B. E. COMMON TO ALL PROGRAMMES
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Exam Hours</th>
<th>CIE Marks</th>
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<td>18MAT31</td>
<td>TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES</td>
<td>03</td>
<td>03</td>
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Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE’s arising in engineering applications, using numerical methods.

Module-1


Inverse Laplace Transforms: Inverse Laplace transform - problems, Convolution theorem to find the inverse Laplace transform (without proof) and problems, solution of linear differential equations using Laplace transform.

Module-2


Module-3


Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform. Simple problems.

Module-4


Module-5

Numerical Solution of Second Order ODE’s: Runge-Kutta method and Milne’s predictor and corrector method (No derivations of formulae).

Calculus of Variations: Variation of function and functional, variational problems, Euler’s equation, Geodesics, hanging chain, problems.

Course Outcomes: At the end of the course the student will be able to:

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5: Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title of the Book</th>
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Reference Books
<table>
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<tr>
<th>No.</th>
<th>Book Title</th>
<th>Author(s)</th>
<th>Publisher</th>
<th>Edition</th>
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<tr>
<td>5</td>
<td>Advanced Engineering Mathematics</td>
<td>Chandrika Prasad and Reena Garg</td>
<td>Khanna Publishing,</td>
<td>2018</td>
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</table>

**Web links and Video Lectures:**
2. http://www.class-central.com/subject/math(MOOCs)
4. VTU EDUSAT PROGRAMME - 20
### Course Overview

**Course Code:** 18IP32  
**CIE Marks:** 40  
**Teaching Hours/Week (L:T:P):** (3:2:0)  
**SEE Marks:** 60  
**Credits:** 04  
**Exam Hours:** 03

### Course Learning Objectives:
- Explain the basic concepts of stress, strain, behaviour of engineering materials under different loading conditions.
- Calculate principal stresses using analytical and graphical methods, shear force and bending moments, deflection and slope of beams, critical loads for different type of columns using Euler’s and Rankine’s equations.
- Plot shear force and bending moment diagrams for beams carrying different types of loads, and various support conditions.
- Determine deflection and slope of beams subjected to various type of loads.
- Compare solid and hollow shafts subjected to torque.

### Modules

#### Module-1

**Simple Stress and Strain:**
Introduