unit IV (8 Hrs)
Network Design in Supply Chain
A: Network Design in Supply Chain

B: Factors Influencing Network Design Decisions – Strategic, Technological, Macroeconomic, Political, Infrastructure, Competitive

Unit V (8 Hrs)
Co-ordination & Technology in the Supply Chains
A: Co-ordination & Technology in the Supply Chains

Text Books
1. Supply Chain Management - Strategy, Planning & Operation – Sunil Chopra & Peter Meindl, Pearson Education

Reference Books
1. Logistical Management - The Integrated Supply Chain Process – Bowersox
2. Christopher, Logistics & Supply Chain Management, Pearson Education
3. Logistics & Supply Chain Management – Raghuram
4. Purchasing & Supply Management - Dobler and Burt
6. Strategic Logistics Management – Lambert
IP40161 :: PLANT ENGINEERING

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:

- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (f, g, h, n)

Unit I (8 Hrs)
Scope of Plant Engineering

A: Scope of Plant Engineering – Importance & Objectives, Nature Of Location Decision, Affecting Facility Location, Single & Multiple Facility Location Models, Qualitative Considerations in Facility Location, Factors Urban v/s Rural Location, Site Selection. Plant Layout – Introduction, Types of Plant Layout: Product, Process, Fixed Postion, Hybrid – Cellular, FMS, etc. Phases of Layout Planning
B: Urban Location versus Rural Location. Case Study in Location Decisions, Location Pattern In India.

Unit II (8 Hrs)
Systematic Layout Planning

B: Need And Advantages Of Planned Material Flow, Factors For Consideration, Types of Flow Patterns, Flow Patterns For Production Lines And Assembly Lines. Case Study in REL Chart .

Unit III (8 Hrs)
Systematic Layout Planning:

B: Criteria For Computerized Facility Layout, Concept Of Computerized Layout
Programs Like CRAFT & PLANET.

**Unit IV**

*(8 Hrs)*

**Material Handling:**

**A:** Material Handling Function, Scope And Functions Of Material Handling, Manual Mechanical Handling Ratio, MH Equipment Types- Positioning Equipment, Unit Load Equipment, Auto Identification & Control Equipment, Transport Equipment – Conveyors, Cranes, Industrial Trucks


**Unit V**

*(8 Hrs)*

**Systematic Handling Analysis**


**Text Books**

1. Systematic Layout Planning …. Richard Muther
2. Systematic Handling Analysis … Richard Muther
3. Plant Layout and Design …. James More
4. Clark, Facility Planning, Pearson Education

**Reference Books**

1. Plant Layout and Material Handling ..By James M Apple
2. Plant Layout By Immer
3. Plant Layout By Shubin
4. Material handling By Allexander
5. Material Handling Equipment By N Rudenko
Credits: 03  Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
  - Aim is to provide insight of the subject
  - Sensitizes the students of the importance of course in real life environment
  - Mapping with PEOs: II, III (g, r)

Unit I  (8Hrs)
Design of Machine Tool Structure
A. Function & Requirement of Machine Tool Structure, Design Criteria from Strength & Stiffness considerations, Concept of Unit Rigidity, Unit Strength under Tension, Unit Strength under Torsion & Unit Strength under Bending for Material of Machine Tool Structures, Compare Steel & Cast Iron on the basis of Material Properties, Manufacturing Problems and Economy, Role of Static & Dynamic Stiffness in the design of elements of machine tools, Profiles of Machine Tool Structures, Factors affecting stiffness of machine tool structures & methods of improving it, Basic Design procedure of machine tool structures
B. Design Case Studies of a) Bed of Lathe, b) Column & Base of Milling Machine, c) Housing of Speed Gear box

Unit II  (8 Hrs)
Design for Fluctuating Loads
A. Stress Concentration and remedies, S.N.Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative damage, Sodberg’s and Goodman’s Diagram
B. Design of components like shaft, bolted joints, springs etc. subjected to variable loading

Unit III  (8 Hrs)
Design of Machine Tool Drives
A. 1) Selection of Electric Motor, 2) Stepped Regulation of Speed, Laws of Stepped Regulation, Why Geometric Progression is used against Arithmetic, Harmonic & Logarithmic despite shortcomings, Relation between Range ratio, Geometric Progression Ratio and No. of Speed Steps, 3) Design of Stepped Drives: Break up of Speed Steps, Structural Formulae, Structural Diagram, Selection of Best Structural Diagram, Ray Diagram, Speed Chart, General recommendations for Developing the Gearing Diagram, Determining the number of teeth of Gears. 4) Speed / Feed Gear box: Limiting Transmission Ratio of Speed / Feed Gear Box
B. Design Case Study of - Speed Gear Box for Lathe, - Feed Gear Box for Drilling Machine. Classification of Speed / Feed Gear Boxes & their Application, Electro-Mechanical Step less Drive; Case Study of CNC Lathe with Electronic Controller for Speed & Feed Step less Regulation

Unit IV
(9 Hrs)
Design of Guide-ways & Power Screws

Unit V
(9 Hrs)
Design of Spindle & Spindle Supports:
A. Function & Requirements of Spindle Units, their Materials, Effect of Machine Tool Compliance on Machining accuracy Design of Spindle for Bending Stiffness: Deflection of Spindle Axis due to a) Bending, b) - due to Compliance of Spindle Supports, c) - due to Compliance of the Tapered Joint. Optimum Spacing between Spindle Supports, Permissible Deflection & Design for stiffness: Additional Check for Strength like Additional Supports, Location of Bearings and Drive elements, Balancing.
Text Books

Reference Books
FF No. : 654

IP40165:: MANUFACTURING SYSTEMS

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II, III (b, j)

Unit I
Hard and soft automation
(8Hrs)

A. Transfer lines, types, work part transfer mechanisms, control of production line, transfer line performance, CNC NC/CNC machine programming: construction, classification, various axes in NC machines, G & M code programming

B. SPMs, automats, machines, machining centers, computer aided programming

Unit II
Automatic material handling and inspection
(8 Hrs)

A. Automatic material handling and inspection, Automated guided vehicles systems, conveyor systems, automated inspection
B. Analysis, carousel storage systems, automatic gauging system

Unit III
Factory automation, Assembly systems
(8 Hrs)

A. Factory automation, Assembly systems, automated assembly, design for automated assembly, vibratory bowl feeders, hopper feeders, rotary disc feeders.
B. Synchronous and non synchronous material transfer, centrifugal, revolving feeders

Unit IV
ROBOTICS: Components, Configuration, Machine vision system
(9 Hrs)
A. ROBOTICS: Components, Configuration, Machine vision system
B. Applications, dc and ac servo driving units, encoders.

Unit V

Computer aided manufacturing, CIM and FMS

A. Computer aided manufacturing, CIM and FMS
B. DNC, cellular manufacturing, group technology, flexible manufacturing systems, computer control system. FMS planning and implementation, Elements of CIM system

Text Books

Reference Books
1. Mechanisation by pneumatic control-Werner Deport and Kurt Stool, Vol. 1, 2
2. Control Systems Engineering-Gopal, Wiley Eastern Ltd
3. Hydraulics and Pneumatics—Andrew Parr
4. Microprocessor-Gaonkar, Penram International
IP40251:: MATERIALS & OPERATIONS MANAGEMENT

Credits: 01

Teaching Scheme: - Tutorial 1 Hrs/Week

Prerequisites:

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: I, III, IV (f, g, i, n, o)

List of Contents
A TERM-WORK containing the record of the following:

1. Assignment on Costs of Inventories, Assignment on EOQ, Quantity Discounts
2. Assignment on Replenishment Systems – Deterministic Models
3. Assignment on Replenishment Systems – Probabilistic Models
4. Assignment on Selective Inventory Control
5. Assignment on Disposal of Surplus and Obsolescent stocks
6. Assignment on MRP – BOM Explosion
7. Assignment on MRP – Netting Requirements
8. Assignment on Demand Forecasting – Forecast Demand & Measure Error
9. Assignment / Case on Aggregate Planning
10. Assignment on Job Shop Scheduling
12. Case let on Scheduling

Text Books
1. Inventory management by L.C. Jhamb, Everest Publishing House
3. Chapman, Fundamentals of Production Planning & Control, Pearson Education

Reference Books
1. Material Management by Dobler Burt
2. Inventory management, Silver and Peterson, John Willey and sons
IP40253:: FINITE ELEMENT METHOD & CAD

Credits: 01

Teaching Scheme: - Tutorial 1 Hrs/Week

Prerequisites: :

Objectives:
- Introduce students to basic concepts in FEM, various elements used and steps in FEM
- Make students to understand problem formulation and solution by FEM for Single degree, Double degree of freedom problem and Axi-symmetric field problems
- Make students to understand mathematical computation when using higher order elements
- Introduce the students to few case studies for FEM analysis.
- Mapping with PEOs: II, III (b,j)

List of Contents
A TERM-WORK containing the record of the following:

1. Solution of differential Equations by Variational methods
2. Solution of Differential equation by Gaerkin method
3. Problems on potential energy method.
4. Problems on obtaining elemental stiffness and load matrices
5. Solution of Beam Analysis single degree of freedom by the above method
6. Evaluation of Shape function for Linear triangular elements
7. Solution of electromagnetic FEA two degree of freedom by the above method
8. Problems on basic transformations - Translation, Rotation, Scaling, Reflection
9. Problem on Oblique projection
10. Programming on Cubic spline
11. Parametric representation of curves
12. Assignment on Feature based modeling

Text Books
Reference Books

IP40255:: POWDER METALLURGY

Credits: 01

Teaching Scheme: Tutorial 1 Hr/Week

Prerequisites:

Objectives:
- Introduce students to basic concepts in powder metallurgy
- Make students understand the applications of powder metallurgy in manufacturing applications
- Mapping with PEOs: III (b, c, h)

List of Contents
A TERM-WORK containing the record of the following:

2. Powder characterization & its effects on properties of sintered parts.
4. Study of various compaction presses
5. Study of methods for improvement in tool life.
6. Study of Theories of sintering mechanism
7. Study of sintering furnaces-characteristics and selection
8. Testing of sintered parts.
9. Study of protective atmospheres, their production & control.
10. Recent developments in cutting tools.
11. Special PM processes like Hot Compaction, Iso static pressing, Hot Iso static compaction
12. Applications of powder metallurgy in engineering components.

Text Books

Reference Books
1. Powder Metallurgy Handbook, ASME
IP40257:: HUMAN FACTORS ENGINEERING

Credits: 01

Teaching Scheme: Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: IV (f, i, k, n)

List of Practical
1. Anthropometric Data Collection – sample, equipment, analysis.
2. Applied Anthropometry – Product Design
3. Applied Anthropometry – Work Place Design (Seating / Standing)
5. Analysis of energy consumption for different activities performed in controlled conditions
6. Analysis of energy consumption for different activities performed in uncontrolled conditions
7. Analyze effectiveness of work environment considering illumination level
8. Analyze effectiveness of work environment considering air velocity using anemometer
9. Analyze effectiveness of work environment considering sound level using sound meter
10. Legal and Safety Aspects.

Text Books
2. E. Grad jean, “Fitting Task to the Man” Taylor and Francis.
Reference Books

1. ILO, “Introduction to Work study”.
3. R. S. Bridger, “Introduction to Ergonomics”, Taylor and Francis
FF No. : 654

IP40259:: LOGISTICS & SUPPLY CHAIN MANAGEMENT

Credits: 01

Teaching Scheme: Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: IV (f, o)

List of Contents

A TERM-WORK containing the record of the following:

Assignments
1. Detailed Study of Supply Chain of any one company in an Industry of your choice
2. Study of Industry Based on ETIG SCM CD
3. Numerical & Cases on Facility Location Models- Single and Multiple Facility Location & Location - Allocation Models
4. Numericals & Caselet on Demand Forecasting
5. Case let on Aggregate Planning
6. Case let on Inventory Management
7. Numerical and Cases on Travelling Salesman Problem
8. Numerical and Cases on Vehicle Routing Problem
9. Comprehensive Case Study on Supply Chain Management
10. Computerized Simulation Game
11. Case Study on Logistics Modeling
12. Industrial Visit

Text Books
1. Supply Chain Management - Strategy, Planning & Operation – Sunil Chopra & Peter Meindl, Pearson Education
IP40261 :: PLANT ENGINEERING

Credits: 01

Teaching Scheme: -Tutorial: 1 Hr/Week

Prerequisites: : NIL

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Mapping with PEOs: III (f, g, h, n)

Assignments
1. Single facility location problems – Quantitative Techniques
2. Multiple facility location problems - Quantitative Techniques
3. Case on – Facility Location
4. Assignment on Process Layout - REL Charts
5. Assignment on Product Layout - Line Balancing
6. Computerized Layout Planning
7. Assignment on Layout Evaluation Techniques
8. Comprehensive Case on – Layout Improvement 1
9. Comprehensive Case on – Layout Improvement 2
10. Comprehensive Case – Material Handling Systems Design 1
11. Comprehensive Case – Material Handling Systems Design 2
12. Industrial Visit

Text Books
1. Systematic Layout Planning …. Richard Muther
2. Systematic Handling Analysis … Richard Muther
3. Plant Layout and Design … James More

Reference Books
1. Plant Layout and Material Handling ..By James M Apple
2. Plant Layout By Immer
3. Plant Layout By Shubin
4. Material handling By Allexander
5. Material Handling Equipment By N Rudenko
IP40363:: MACHINE TOOL DESIGN

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Application of the theory, Understanding of fundamentals of the subject
- Mapping with PEOs: II, III (j, r)

List of Practical
1. Design and Working Drawing of Speed Gear Box for Lathe
2. Design and Working Drawing of Feed Gear Box for Drilling Machine
3. Design and Working Drawing of Lathe Bed,
4. Design and Working Drawing of Milling Machine Column,
5. Design and Working Drawing of Milling Machine Base
6. Design and Working Drawing of Sliding Friction Power Screw
7. Design and Working Drawing of Rolling Friction Power Screw
8. Design and Working Drawing of Spindle for Lathe
9. Design and Working Drawing of Spindle-Support for Lathe
10. Design and Working Drawing of Guide Ways of VIT Anil Lathe
11. Study of Step-less Drives : VIT CNC Lathe
12. Study of Machine Tool Control Systems for Speed & Feed

Text Books

Reference Books
IP40365:: MANUFACTURING SYSTEMS

Credits: 01  
Teaching Scheme: - Laboratory: 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: (b, h, i, q)

List of Practical

1. Programming using linear interpolation on CNC machine.
2. Programming using circular interpolation on CNC machine.
3. Programming using automatic canned cycles on CNC machine
4. Programming using complex functions on CNC machine
5. Study of Programming on Robot application.
7. Analysis of AGVs.
8. Conveyor system analysis.
9. Problem 1 on assembly Line balancing.
10. Problem 2 on assembly Line balancing
11. FMS performance “Bottleneck Model”.
12. Analysis of transfer lines with no internal storage.

Text Books:

Reference Books:
1. Mechanization by pneumatic control-Werner Deport and Kurt Stool, Vol.1, 2
3. P.Radhakrishnan, S.Subramaniyum, V.Raju, “CAD\CAM\CIM”- New Age Interanational Pvt Ltd.
IP 43751:: PROJECT STAGE II

Credits: 4  
Teaching Scheme: - Practical 2 Hrs/Week

Prerequisite : Nil

Objectives:

- To train the students to apply their engineering knowledge to real life problem solving.
- Mapping with PEOs: IV (e, f, g, i, n)

The project work could be of the following nature:

1. Manufacturing / Fabrication of a prototype machine including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
2. Improvement of existing machine / equipment / process.
3. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problems related to Productivity improvements.
6. Problems related to value engineering.
7. Problems relating to material handling system.
10. Product design and development.
11. Analysis, evaluation and experimental verification of any engineering problem encountered.
13. Quality improvements, In-process Inspection, Online gauging.
15. Time and Motion study, Job evaluation.
16. Ergonomics and safety aspects under industrial environment
17. Management Information System.
18. Market Analysis in conjunction with Production Planning and Control.

OR

Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hitech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its
validation or comparison with available benchmarks / results. Design/development and Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.

The project work shall be taken up individually or in a group consisting of not more than 4 students.

A report containing maximum 30 pages shall be submitted based on the background, need and scope of the project, project specifications, activities involved in the project and activity plan, study of literature and basic theory, and work completed (if any).

**Guidelines:**

- Report shall be typed or printed.
- Figures and tables shall be on separate pages and attached at respective positions.
- Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students shall be included on every certified report copy.
- Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.
MODULE VIII
### Structure & Syllabus of B.E. (Production) Program – Pattern ‘B11’

#### FF No. 653 Issue No.1, Rev No.1 dated 2/4/2011


<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
</tr>
</thead>
</table>
| S5          | IP40152      | *Elective Group III  
 • Financial Management & Costing  
 • Reliability Engineering  
 • World Class Manufacturing | 3 0 0 | 3 |
|             | IP40154      |              |                            |         |
|             | IP40156      |              |                            |         |
| S6          | IP40158      | *Elective Group II  
 • Operations Research  
 • Surface Engineering  
 • Product Design & New Product Development  
 • Entrepreneurship Development | 3 0 0 | 3 |
|             | IP40160      |              |                            |         |
|             | IP40162      |              |                            |         |
|             | IP40164      |              |                            |         |
| S7          | IP40166      | Project Management | 3 0 0 | 3 |
| S8          | IP40168      | Process Engineering | 3 0 0 | 3 |
| T3          | IP40252      | *Elective Group III  
 • Financial Management & Costing  
 • Reliability Engineering  
 • World Class Manufacturing | 0 1 0 | 1 |
|             | IP40254      |              |                            |         |
|             | IP40256      |              |                            |         |
| T4          | IP40258      | *Elective Group II  
 • Operations Research  
 • Surface Engineering  
 • Product Design & New Product Development  
 • Entrepreneurship Development | 0 1 0 | 1 |
|             | IP40260      |              |                            |         |
|             | IP40262      |              |                            |         |
|             | IP40264      |              |                            |         |
| P3          | IP40366      | Project Management | 0 0 2 | 1 |
| P4          | IP40368      | Process Engineering | 0 0 2 | 1 |
| PS3         | IP47352      | Project Stage III | 0 0 8 | 6 |
| Total       |              |              | 12 2 12                  | 22      |
IP40152 :: FINANCIAL MANAGEMENT & COSTING

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- To learn and understand applications of costing in engineering
- To learn and understand cost estimation, cost analysis
- Mapping with PEOs: IV (f, g)

Unit I

(8 Hrs)

Financial Management

A. Nature and Scope of Finance Function; Financial goal - profit vs. wealth Maximization; Finance functions – investment, Ratio Analysis Classification, Ratio Analysis and its limitations. Types of Ratios – Activity Turnover, Profitability, Liquidity, etc


Unit II

(8 Hrs)

Capital Budgeting & Working Capital Management

A: Nature of investment decisions; Investment evaluation criteria – net present value, internal rate of return, profitability index, payback period, accounting rate of return; Meaning, significance and types of working capital; calculating operating cycle period and estimation of working capital requirements; Financing of working capital and norms of bank finance; Sources of working capital; Commercial paper; Factoring services

B: NPV and IRR comparison; Capital rationing. B. Various committee reports on bank finance; Dimensions of working capital management.

Unit III

(8 Hrs)

Cost

B. Accounting for Prime Cost.

Unit IV  
(8 Hrs)

Overheads


B. Accounting for Overheads. Preparation of Cost Sheet & Cost Statement

Unit V  
(8 Hrs)

Marginal Costing:


B. Concept of Break-Even, P/V Ratio, Margin of Safety.

Text Books


Reference Books

IP40154:: RELIABILITY ENGINEERING (ELECTIVE I)

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:

- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: III (g, h)

Unit I  
Introduction to Reliability  
(8Hrs)

A. Introduction to Reliability, Importance of reliability, trade off between cost, quality and reliability, quality and safety, bathtub concept, MTBF, MTTR, hazard rate, failure rate.
B. Probability and sampling, cumulative probability distribution function, data and distributions.

Unit II  
System Safety Analysis  
(8 Hrs)

A. Fault tree and event tree concept, construction and analysis, failure modes effects and criticality analysis, systems approach
B. Techno-physio constraints, typical failure analysis, risk priority number and its allocation.

Unit III  
System Reliability and Redundancy  
(8 Hrs)

A. System reliability and redundancy, Active and Passive Redundancy, redundancy allocation and limitations, Evaluation of overall system reliability, allocation of reliability.
B. Conditional probability
Unit IV
(9 Hrs)
Loads, Capacity, Maintainability and Availability
A. Preventive maintenance, Testing and repair, reliability centered maintenance, system availability and maintainability.
B. Reliability and safety factors, Repetitive loading.

Unit V
(9 Hrs)
Reliability Testing and Failure Interactions
A. Reliability testing and Failure Interactions, accelerated life testing, Markov analysis of two independent components, reliability with standby system, multicomponent systems.
B. Reliability growth models, grouped and ungrouped data, censored data, DTMC and CTMS models.

Text Books

Reference Books
IP40156:: WORLD CLASS MANUFACTURING

Credits: 03
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:

• To apply the concepts of lean manufacturing in industrial situations to improve productivity and eliminate the wastes.
• Mapping with PEOs: IV (f, o)

Unit I
WCM & Lean Manufacturing


B. Hall’s, Schonberger,s framework of World Class Manufacturing, Various models of world class manufacturing

Unit II
Lean Manufacturing Tools & Techniques 2


Unit III
Total Productive Maintenance
Maintenance – Breakdown, Preventive, Predictive. TPM: Concept & Origin, Outline of TPM – 8 Pillars, TPM Performance Measures – PQCDSM & OEE, Introduction to Autonomous Maintenance (Jishu Hozen) activities, Small-Group activities of TPM. Introduction to 5S: Steps in 5S Methodology, Concept of 1S(Seiri), 2S(Seiton), 3S (Seiso), 4S (Shiketsu), 5S, (Shitsuke). Implementation of 1S & 2S
B. MBNQA, EFQM Award, RBNQA Award, JIPM TPM Award, Losses & Abnormalities in TPM, Home Assignment on 5S

Unit IV

Business Process Reengineering

B. Tools in BPR

Unit V

Theory of Constraints

A. Introduction to TOC, Concept, Constraints – Types, Concept of Throughput, Inventory & Operating Expenses, Throughput Accounting, TOC Methodology, Numerical & Cases in TOC. Application of TOC in industry

Text Books

1. Learning to See, James Womack & Daniel Jones

Reference Books

1. World Class Manufacturing -A strategic perspective by B.S. Sahay, Saxena, Macmillan, India
2. Cause and Effect Lean – The essentials of Lean Manufacturing by John Bicheno
3. World Class Manufacturing – Richard Schonberger
4. Introduction to TPM: Total Productive Maintenance by Nakajima Seiichi
5. Total Productive Maintenance by Terry Wireman (Industrial Press)
6. Management Of Industrial Maintenance By A. Kelley, M.J. Harris (Newness Butterworths)
7. Complete Handbook of Maintenance Management By J.E. Heintzelman (Prentice Hall)
8. TPM material/ books published by JIPM (Japanese Institute of Plant Maintenance)
**IP40158:: OPERATIONS RESEARCH**

**Credits:** 03  
**Teaching Scheme:** - Theory 3 Hrs/Week

**Prerequisites:** Nil

**Objectives:**  
- To make the students understand the concepts & broad principles of contents of the course  
- Aim is to provide insight of the subject  
- Sensitizes the students of the importance of course in real life environment  
- Mapping with PEOs: IV (a, f, i, n)

**Unit I**

*(8 Hrs)*

**Linear Programming**

A) **Linear Programming:** Linear Programming, Formulation of LP Problem, Standard Form, Solution using Simplex Method. Duality. Special Conditions in LPP. Economic Interpretation of Dual, Solution of LPP using Duality concept, Dual Simplex Method. Sensitivity Analysis. Big M method Two phase method.

B) Solution of LPP using TORA & Solver in Excel

**Unit II**

*(8 Hrs)*

**Integer Programming & Dynamic Programming**


B. Case studies based on Integer Programming & Dynamic Programming

**Unit III**

*(7 Hrs)*

**Goal Programming & Decision Making Tools**

A. **Goal Programming & Decision Making Tools:** Goal Programming-Definition, Introduction, Problems, Analytical Hierarchy Process, Decision Tree – Logic. Decision making under risk (EMV criteria) and Decision making under uncertainty.

B. Case studies based on Goal Programming & Decision Making Tools
Unit IV

Replacement Model & Theory of Games

A. Replacement Model: Replacement of capital equipments that deteriorates with time, time value of money (a) remains same (b) changes with constant rates during period. Equipment renewal policy, group and individual replacement. Individual Replacement, Group Replacement Policies, Problems. Game Theory: Game theory Introduction, Terminology, Two-person zero sum game, minimax and maximin principle, Saddle Point, Games with pure and mixed strategies, Dominance property, Solutions with Graphical methods,

B. Case studies on Replacement Models & Game Theory: L.P. method, approximation method.

Unit V

Queuing Theory & Simulation

A. Queuing Theory: Introduction, terminology, Poisson single and multi channel queuing system models: M/M/1 Model, M/M/C Model, M/Ek/1 Model. Simulation: Definition, Introduction, Application, Monte Carlo Simulation. Applications of Simulation, Generation of Random Numbers.

B. Simulation software, Building Model on Simulation Software, Running the simulation, Understanding the results

Text Books

2. Paneerselvam Operations Research, Prentice Hall of India

Reference Books

Bansilal Ramnath Agarwal Charitable Trust’s
Vishwakarma Institute of Technology, Pune – 411 037
Department of Industrial & Production Engineering

FF No. 654

IP40160:: SURFACE ENGINEERING

Credits: 03  Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
• To make the students understand the concepts & broad principles of contents of the course
• Develop conceptual framework of the course
• Mapping with PEOs:

Unit I (8Hrs)
Basic Principles & Pretreatment of Substrate
A. Introduction of Surface dependent properties Classification and scope of surface engineering in metals, ceramics, polymers and composites, tailoring of surfaces of advanced materials. Surface protection (Physical) Surface dependent engineering properties, viz., wear, friction, corrosion, fatigue, etc.; common surface initiated engineering failures; mechanism of surface degradation; importance and necessity of surface engineering. Classification & Selection of Cleaning processes. Acid & Alkaline, Salt bath, Ultrasonic, Mechanical cleaning, Pickling & de scaling etc. Process details of each, applications of each Environmental concern of each.

B. Various purposes of Surface engineering

Unit II (8Hrs)
Surface Coatings

B. Scope and application of conventionally deposited materials.

Unit III (8Hrs)
Thermal Spray coatings
A. Process details of all type of Thermal spray coatings like Flame, Electric, Plasma arc Detonation gun & High velocity Oxy Fuel. Advantages & limitations of each type.

Unit IV
Thin Film Coatings & High Energy processes

A. All Process details of Physical vapour deposition & Chemical vapour deposition. Ion implantation, Laser assisted surface modification & Electron beam treatment. Diamond & Diamond like Carbon thin film coatings
B. Applications of the above processes.

Unit V
Characterization of coatings & Recent trends in surface engineering

A. Quality Assurance, surface geometry – characterization techniques (conventional and recent trends); coating thickness measurements – laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement – conventional methods and recent developments, Measurement of mechanical properties of engineered surface in nano scale; Evaluation of tribological characteristics of engineered surface in macro, micro and nano scale.
B. Tribological coatings for engineering components & their evaluation

Text Books
1. N.J. Persson, Sliding Friction
2. Surface Engineering Process, Fundamentals & Applications Vol 1 & 2 Lecture notes Of SERC school on Surface Engineering

Reference Books
1. The Friction and Lubrication of Solids, Frank Philip Bowden, Oxford Classic Texts
2. Engineering Tribology, Gwidon Stachowiak, A W Batchelor,
3. Surface Engineering, ASM Hand Book, Vol. 5,
IP40162:: PRODUCT DESIGN & NEW PRODUCT DEVELOPMENT

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject.
- Mapping with PEOs: I (d, h)

Unit I (8 Hrs)
B: - . Function trees system functionality, augmentation, Aggregation, common basis, functional modeling methods.

Unit II (8 Hrs)
A:- Product tear down and experimentation, benchmarking and establishing engineering specification. Product portfolios and portfolio architecture. Tear down process, tear down methods, post teardown reporting, benchmarking approach, support tools, setting specifications.
B: - Portfolio architecture, types, platform, functional architecting, optimization selection. Product modularity, modular design

Unit III (8 Hrs)
A:- Concepts and Modeling, Generation of concepts, information gathering and brain stormsing, directed search, morphological analysis, combining solutions. Decision making, estimation of technical feasibility, concept selection process, selection charts, measurement theory, numerical concept scoring, design evaluation scheme, concept embodiment, geometry and layout, system modeling, modeling of product metrics,
B:- Selection of model by performance specifications, physical prototyping, informal and formal models.

Unit IV (8 Hrs)
A:- Design materials & human factors in product design, material properties, metals, plastics, rubber, woods & factors considered while designing for metals, plastics, rubber, woods etc. Anthropometry factors, physiological factors, psychology factors, anatomy factors. Economic factors influencing design, product value, safety, reliability & environmental considerations, Economic analysis, break even analysis, profit & competitiveness, Economic of a new product design.

B :- Case study based upon Economic analysis, break even analysis, profit & competitiveness, Economic of a new product design.

Unit V

A:- Value engineering in product design & Modern Approaches to Product Design

B:- Techniques to reduce environmental impact like minimum material usage, disassembly, recycle ability, remanufacturing, high impact material reduction, energy efficiency, regulation and standards, Value analysis tests with examples in the form of case studies

Text Books
1. Otto, Product Design, Pearson Education
4. Trott, Innovation Management & New Product Development, 4/e, Pearson Education

Reference Books
4. Product Design for manufacturing and Assembly Geoffry Boothroyd, pETER dewhurst, Winstn Knight Marcel Dekker Inc., USA.
5. Product Design : A practical guide to systematic methods of new product development, Mike Baxter, Champman and Hall.
IP40164 :: ENTREPRENEURSHIP DEVELOPMENT

Credits: 03
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites:
GENERAL ENTREPRENEURSHIP TENDENCY TEST.

Students need to exhibit and possess the will to develop entrepreneurship tendencies. Students who are keen on starting their own business alone may take this course. All branch students should be permitted to take this course. 15% seats reserved for the industrial and production engineering department.

Students will be required to choose a line of business and try to implement those ideas during the course of the semester as though they were actually doing business.

Objectives:
- To provide the motivational inputs to students to become entrepreneurs
- To enable students to understand the importance of national wealth generation
- To teach students the legal formalities of starting a business with a few assignments
- To teach students to make efficient business cases identify opportunities and apply for loans to become independent business persons.
- To sensitizes the students with the importance of being self employed professionals on the planet instead of slavishly working under someone else.
- Major objective is to ensure that they become entrepreneurs and actually start a business and not just become bookworms of an entrepreneurship academic subject
- Mapping with PEOs: V (j, i)

Unit I (8 Hrs)
Introduction Motivation Inputs To Entrepreneurship

B. Administration inputs to entrepreneurship – planning scheduling, time management

Unit II
Legal inputs to entrepreneurship (8 Hrs)
B: Shop ACT Business cards, venue Ambience,

Unit III
Business opportunity identification inputs to entrepreneurship (8 Hrs)

B. How to formulate a business and project plan. Project counseling to students

Unit IV
Marketing Inputs To Entrepreneurship (8 Hrs)
A. What to sell and how to sell?: Market research and survey, overview on methods of forecasting, launching and marketing the products and services, sales and distribution, project feasibility study – market feasibility, technical feasibility, sources of finance, financial feasibility – project costing and budgeting, product costing. Where to find finance and how to get project finance for a business; Legal input to a business. Marketing inputs to entrepreneurship: How to prepare a business plan and strategise. How to identify the right strategy for market development. Exploiting an attractive market. Creating competitive advantages for the market. Creating the right strategy. Inputs for strategy development
B. Vision and Strategy planning, Product/Process evaluation assignment for chosen business.

Unit V
Problem solving inputs to entrepreneurship (8 Hrs)
A. How to solve problems as and when they arrive? Business crisis and how to solve them when they arise. Review of Cash crisis Starting Crisis, Delegation crisis, Management crisis and Succession crisis. Review of methods to solve each crisis. Methods to solve new crisis which may arrive in the future. Review of luck and the business cycle.

B. Tax and relativity of moral ethics in adverse business (corrupt) environments.

**Text Books**
2. Class notes on entrepreneurship

**Reference Books**
1. Dr J. S. Juneja, Small and Medium Enterprise: Challenges and opportunities
2. Kondalah, chukka; Enterprise in the new millennium, McGraw-Hill publication
4. Gopal & Ramamurthy; Project management Handbook, Macmilan.
IP40166:: PROJECT MANAGEMENT

Credits: 03  Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: IV (f, o)

Unit I
Introduction:
B. Role & Functions of Project Manager

Unit II
Project Life Cycle Phases
B: Project Organization & Management. Project Organization Structure

Unit III
Important Aspects of Project Feasibility


B. Socio-Economic: Socio-Cost Benefit Analysis. Effective Rate of Protection, Domestic Resource Cost

Unit IV

Project Planning & Scheduling


B.: Time Management: effective time management, management pitfalls, project communications, project management bottlenecks.

Unit V

Project Cost Management


B. Project Management Information system and control

Text Books

1. Narendra Singh; Project Management & Control; Himalaya Publishing House, Mumbai.
2. S.Choudary, Project Management, Tata McGraw Hill
3. Prasanna Chandra; Preparation, Appraisal, Budgeting & Implementation
4. Pinto, Project Management – Achieving Competitive Advantage & MS Projects, Pearson Education

Reference Books

1. Maylor, Project Management, Pearson Education,
2. Gopal & Ramamurthy; Project Management Handbook; Macmilan.
3. Project Management Body of Knowledge
IP40168:: PROCESS ENGINEERING

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Knowledge about basic machining processes and tooling

Objectives:
- To develop the Process planning skill for the manufacturing
- Mapping with PEOs: II (h, i)

Unit I  (8Hrs)
Product and Process Engineering

A. Product and Process Engineering, Dimensional and tolerance analysis ,Types of dimensions, Measuring geometry of form –Flatness, parallelism, straightness, Tolerance analysis-causes of work piece variations, to express limits and tolerance, tolerance stack, purpose of tolerance chart, Rules for adding and subtracting ,layout of tolerance chart
B. General Manufacturing processes, Product Engineering, DFM, DFMA ,Process Engineering, communications, squareness, angularity ,roundness, concentricity and eccentricity ,symmetry surface quality and surface integrity, surface finish affecting product properties and product cost, base lines, direction of specific dimensions .

Unit II  (8 Hrs)
Work piece Control &Classifying operations

A. Work piece Control &Classifying operations , concept of location, geometrical control, dimensional control, mechanical control. alternate location. , Classifying operations , qualifying and requalifying operations
B. Equilibrium theories, Basic process operations, principal process operations, major operations, auxiliary process operations.

Unit III  (8 Hrs)
Selection of Equipment and toolings

B. General purpose, special purpose machines, jigs fixtures moulds, pattern, core boxes, dies, templates, gauges.

Unit IV
Selecting and planning the process

A. Selecting and planning the process, Function, Economy and appearance, fundamental rules for manufacturing process, eliminating operations, combined operations, selecting proper tooling, availability of equipment, effect of operations speed on performance of economy, make or buy decision. Computer aided process planning.
B. Engineering approach, basic design of product, influence of process engineering on product design, specifications, materials and its cost analysis.

Unit V
Process sheet design

A. Process sheet design, Determining manufacturing sequence, Factors for operation sequence, major process sequence, Operation routing, process picture, process picture sheet, processing dimensions and views.
B. combining operations, routing uses routing description.

Text Books
3. “System approach to computer integrated design and manufacturing”, Nanu sah

Reference Books
2. “Manufacturing catalogues for cutting tools and inspection equipments”
3. “CAD\CAM\CIM”- P.Radha krishnan , S.Subrmaniyum, V.Raju, New Age International Pvt Ltd
IP40252:: FINANCIAL MANAGEMENT & COSTING

Credits: 01

Prerequisites: Nil

Objectives:
- To give an idea about the scope of Financial Management & Costing
- Mapping with PEOs: IV (f, g)

List of Contents
Tutorials containing the record of the following:

Assignments:
1. Goals of Financial Management
2. Assignment on Ratio Analysis 1
3. Assignment on Ratio Analysis 2
4. Assignment on Investment Evaluation Criteria
5. Sources of Capital
6. Assignment on Working Capital Management
7. Assignment on Cost Sheet
8. Assignment on Material Cost
9. Assignment on Labor Cost
10. Assignment on Overheads
11. Assignment on Marginal Costing
12. Assignment on Budgeting

Text Books

Reference Books

**IP40254:: RELIABILITY ENGINEERING**

Credits: 01

**Teaching Scheme:** Tutorial 1 Hr/Week

**Prerequisites:** Knowledge about basic machining processes and tooling

- **Objectives:** To develop the Process planning skill for the manufacturing
- **Mapping with PEOs:** III (g, h)

A TERM-WORK containing the record of the following:

**Assignments**
1. Definitions of CDF and PDF.
2. Comment with examples on trade off bet. Cost, quality and reliability.
3. Case study 1 on FMECA
4. Case study 2 on FMECA
5. Problem on allocation of reliability.
6. Problem on improvement of reliability due to preventive maintenance.
7. Note on reliability centered maintenance
8. Note on life testing methods
9. Problems on Series systems
10. Problems on Parallel systems
11. Problems on Standby systems
12. Probability concepts-problems

**Text Books**

**Reference Books**
IP40256:: WORLD CLASS MANUFACTURING

Credits: 01

Teaching Scheme: - Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- To verify the principal of course
- Mapping with PEOs: IV (f, o)

List of Practical
Assignments on the following
1. Value Stream Mapping – Current State
2. Value Stream Mapping – Future State
3. Case – Design of JIT / Kanban System
4. Case – Cellular Manufacturing
5. Case – Setup Time Reduction (SMED Philisophy)
7. Assignment on TPM Performance Measures
8. Assignment on 5S: Implementation of 1S
9. Assignment on 5S: Implementation of 2S
10. Case on BPR
11. Numerical on TOC
12. Case Study on Application of TOC

Text Books
1. Operations Management for Competitive Advantage – Chase
2. Making Common Sense Common Practice – Mooref

Reference Books
1. Managing Technology & Innovation for Competitive Advantage - Narayanan
2. Just In Time Manufacturing - M.G.Korgaonkar
3. World Class Manufacturing - B.S.Sahay
4. World Class Manufacturing - Schonberger
IP40258: OPERATIONS RESEARCH

Credits: 01

Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (h, j)

TERM-WORK containing the record of the following:

Assignments
1. Assignment Linear Programming methods like Dual Simplex Method.
2. Assignment Sensitivity Analysis in Linear Programming problems
3. Assignment on Integer Programming problems
4. Assignment on Dynamic Programming problems
5. Assignment on Goal Programming & Decision Making Tools
6. Assignment on Replacement Model for items that deteriorate
7. Assignment on Replacement of sudden failure items
8. Assignment on Game Theory: Graphical method
9. Assignment on Game Theory: Analytical methods
10. Assignment on Queuing Theory
11. Assignment on Simulation
12. Building Model on Simulation Software.

Text Books
2. Paneerselvam Operations Research, Prentice Hall of India

Reference Books

IP40260:: SURFACE ENGINEERING

Credits: 01  
Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites:

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: III (b, g, h)

List of Contents
1. Preparation of Substrate by Acid & Alkaline, Salt bath, cleaning for surface treatments.
2. Preparation of Substrate by Ultrasonic and Mechanical cleaning for surface treatments.
3. Various purposes of Surface engineering
4. Electroplating – Theory of electro plating
5. Plating of non metallic materials.
6. Study of Diffusion coatings like carburising, nitriding, cyaniding, hot dipping
7. Study of Diffusion coatings like galvanizing, anodizing, Aluminising, Phosphetising
8. Study of various type of Thermal spray coatings like Flame, Electric, Plasma arc Detonation gun & High velocity Oxy Fuel.
9. Study of Thin Film Coatings & High Energy processes
10. Wear testing of Wear resistant coatings.
11. Coating thickness measurement.
12. Case depth measurements of surface hardened components.

Text Books
1. N.J. Persson, Sliding Friction
2. Surface Engineering Process, Fundamentals & Applications Vol 1 & 2 Lecture notes Of SERC school on Surface Engineering

Reference Books
IP40262:: PRODUCT DESIGN & NEW PRODUCT DEVELOPMENT

Credits: 01

Teaching Scheme: Tutorial 1 Hr/Week

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: I (d, h)

Prerequisites:

List of Assignments
1) Assignment On Product Development Process
2) Assignment on Modeling process
3) Assignment on product tear down
4) Assignment on Optimization Selection
5) Assignment on Numerical concept scoring & System modeling
6) Assignment on physical prototyping.
7) Assignment on Break Even Analysis
8) Assignment on Profit & Competitiveness,
9) Assignment on Economic of a new product design
10) Assignment on Quality Function Development (QFD)
11) Assignment on value analysis job plan
12) Assignment on Product Life Cycle Management

Text Books

Reference Books
1. Product design & Manufacture- Jhon R Lindbeck
4. Company 19811.Industrial Design-Mayall
IP40264:: ENTREPRENEURSHIP DEVELOPMENT

Credits: 01

Teaching Scheme: - - Tutorial 1 Hr/Week

Prerequisites: : Nil

Objectives:

- To provide the motivational inputs to students to become entrepreneurs
- To enable students to understand the importance of national wealth generation
- To teach students the legal formalities of starting a business with a few assignments
- To teach students to make efficient business cases identify opportunities and apply for loans to become independent business persons.
- To sensitizes the students with the importance of being self employed professionals on the planet instead of slavishly working under someone else.
- **Major objective is to ensure that they become entrepreneurs and actually start a business and not just become bookworms of an entrepreneurship academic subject**
- Mapping with PEOs: V (j, i)

List of Contents

A TERM-WORK containing the record of the following:

Assignments :
1. Administration inputs to entrepreneurship – planning scheduling, time management
2. Preparation of Business cards
3. How to formulate a business and project plan
5. Market potential analysis of the business.
6. Tax and relativity of moral ethics in adverse business (corrupt) environments.
7. Study of Shop ACT

Text Books

2. Class notes on entrepreneurship
Reference Books

1. Dr J. S. Juneja, Small and Medium Enterprise: Challenges and opportunities
2. Kondalah, chukka; Enterprise in the new millennium, McGraw-Hill publication
4. Gopal & Ramamurthy; Project management Handbook, Macmilan.
5. Prassanna Chandra; Preparation, Appraisal, Budgeting and Implementation.
IP40366:: PROJECT MANAGEMENT

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Application of the theory
- Understanding of fundamentals of the subject
- Mapping with PEOs: IV (f, o)

List of Practical Assignments On following
1. Preparation of Project Feasibility Report
   a. Project Identification, Definition
   b. Project Feasibility – Managerial/Organizational Perspective
   c. Project Feasibility – Marketing, Exit Plan
   d. Project Feasibility – Operational
   e. Project Feasibility – Financial, Financial Projections
2. Assignment on Capital Budgeting – PBP, Discounted PBP, NPV, IRR, Annual Worth
3. Numerical on PERT/CPM – Calculation of Floats, Determination of Critical Path & Project Duration
4. Case let - Project Crashing
5. Case let - Resource Leveling & Resource Smoothening
6. Project Planning & Scheduling (Using MS Projects) 1 – Preparation of Statement of Works, WBS
7. Project Planning & Scheduling (Using MS Projects) 2 – Network Diagram, Gantt Charts, Project Monitoring

Text Books
1. Narendra Singh; Project Management & Control (1998 ); Himalaya Publishing House, Mumbai.
2. S.Choudary, Project Management

Reference Books
1. Gopal & Ramamurthy; Project Management Handbook; Macmilan.
2. Prasanna Chandra; Preparation, Appraisal, Budgeting & Implementation
3. Project Management Body of Knowledge

IP40368:: PROCESS ENGINEERING

Credits: 01

Teaching Scheme: - Laboratory 2 Hrs/Week

Prerequisites: Nil

Objectives:
- To develop skills in the subject
- Verify the principles of the course
- Mapping with PEOs: II (h, i)

List of Practicals
1. Process parameters and machining time determination of lathe operations.
2. Process parameters and machining time determination of milling operations.
3. Process picture conventions
4. Process sheet format
5. Dimensional and tolerance analysis of part print.
7. Identification of locating areas on work piece.
8. Identification of, clamping, holding areas on work piece
9. Process sheet design of one component for mass production
10. Process sheet design of one component CNC for batch production
11. Time estimation for assembly using flow charting techniques
12. Industrial visit to study process designing and its report

Text Books
2 “Computer aided process planning”, P.W.Wang, J.Kelly
3 “System approach to computer integrated design and manufacturing”, Nanua singh

Reference Books
2 “Manufacturing catalogues for cutting tools and inspection equipments”
3 “CAD\CAM\CIM”- P.Radhakrishnan , S.Subramaniyum, V.Raju, New Age
4 “ Manufacturing Systems Engg”, K.Hitomi , John Willey Groover Mikell. P.
Objectives:
- To train the students to apply their engineering knowledge to real life problem solving.
- To train the students to plan, implement and execute project work so as to satisfy the stated objectives of the project.
- Mapping with PEOs: IV (e, f, g, i, n).

The project work could be of the following nature:
1. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
2. Improvement of existing machine / equipment / process.
3. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problems related to Productivity improvements.
6. Problems related to value engineering.
7. Problems relating to material handling system.
10. Product design and development.
11. Analysis, evaluation and experimental verification of any engineering problem encountered.
13. Quality improvements, In-process Inspection, Online gauging.
15. Time and Motion study, Job evaluation.
16. Ergonomics and safety aspects under industrial environment
17. Management Information System.
18. Market Analysis in conjunction with Production Planning and Control.

OR

Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hitech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available...
benchmarks / results. Modelling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available benchmarks / results. Design/development and Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipments.

The project work shall be taken up individually or in a group consisting of not more than 4 students.

A report containing maximum 30 pages shall be submitted based on the background, need and scope of the project, project specifications, activities involved in the project and activity plan, study of literature and basic theory, and work completed (if any).

Guidelines:

- Report shall be typed or printed.
- Figures and tables shall be on separate pages and attached at respective positions.
- Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students shall be included on every certified report copy.
- Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.
Honors in Production Engineering.
### Structure for Honors (Production Engineering)

**Eligible Students:** Production Engineering

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<td>Industrial Maintenance &amp; Safety Engineering</td>
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<td>S₂</td>
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<td>S₃</td>
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Total
IP28101: INDUSTRIAL MAINTENANCE & SAFETY ENGINEERING

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To learn and understand applications of costing in engineering
- To learn and understand cost estimation, cost analysis
- Mapping with PEOs: III (a, k, l,)

Unit I (8 Hrs)
Principles And Practices Of Maintenance Planning

A Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability

B. Maintenance organization. Maintenance economics.

Unit II (8 Hrs)
Maintenance Policies – Preventive Maintenance

A. Maintenance categories – Comparative merits of each category – Preventive maintenance Repair cycle – Principles and methods of lubrication – TPM.
B. Maintenance schedules

Unit III (8 Hrs)
Condition Monitoring

A. Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes –
B. Pistol thermometers – wear-debris analysis

Unit IV (8 Hrs)
INTRODUCTION TO THE DEVELOPMENT OF INDUSTRIAL SAFETY
AND MANAGEMENT


B. Industrial psychology in accident prevention – Safety trials.

Unit V (8 Hrs)
PREVENTION AND PROTECTIVE EQUIPMENTS

Industrial hygiene – Occupational safety – Diseases prevention – Ergonomics – Occupational diseases, stress, fatigue, health, safety and the physical environment – Engineering methods of controlling chemical hazards, safety and the physical environment – Control of industrial noise and protection against it –

B. Code and regulations for worker safety and health.

Text Books

Reference Books
IP38101:: INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: III (b, d, g, h)

Unit I  (8 Hrs)
INTRODUCTION
A. Need for IPPD – Strategic importance of Product development – Integration of customer, designer, material supplier and process planner - Competitor and Customer – behaviour analysis Understanding customer – promoting customer understanding – Involve customer in development and managing requirements – Organization
B. Process management and Improvement – Plan and establish product specifications

Unit II  (8 Hrs)
CONCEPT GENERATION AND SELECTION
B: Benefits of selection

Unit III  (8 Hrs)
PRODUCT ARCHITECTURE

B. Applications in Real Life Situations

Unit IV

INDUSTRIAL DESIGN


B. Secondary systems – Architecture of the chunks – Creating detailed interface specifications

Unit V

DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT


B. Secondary systems – Architecture of the chunks – Creating detailed interface specifications

Text Books

IP38102:: ROBOTICS

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Basic Techniques of Industrial Engineering

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Mapping with PEOs: II (d, f, i)

Unit I
Fundamentals Of Robot

B. Different applications

Unit II
Robot Drive Systems And End Effectors

A: Service Be
B: External Grippers – Selection and design considerations

Unit III
Sensors And Machine Vision

(8 Hrs)

(8 Hrs)

(8 Hrs)
A. Requirements of a sensor – Principles and applications of the following types of sensors – Position of sensors (Piezoelectric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors) – of flight range finders, Laser range meters – Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors) – Touch sensors (Binary Sensors, Analog sensors) – Wrist sensors – Compliance sensors – Slip sensors. Camera, Frame grabber, Sensing and digitizing image data – Signal conversion, Image storage and Lighting techniques – Image processing and analysis – Data reduction, Segmentation, Feature extraction, Object recognition and other algorithms – Applications – Inspection, Identification,

B. Range sensors (Triangulation principle, Structured, Lighting approach, Time Visual serving and Navigation

Unit IV (8 Hrs)
Robot Kinematics And Robot Programming

A. Forward kinematics, Inverse kinematics and Differences – Forward kinematics and Reverse kinematics of Manipulators with two, three degrees of freedom (In 2 Dimensional) – Four degrees of freedom (In 3 dimensional) – Deviations and problems.

Teach pendant programming – Lead through programming – Robot programming Languages – VAL programming – Motion commands, sensor commands, end effector commands and simple

B programs.

Unit V (8 Hrs)
Implementation And Robot Economics


Text Books

Reference Books
IP48151:: ADVANCED MATERIALS TECHNOLOGY

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To get an idea about the Energy Sector, which is expected to be the fastest growing sector in the country.
- To maximize the efficiency from generation to distribution and ensure effective recovery of bills.
- Mapping with PEOs: II (c, g, p)

Unit I (8 Hrs)
Review Of Mechanical Behaviour Of Materials

Unit II (8 Hrs)
Surface Modification Of Materials

Unit III (8 Hrs)
Advanced Heat Treatment Of Materials
A. Unconventional surface hardening techniques – Heat treatment of Al,, Cu, Ni and Ti alloys – Polymer quenchants.
B. Heat treatment of critical mechanical elementslike gears tools, dies, springs, shafts
Unit IV  
**Modern Materials And Alloys**  
(8 Hrs)

A. Super alloys – Refractory materials – Ceramics and their applications – Low melting alloys –shape memory alloys – Metal matrix  
B. ceramic matrix composites

Unit V  
**Applications Of Advanced Materials**  
(8 Hrs)

A. Ti and Ni based alloys for gas turbine applications – Maraging and Cryogenic steels – Newer materials and their treatment for automobile applications  
B. – Materials for Aerospace, Marine and nuclear systems.

**Text Books**


**Reference Books**

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (a, d,)

Unit I  
Mechatronics, Sensors And Transducers  
B. Selection of sensors.

Unit II  
Actuation Systems  
B Mechanical actuation systems – Cams – Gear trains – Ratchet and pawl – Belt and chain Drives – Bearings –

Unit III  
System Models And Controllers  
B. Adaptive control – Digital logic control – Micro processors control
Unit IV (8 Hrs)

Programming Logic Controllers

A. Programmable logic controllers – Basic structure – Input / Output processing – Programming – Mnemonics – Timers, internal relays and counters – Shift registers – Master and jump controls –
B. Data handling – Analogs input / output – Selection of a PLC problem

Unit V (8 Hrs)

Design Of Mechatronics System

A. Stages in designing mechatronics systems – Traditional and mechatronic design – Possible design solutions.
B. Case studies of mechatronics systems pick and place robot – Automatic car park

Text Books


Reference Books

ICP48351:: CREDITS FOR LAB COURSES

Composition for Selection of 5 Credits for Honors / Minor Course

(A) Comprehensive Viva Voce – Compulsory at the end of Semester VIII – 1 Credit
(B) Elective Component
   a. Laboratory courses – Maximum Credits - 2
      (for award of 1 Credit the lab course would have a teaching scheme of 2 Hrs. / week and a plan of 12 practicals). The credit to be awarded as per the ISA and ESA guidelines for the compulsory lab courses.
   b. Research publication – Maximum Credits – 1
      (Research Publication in a Magazine / Transaction / Journal as decided by the honors / minor co-ordinator)
   c. Seminar - Maximum Credits – 1
      (Seminar to be given on a topic consistent with the scope of the Honors or Minor. The topic Selection is to be approved by the honors / minor co-ordinator. The assessment and evaluation scheme would as per the guidelines used for Technical Seminar at UG level by respective Dept.)
   d. Honors / Minors Project – Maximum Credits – 2
      (Project Topic and Scope, its progress and final assessment consistent with the scope of the Honors or Minor. The topic Selection is to be approved by the honors / minor co-ordinator. The assessment would as per the guidelines and evaluation scheme used for Project Work at UG level by respective Dept.)
   e. Industrial Training – Maximum credits – 4
      (An Industrial Training in an Industry identified by the student, approved by the honors / minor co-ordinator & Head of Department. The assessment would as per the guidelines and evaluation scheme used for Industrial Training at UG level by respective Dept.)

Note:
   a. 4 Credits would be awarded to the students for a complete 12 Week Industrial Training and meeting with the assessment and evaluation requirements
   b. Provision can be made for the students unable to procure a 12 week Industrial Training. A 4 week or 8 week Industrial Training may also be offered. 2 credits will be awarded for 8 week Industrial Training and 1 Credit would be awarded to the students for a 4 Week Industrial Training, meeting with the assessment and evaluation requirements
   c. No Industrial Training less than 4 weeks be considered for award of 1 Credit
   d. No cumulative addition of Industrial Training period would be considered for award of credits
The student is expected to earn 1 Credit from Part (A) and remaining 4 Credits from Part (B)
### Structure for Minor (Production Engineering)

**Eligible Students:** Industrial/Mechanical Engineering

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
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<tr>
<td>S₁</td>
<td>IP29151</td>
<td>Quality Assurance</td>
<td>3 Lect., 0 Tutorial, 0 Practical</td>
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<tr>
<td>S₂</td>
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<td>Metal Cutting &amp; Tool Design</td>
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<td>S₃</td>
<td>IP39152</td>
<td>Material Forming &amp; Die Design</td>
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<td>3</td>
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<tr>
<td>S₄</td>
<td>IP49151</td>
<td>Process Engineering</td>
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<td>S₅</td>
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<td>Machine Tool Design</td>
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<td>Credits for Lab Courses (Group Selection)</td>
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<td><strong>Total</strong></td>
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<td>15 Lect., - Tutorial, - Practical</td>
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</table>
IP29151 :: QUALITY ASSURANCE

Credits: 03  Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites:

Objectives:
• To make the students understand the concepts & broad principles of contents of the course
• Develop conceptual framework of the course
• Sensitizes the students of the importance of course in real life environment
• Mapping with PEOs: II (h, j, k)

Unit I  Introduction to Quality  (8 Hrs)

A. Meaning of Quality, Approaches to Quality as proposed by Deming (PDCA Cycle), Juran, Crosby. Concept of TQM

B. Introduction: Characteristics of Quality, Quality of Product versus Quality of Service, Cost of Quality, Value of Quality.

Unit II  Acceptance Sampling  (8 Hrs)


B. 100% Inspection versus Sampling Inspection.

Unit III  Statistical Process Control  (8 Hrs)


B. Variations – Concept, P and C Charts, Introduction to Statistical Process Control:
Unit IV  
**Total Quality Management**  
8 Hrs)

A. Introduction to TQM, Quality Improvement Tools: 7 QC Tools Pareto Chart, Fishbone Diagram, 7 QM Tools – Program Decision Process Chart, Tree Diagram, Affinity Diagram, Prioritization Matrix, etc.
B. Run Charts, Scatter Diagram, Process Flow Chart. – Check Sheet, Histogram, Quality Circles.

Unit V  
**Six Sigma & Quality awards**  
8 Hrs)

A. Introduction to Six Sigma: Definition, Concept, Methodology. & DMAIC Approach, Importance and overview of ISO 9000: Standard clauses such as Quality Management System.

**Text Books**

1. Amitav Mitra, Fundamentals of Quality Control & Improvement, Pearson Education
2. Phadke, Quality Engineering using Robust Design, Pearson Education

**Reference Books**

1. J.M. Juran & F.M.Gryna , Quality Planning and Analysis.
IP39151 :: METAL CUTTING & TOOL DESIGN

Credits: 03
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites (If any):

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (b, r)

Unit I
Tool nomenclature
(08 Hrs)
A. milling cutter, broach
B. Single point cutting tool, various tool elements, Designation of cutting tools in ORS & ASA Systems, Importance of tool angles, Method of machining- orthogonal, oblique cutting, Nomenclature of drill

Unit II
Theory of metal cutting
(08 Hrs)
A. Mechanics of chips formation, types of chips, determination of shear angle, chip reduction factor, velocity relationship, merchant force circle, estimation of cutting forces, Tool dynamometer. Heat generation & tool life
B. Heat generation in cutting, Functions of cutting fluid, characteristics of cutting fluid, types of cutting fluid, Tool wear, Tool life, modified Taylor’s equation, Tool dynamometers.

Unit III
Design of cutting tools
(08 Hrs)
A. Tool materials, design of single point cutting tool, form tool, drill, reamer
B. Design of broach & plain milling cutter

Unit IV
Fundamentals of jig & fixtures
(08 Hrs)
A. Introduction to jig & fixture, difference between jig & fixtures. Classification of jig &
fixtures. Principle of location, types of locators. Principle of guiding elements Types of guiding elements, Principle of clamping elements, Types of clamps
B. Types of Jigs & Fixtures.

Unit V

Design of Jig & Fixtures

A. Concept of modular fixtures.
B. General guidelines & procedures for design of jig & fixtures, Bodies, bases & frame, Design of locators, Design of guiding elements, Analysis of number of clamping forces required & their magnitude

Text Books
1. P C Sharma, Production Engg, Khanna publishers.
2. M.H.A. Kempster, Introduction to Jigs and fixtures design

Reference Books
1. Tool Engg by Nagpal
2. Dolalson, Lecain and Goold, Tool design, Tata McGrawhill.
3. Hoffman, Introduction to Jigs and fixtures.
6. R. K. Jain, Production technology, Khanna Publishers
7. Milton Shaw, Metal cutting principle
IP39152: MATERIAL FORMING & DIE & MOULD DESIGN

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Manufacturing Processes 1 & 2

Objectives:
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: III (b, p, r)

Unit I  
Fundamentals of Material Forming  
(08 Hrs)

A. Concept of flow stress determination, Effect of temperature, strain rate, Mohrs circle for three dimensional state of stress  Theory of plasticity- Yield criteria of Von mises criteria and Tresca criteria. Classification of material forming process, Concept of workability, formability and forming diagram.
B. Engineering stress-strain and true stress-strain, Strain hardening, work done in tensile test, temperature rise in plastic deformation compression test

Unit II  
Rolling of Metals  
(08 Hrs)

A. Scope and importance of rolling. Types of Rolling Mills- Construction and working. Roll bite, reduction, elongation and spread. Deformation in rolling and determination forces required. Process variables, redundant deformation. Roll flattening
B. Roll camber - its effect on rolling process, mill spring. Defects in rolling. Automatic gauge control- Lubrication in rolling

Unit III  
Design of Blanking & Progressive dies  
(08 Hrs)

A. Shearing force, press capacity, clearances, die & punch size types of strippers, types of pilots, types of stoppers, selection of dowel pins & allen screws., center of pressure of progressive die
B. Problems on progressive and blanking die design.

Unit IV  
Design of Drawing & Bending Dies  
(08 Hrs)
A. Deep drawing mechanism, Design of deep drawing die: blank size, no of draws, drawing punch and die size, drawing force, press capacity and ironing.
B. Types of Bending dies, developed length calculation, bending force, spring back & methods used to overcome it, press brake.

Unit V

(08 Hrs)

Design of Forging Dies

A. Design of forging die for multi-impression die-: selection of parting line, drafts, fillet & corner radii, ribs & webs, stock size calculation, flash & gutter, design of fullering, edging, blocking, finishing impressions, trimming dies, Die block dimensions, die inserts.
B. Design of upset forging die : Up setters, stock size calculation, Rules for upset forging.

Text Books

1. Dieter, Mechanical Metallurgy

Reference Books

1. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co.
2. Surender Kumar, Principles of Metal Working.
3. ASM Metal handbook Vol: 4 forming.
4. Mechanical working of metals by J.N. Harris
5. G.W. Rowe, Principles of industrial metal working process, Edward Arnold
IP49151:: PROCESS ENGINEERING

Credits: 03

Prerequisites: Knowledge about basic machining processes and tooling

Objectives:

- To develop the Process planning skill for the manufacturing
- Mapping with PEOs: II (h, i)

Unit I (8Hrs)
Product and Process Engineering

A. Product and Process Engineering, Dimensional and tolerance analysis , Types of dimensions, Measuring geometry of form – Flatness, parallelism, straightness, Tolerance analysis-causes of work piece variations, to express limits and tolerance, tolerance stack, purpose of tolerance chart, Rules for adding and subtracting, layout of tolerance chart
B. General Manufacturing processes, Product Engineering, DFM, DFMA, Process Engineering, communications, squareness, angularity, roundness, concentricity and eccentricity, symmetry surface quality and surface integrity, surface finish affecting product properties and product cost, base lines, direction of specific dimensions.

Unit II (8 Hrs)
Work piece Control & Classifying operations

A. Work piece Control & Classifying operations, concept of location, geometrical control, dimensional control, mechanical control, alternate location, Classifying operations, qualifying and requialifying operations

B. Equilibrium theories, Basic process operations, principal process operations, major operations, auxiliary process operations.

Unit III (8 Hrs)
Selection of Equipment and toolings

B. General purpose, special purpose machines, jigs fixtures moulds, pattern, core boxes, dies, templates, gauges.

Unit IV
Selecting and planning the process (9 Hrs)
A. Selecting and planning the process, Function, Economy and appearance, fundamental rules for manufacturing process, eliminating operations, combined operations, selecting proper tooling, availability of equipment, effect of operations speed on performance of economy, make or buy decision. Computer aided process planning.
B. Engineering approach, basic design of product, influence of process engineering on product design, specifications, materials and its cost analysis.

Unit V
Process sheet design (9 Hrs)
A. Process sheet design, Determining manufacturing sequence, Factors for operation sequence, major process sequence, Operation routing, process picture, process picture sheet, processing dimensions and views
B. Combining operations, routing uses routing description.

Text Books
3. “System approach to computer integrated design and manufacturing”, Nanua Singh

Reference Books
2. “Manufacturing catalogues for cutting tools and inspection equipments”
3. “CAD\CAM\CIM”- P.Radakrishnan, S.Subrmaniyum, V.Raju, New Age International Pvt Ltd
IP49152:: MACHINE TOOL DESIGN

Credits: 03

Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Aim is to provide insight of the subject
- Sensitizes the students of the importance of course in real life environment
- Mapping with PEOs: II, III (g, r)

Unit I
Design of Machine Tool Structure

A. Function & Requirement of Machine Tool Structure, Design Criteria from Strength & Stiffness considerations, Concept of Unit Rigidity, Unit Strength under Tension, Unit Strength under Torsion & Unit Strength under Bending for Material of Machine Tool Structures, Compare Steel & Cast Iron on the basis of Material Properties, Manufacturing Problems and Economy, Role of Static & Dynamic Stiffness in the design of elements of machine tools, Profiles of Machine Tool Structures, Factors affecting stiffness of machine tool structures & methods of improving it, Basic Design procedure of machine tool structures
B. Design Case Studies of a) Bed of Lathe, b) Column & Base of Milling Machine, c) Housing of Speed Gear box

Unit II
Design for Fluctuating Loads

A. Stress Concentration and remedies, S.N.Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative damage, Sodberg’s and Goodman’s Diagram
B. Design of components like shaft, bolted joints, springs etc. subjected to variable loading

Unit III
Design of Machine Tool Drives

A. 1) Selection of Electric Motor, 2) Stepped Regulation of Speed, Laws of Stepped Regulation, Why Geometric Progression is used against Arithmetic, Harmonic & Logarithmic despite shortcomings, Relation between Range ratio, Geometric Progression Ratio and No. of Speed Steps, 3) Design of Stepped Drives: Break up of Speed Steps, Structural Formulae, Structural Diagram, Selection of Best Structural Diagram, Ray Diagram, Speed Chart, General recommendations for Developing the Gearing Diagram, Determining the number of teeth of Gears. 4) Speed/Feed Gear Box: Limiting Transmission Ratio of Speed/Feed Gear Box

B. Design Case Study of - Speed Gear Box for Lathe, - Feed Gear Box for Drilling Machine. Classification of Speed/Feed Gear Boxes & their Application, Electro-Mechanical Step less Drive; Case Study of CNC Lathe with Electronic Controller for Speed/Feed Step less Regulation

Unit IV

(9 Hrs)

Design of Guide-ways & Power Screws


Unit V

(9 Hrs)

Design of Spindle & Spindle Supports:

A. Function & Requirements of Spindle Units, their Materials, Effect of Machine Tool Compliance on Machining accuracy Design of Spindle for Bending Stiffness: Deflection of Spindle Axis due to a) Bending, b) - due to Compliance of Spindle Supports, c) - due to Compliance of the Tapered Joint. Optimum Spacing between Spindle Supports, Permissible Deflection & Design for stiffness: Additional Check for Strength like Additional Supports, Location of Bearings and Drive elements, Balancing.

Text Books

Reference Books
(A) Comprehensive Viva Voce – Compulsory at the end of Semester VIII – 1 Credit

(B) Elective Component

a. Laboratory courses – Maximum Credits - 2
(for award of 1 Credit the lab course would have a teaching scheme of 2 Hrs. / week and a plan of 12 practicals). The credit to be awarded as per the ISA and ESA guidelines for the compulsory lab courses.

b. Research publication – Maximum Credits – 1
(Research Publication in a Magazine / Transaction / Journal as decided by the honors / minor co-ordinator)

c. Seminar - Maximum Credits – 1
(Seminar to be given on a topic consistent with the scope of the Honors or Minor. The topic Selection is to be approved by the honors / minor coordinator. The assessment and evaluation scheme would as per the guidelines used for Technical Seminar at UG level by respective Dept.)

d. Honors / Minors Project – Maximum Credits – 2
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e. Industrial Training – Maximum credits – 4
(An Industrial Training in an Industry identified by the student, approved by the honors / minor co-ordinator & Head of Department. The assessment would as per the guidelines and evaluation scheme used for Industrial Training at UG level by respective Dept.)

Note:

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c. No Industrial Training less than 4 weeks be considered for award of 1 Credit

d. No cumulative addition of Industrial Training period would be considered for award of credits
The student is expected to earn 1 Credit from Part (A) and remaining 4 Credits from Part (B)
MINOR IN METALLURGY
**FF No. 653 Issue No.1, Rev No.1 dated 2/4/2011**

**Structure for Minor (Metallurgy Engineering)**  
**Eligible Students: - Production/Mechanical Engineering**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/week)</th>
<th>Credits</th>
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<tbody>
<tr>
<td>S1</td>
<td>IP29161</td>
<td>Heat Treatments</td>
<td>3</td>
<td>0</td>
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<tr>
<td>S2</td>
<td>IP39161</td>
<td>Powder Metallurgy</td>
<td>3</td>
<td>0</td>
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<tr>
<td>S3</td>
<td>IP39162</td>
<td>Material Characterization &amp; Failure Analysis</td>
<td>3</td>
<td>0</td>
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<tr>
<td>S4</td>
<td>IP49161</td>
<td>Surface Engineering</td>
<td>3</td>
<td>0</td>
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<tr>
<td>S5</td>
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<td>Materials Joining</td>
<td>3</td>
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<td>Credits for Lab Courses (Group Selection)</td>
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**Total** | **15** | **-** | **-** | **20**
IP29161: HEAT TREATMENTS

Credits: 03  |  Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Elementary knowledge of Physical Metallurgy

Objectives:
- To understand the Fundamentals of Alloy Steels.
- To understand working principle of different Heat treatment Furnaces
- To understand principle of various Heat Treatments.
- Mapping with PEOs: I, II, III (c, g, h)

Unit I
Alloy steels
(8 Hrs)

A. Classification and role of alloy additions,
   Low alloy steels: HSLA, Micro alloyed, Dual phase steels, Free cutting steels, Spring steels etc.
B. Effect of alloying elements on micro-structure and properties of steels.

Unit II
Tool Steel
(8 Hrs)

A. Selection criteria and properties of Tool steels, Classification of Tool Steels: Cold work, Hot Work Tool Steels, HSS etc. Heat treatments of Tool steels, TTT diagram, Secondary hardness, Subzero treatment, Super HSS.
Control of quenching parameters, quenching fixtures, Dimensional changes during hardening and tempering.
B. Other cutting materials: Cermets, Cemented carbides, Stellites etc

Unit III
Stainless Steels
(8 Hrs)

A. Fe-Cr Phase Diagram, Classification Of Stainless Steels, Embrittlement, Sensitization, weld decay , Precipitation Hardening, Stainless Steels, Marageing Steels, Heat Resisting Steels, Trip Steels etc.
B. Elimination weld decay

Unit IV
Surface hardening
(8 Hrs)

B. Application of surface hardening treatments

Unit V  
(8 Hrs)
Heat treatment furnaces

A. Study of Important Industrial Heat Treatment Furnaces.

B. Shop problems and remedies: some typical case studies.

<table>
<thead>
<tr>
<th>Text Books</th>
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</table>

<table>
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<tr>
<th>Reference Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. ASM Hand Book , Heat Treatment ,Vol.No.4</td>
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</table>
IP39161:: POWDER METALLURGY

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: II (h, q)

Unit I
Powder Production
(8 Hrs)

A. classification of metal powder production methods, Reduction, Atomization & developments in it, Electrolysis etc. Characteristics of powders and properties - production methodology and quality control. Preparation of powder: grading, sizing, blending, handling and storage. Testing of powders. Particle size distribution, surface conditions, purity, flow properties, porosity, true and apparent density, Green compact strength.

B. Historical development, Basic principles of Powder Metallurgy

Unit II
Compaction
(8 Hrs)

A. Fundamentals of compaction, presses used, selection of presses, Automation and Handling of powder, tool clearances, Die design principles, wear reclamation, Die and punch materials selection and heat treatment, surface treatment properties, compact density variations, effect of blending powders, lubricants and lubrication in process. Pressure less powder shaping.

B. Improvement of press tool life

Unit III
Sintering
(8 Hrs)

A. Principle, time temperature effects, Theories of sintering mechanism. Sintering methods, sintering furnaces-characteristics and selection. Dimensional and property changes after sintering, Rapid sintering processes, impregnation. Liquid phase sintering Activated sintering.
B. Sintering atmosphere and its impact on process performance

Unit IV
Special P.M. processes & Secondary Operations

A. Secondary operations like sizing, coining, Oil impregnation, heat treatments, Steam treatment. Special PM processes like Hot Compaction, Iso static pressing, Hot Iso static compaction merits, demerits and typical applications. Powder metal products with polymer blends, Powder roll compaction. P.M. Forging, Powder Extrusion, Injection molding, Spray deposition forming
B. Comparison between various special PM processes.

Unit V
Powder Metallurgy Applications & Economics

A. Production details of common PM structural parts like gears, levers, ratchets, etc. lamp filament and filament support, refractory metal components, electrical contact material, Cemented Carbide tools and wear parts, brakes and clutch lining material, porous bearings and filters, catalytic components etc. Advantages and limitations of powder metallurgy. Production of nano composites.
B. Economics, Quality assurance, Manufacturing Competitiveness due to conservation of energy, Materials, Operations, Durability, rigidity, near net – shape, surface finish and machining.

Text Books

Reference Books
**IP39162:: MATERIAL CHARACTERIZATION & FAILURE ANALYSIS**

- **Credits:** 03
- **Teaching Scheme:** - Theory 3 Hrs/Week

**Prerequisites:** Basic knowledge of Material Science

**Objectives:**
- To develop a background for academics and industrial research.
- To understand principle, working and operation of different analytical tools.
- To understand, correlate and interpret the results for Failure analysis
- Mapping with PEOs: I II, III (c,p)

### Unit I

**Quantitative Metallography**

A. Introduction, scope of the subject, and classification of techniques of characterization: macro and micro-characterization, bulk-averaging techniques. Measurement of volume fraction of phases, Methods of grain size measurement, inclusion-rating determination, mean spacing and interlamellar spacing. Particle size measurement. Image processing and analysis of the data provided by optical, electron microscopy and other techniques.

B. Applications of Quantitative Metallography

### Unit II

**X-ray Diffraction**

A. Production and properties of x-rays, Absorption of x-rays and filters, Stereographic projection, diffraction of X-rays through crystals. Bragg's law, structure factor, Laue and Powder methods, Indexing of powder photographs, Determination of lattice parameters of cubic metals and alloys using powder method. Some simple applications of X-rays to metallurgical problems such as determination of lattice strains, particle size; residual stresses, preferred orientation, recovery, recrystallisation and grain growth during annealing.

B. Applications of X-rays to material characterization

### Unit III

**Study of Transmission Electron Microscope**

(8 Hrs)
A. Elements of electron optics, resolving power, image formation, contrast mechanism, bright field and dark field images, selected area diffraction, techniques of specimen preparation, Study of scanning electron microscope (SEM), optics of SEM, image formation – plane and fractured surface, resolving power, modes of operation, magnification, depth of focus, methods of specimen preparation,
B. Applications of SEM and TEM

Unit IV

Fatigue and Creep

A. Cyclic Loading, Cyclic stress and cyclic strain controlled fatigue, Fatigue life estimation of notched components, Fatigue Initiation Mechanism, Crack Growth, Fatigue Failure, Second Order Terms, Predicting Direction of Crack Growth, Crack Closure, and Corrosion Fatigue.
B. Factors affecting Fatigue Life, High temperature materials

Unit V

Failure analysis & prevention of failure.

A. Case studies of some common engineering components.
B. Case analysis and literature review

Text Books

5. P.G. Ormandy - An introduction to Metallurgical Laboratory Techniques - Pergamon Press (For Vacuum techniques)
Reference Books

2. ASM Handbook Vol. 11 Failure Analysis
IP49161: SURFACE ENGINEERING

Credits: 03  Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To make the students understand the concepts & broad principles of contents of the course
- Develop conceptual framework of the course
- Mapping with PEOs: I, II (a,j)

Unit I
Basic principles & Pretreatment of substrate

A. Introduction of Surface dependent properties Classification and scope of surface engineering in metals, ceramics, polymers and composites, tailoring of surfaces of advanced materials. Surface protection (Physical) Surface dependent engineering properties, viz., wear, friction, corrosion, fatigue, etc.; common surface initiated engineering failures; mechanism of surface degradation; importance and necessity of surface engineering. Classification & Selection of Cleaning processes. Acid & Alkaline, Salt bath, Ultrasonic, Mechanical cleaning, Pickling & de scaling etc. Process details of each, applications of each Environmental concern of each.

A. Various purposes of Surface engineering

Unit II
Surface Coatings


B. Scope and application of conventionally deposited materials.

Unit III
Thermal Spray coatings

A. Process details of all type of Thermal spray coatings like Flame, Electric, Plasma arc Detonation gun & High velocity Oxy Fuel. Advantages & limitations of each type.
B. Applications of all types of Thermal spray coatings.

Unit IV
Thin Film Coatings & High Energy processes

A. All Process details of Physical vapour deposition & Chemical vapour deposition. Ion implantation, Laser assisted surface modification & Electron beam treatment. Diamond & Diamond like Carbon thin film coatings
B. Applications of the above processes.

Unit V
Characterization of coatings & Recent trends in surface engineering

A. Quality Assurance, surface geometry – characterization techniques (conventional and recent trends); coating thickness measurements – laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement – conventional methods and recent developments, Measurement of mechanical properties of engineered surface in nano scale; Evaluation of tribological characteristics of engineered surface in macro, micro and nano materials.
B. Tribological coatings for engineering components & their evaluation

Text Books
1. N.J. Persson, Sliding Friction
2. Surface Engineering Process, Fundamentals & Applications Vol 1 & 2 Lecture notes Of SERC school on Surface Engineering

Reference Books
1. The Friction and Lubrication of Solids, Frank Philip Bowden, Oxford Classic Texts
2. Engineering Tribology, Gwidon Stachowiak, A W Batchelor,
3. Surface Engineering, ASM Hand Book, Vol. 5,
IP49162:: MATERIALS JOINING

Credits: 03  
Teaching Scheme: - Theory 3 Hrs/Week

Prerequisites: Nil

Objectives:
- To understand basic principles of joining materials.
- To be able to analyze metallurgical phenomena occurring in joining processes.
- Mapping with PEOs: I, II (b)

Unit I  
(8 Hrs)
Joining Processes

B. Classification of Joining Processes

Unit II  
(8 Hrs)
Fusion Welding,

B. Applications of welding processes

Unit III  
(8 Hrs)
Heat Source & Chemical Reactions in Welding Efficiency,

B. Numericals based on heat source

Unit IV  
(8 Hrs)
Heat affected Zone

A. Fusion Zone, Solidification, Effect of Cooling Rate, Partially Melted Zone, Liquation, Heat Affected Zone, Defects in Welded Joints, Micro-Segregation, Macro-Segregation,
Banding, Gas Porosity, Inclusions

B. Weld Metal Cracking, Liquation Cracking, Hydrogen Cracking

Unit V

Solid Phase Welding


B. Application based on solid phase welding

Text Books


Reference Books

Composition for Selection of 5 Credits for Honors / Minor Course

(A) Comprehensive Viva Voce – Compulsory at the end of Semester VIII – 1 Credit

(B) Elective Component
a. Laboratory courses – Maximum Credits - 2
   (for award of 1 Credit the lab course would have a teaching scheme of 2 Hrs. / week and a plan of 12 practicals). The credit to be awarded as per the ISA and ESA guidelines for the compulsory lab courses.

b. Research publication – Maximum Credits – 1
   (Research Publication in a Magazine / Transaction / Journal as decided by the honors / minor co-ordinator)

c. Seminar - Maximum Credits – 1
   (Seminar to be given on a topic consistent with the scope of the Honors or Minor. The topic Selection is to be approved by the honors / minor co-ordinator. The assessment and evaluation scheme would as per the guidelines used for Technical Seminar at UG level by respective Dept.)

d. Honors / Minors Project – Maximum Credits – 2
   (Project Topic and Scope, its progress and final assessment consistent with the scope of the Honors or Minor. The topic Selection is to be approved by the honors / minor co-ordinator. The assessment would as per the guidelines and evaluation scheme used for Project Work at UG level by respective Dept.)

e. Industrial Training – Maximum credits – 4
   (An Industrial Training in an Industry identified by the student, approved by the honors / minor co-ordinator & Head of Department. The assessment would as per the guidelines and evaluation scheme used for Industrial Training at UG level by respective Dept.)

Note:

a. 4 Credits would be awarded to the students for a complete 12 Week Industrial Training and meeting with the assessment and evaluation requirements
b. Provision can be made for the students unable to procure a 12 week Industrial Training. A 4 week or 8 week Industrial Training may also be offered. 2 credits will be awarded for 8 week Industrial Training and 1 Credit would be awarded to the students for a 4 Week Industrial Training, meeting with the assessment and evaluation requirements
c. No Industrial Training less than 4 weeks be considered for award of 1 Credit
d. No cumulative addition of Industrial Training period would be considered for award of credits

The student is expected to earn 1 Credit from Part (A) and remaining 4 Credits from Part (B)
A) **Mid Semester Examination**

1. Students reporting in morning slot will have examination in morning slot. Those in evening slot will have examination in evening slot.
2. 20 multiple choice based questions to be attempted in 30 minutes x no. of theory courses i.e. 100 questions in 150 minutes for F.E., 80 questions in 120 minutes for S.E., T.E., B.E., M.E., 20 questions in 30 minutes for Honors, Minor, Fast Track, etc.
3. A scrambled mix of questions will be generated through software.
4. Mid Semester Examination will be based on Unit II & Unit III.
5. There will be one mark for each correct answer and (-) 0.25 marks for every wrong answer.
6. For a typical 3 hour Mid Semester Examination, first 15 minutes would be used for student attendance, record keeping, seat allocation, log in procedure if any, etc. Next 150 minutes for actual examination. A timer indicating time remaining to be provided by ERP. 15 minutes for processing & results.
7. A visual alarm / flash would be given 10 minutes before completion of 150 minutes as a warning. For auto generation of every theory course result out of 20 and dispatch of the marks on student mobile and mail ID as well as parent mail ID.
8. No repeat examination under any circumstances.
B) Seminar – Conduct, Evaluation, etc.

**Seminar – (T.E.- Semester I)**

1. Review – I: during Mid Semester Examination (Compulsory) as per the Academic Calendar.
2. Review – II: The last week of November (Optional)
3. For poor performing students identified by the examination panel, a second review to be taken. Review II optional for other students. For Review II, deduction of 10 marks will take place.
4. Seminar is an individual activity with separate topic and presentation.
5. Duration of presentation – 20 minutes
   Question and answer session – 10 minutes

**Seminar Evaluation Scheme:**

1. Attendance during Semester – 10 marks
2. Attendance during Seminar presentation self & peer – 10 marks
3. Relevance of Seminar topic – 10 marks
4. Timely Abstract submission – 10 marks
5. Literature review – 10 marks
6. Technical contents – 10 marks
7. Presentation – 25 marks
8. Question & answer Session – 15 marks

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100 marks
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C) **Equivalence**

For the courses belonging to 2008 structure counseling sessions for failure students will be arranged. The Head of Department will appoint faculty identified as subject experts as counselors. The previous examination scheme i.e.

Class Test – 10 marks
T.A. through Home assignment – 10 marks
A written paper MSE – 30 marks
A written paper ESE – 50 marks

Will be followed. The entire processing based on 2008 structure related coding scheme will be followed. Counseling + Administration + Examination charges will be the basis for fees considered for such students.
D) Extra Credits

A student planning to take extra credits may be considered under following categories:

(a) A student carrying a backlog and re-registering for the previous course – Re-registration charges as applicable. Consideration of all courses registered for during that Semester of Academic Year for SPI calculation.

(b) Student planning to take extra courses as a fast track opportunity – Administration, processing and examination charges will be considered. In any case the student has to pay the college fees for four years. This fast track facility would enable the student to undergo an industrial training, an exchange programme, research contribution in I.I.T. under scheme such as KVPY without any academic compromises for credit transfer. The phase-wise development and completion of project activity cannot be considered at an accelerated pace under fast track scheme. The registration under fast track is subject to having a CPI 8.0 or above and no backlog for consideration of registration to an additional course.

(c) Students opting for earning extra credits by selection of courses in addition to the courses prescribed by respective BOS which are single Semester activities and not the part of Honors / Minor scheme. Such students will be expected to pay charges equivalent to re-registration (proportionate credit based payment). The registration for such courses is subject to permission given by the Chairman BOS of the Board in the purview of which the subject is identified. Such permissions will be given based on meeting with prerequisite subject.

1. In any case (a), (b) or (c) the candidate cannot register for more than 8 credits.

2. A suitable reflection of completion of the said course will be made in the candidate’s Grade statement.

For part (c) a separate grade & GPA will be calculated. That GPA will not be clubbed with the other regular courses for SPI, CPI calculation.
E) **Home Assignment**

A Home Assignment Calendar for Semester is prepared as under:

<table>
<thead>
<tr>
<th>Week No.</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Home Assignments</td>
</tr>
<tr>
<td>2</td>
<td>No Home Assignments</td>
</tr>
<tr>
<td>3</td>
<td>No Home Assignments</td>
</tr>
<tr>
<td>4</td>
<td>S1 / S2 – HA1</td>
</tr>
<tr>
<td>5</td>
<td>S3 / S4 / S5* - HA1</td>
</tr>
<tr>
<td>6</td>
<td>S1 / S2 – HA2</td>
</tr>
<tr>
<td>7</td>
<td>S3 / S4 / S5* - HA2</td>
</tr>
<tr>
<td>8</td>
<td>S1 / S2 – HA3</td>
</tr>
<tr>
<td>9</td>
<td>S3 / S4 / S5* - HA3</td>
</tr>
<tr>
<td>10</td>
<td>S1 / S2 – HA4</td>
</tr>
<tr>
<td>11</td>
<td>S3 / S4 / S5* - HA4</td>
</tr>
<tr>
<td>12</td>
<td>S1 / S2 – HA5</td>
</tr>
<tr>
<td>13</td>
<td>S3 / S4 / S5* - HA5</td>
</tr>
<tr>
<td>14</td>
<td>No Home Assignments</td>
</tr>
<tr>
<td>15</td>
<td>No Home Assignments</td>
</tr>
<tr>
<td>16</td>
<td>No Home Assignments</td>
</tr>
</tbody>
</table>

The Home Assignments will be based on the self study component i.e. part B of every theory course syllabus. The Saturday or last working day will be the default deadline for submission of Home Assignment of that week. For example by the Saturday ending Week No. 9, Home Assignment No. 3 for subject S3/ S4/ S5 (if applicable) must be submitted.

1. *S5 can be OE1 / OE2 / OE3 / Honors/ Minor / Re-registration category (a) / Category (b) / Category (c).

2. For subjects S1, S2, S3, S4 & S5 (if any), the composition of the Teacher Assessment marks will be as follows:

---


<table>
<thead>
<tr>
<th></th>
<th>S1,S2 with Tutorial</th>
<th>S3,S4,S5 without Tutorial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Assignment</td>
<td>30 marks</td>
<td>30 marks</td>
</tr>
<tr>
<td>Tutorial</td>
<td>30 marks</td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>30 marks</td>
<td>30 marks</td>
</tr>
<tr>
<td>Attendance :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) &gt; 90%</td>
<td>10 marks</td>
<td>10 marks</td>
</tr>
<tr>
<td>(b) 75% to 90%</td>
<td>5 marks</td>
<td>5 marks</td>
</tr>
<tr>
<td>(c) &lt;75%</td>
<td>0 marks</td>
<td>0 marks</td>
</tr>
<tr>
<td></td>
<td>100 marks converted to 15 marks</td>
<td>70 marks converted to 15 marks</td>
</tr>
</tbody>
</table>

**Explanation:**

1. Tutorials to be conducted with continuous assessment throughout the Semester. Final assessment out of 30 marks for Tutorial.
2. Class Test to be conducted during a regular theory class within the time period mentioned in the Academic Calendar.
3. Class Test marks are to be entered immediately as mentioned in Academic Calendar.
4. Attendance percentage to be calculated at the end of Semester after completing all lectures as per the lesson plan.
F) **Mini Project**

Teaching Scheme: Theory – 0 ; Tutorial – 0 ; Laboratory – 2 Hrs / week

For F.E., S.E. & T.E. students in every Semester a Mini Project be carried out. The objectives behind the Mini Project are:

1. Scope for creativity
2. Hands on experience
3. Academic occupancy

Mini Project will be based on all subjects of that Semester except GP.

1. The Semester Mini Project will be for a group of 3 to 5 students. Head of Department to appoint Mini Project Guides. 2 credits will be awarded to the candidate after the viva voce and project demonstration at the End of Semester.
2. Group formation, discussion with faculty advisor, formation of the Semester Mini Project statement, resource requirement, if any should be carried out in the earlier part of the Semester. The students are expected to utilize the laboratory resources before or after their contact hours as per the prescribed module.

The Assessment Scheme will be:
(a) Continuous Assessment 50 marks
(b) End Semester 50 marks

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100 marks
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G) **Project Stage I Evaluation**

The project activity is broken in 3 stages:

The Project Stage I will be in T.E Semester II irrespective of student module. The evaluation of Project Stage I will be as follows:

<table>
<thead>
<tr>
<th>Group formation &amp; attendance / reporting to guide</th>
<th>20 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic finalization / Statement</td>
<td>20 marks</td>
</tr>
<tr>
<td>Literature Survey</td>
<td>20 marks</td>
</tr>
<tr>
<td>Abstract</td>
<td>20 marks</td>
</tr>
<tr>
<td>Presentation</td>
<td>20 marks</td>
</tr>
</tbody>
</table>

Project Stage II and Project Stage III evaluations will be based on Department specific norms.
H) Composition for Selection of 5 Credits for Honors / Minor Course

(Applicable for B11 and A11 Patterns)

(A) Comprehensive Viva Voce – Compulsory at the end of Semester VIII – 1 Credit

(B) Elective Component

a. Laboratory courses – Maximum Credits - 2
(for award of 1 Credit the lab course would have a teaching scheme of 2 Hrs. / week and a plan of 12 practicals). The credit to be awarded as per the ISA and ESA guidelines for the compulsory lab courses.

b. Research publication – Maximum Credits – 1
(Research Publication in a Magazine / Transaction / Journal as decided by the honors / minor co-ordinator)

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(An Industrial Training in an Industry identified by the student, approved by the honors / minor co-ordinator & Head of Department. The assessment would as per the guidelines and evaluation scheme used for Industrial Training at UG level by respective Dept.)
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c. No Industrial Training less than 4 weeks be considered for award of 1 Credit.

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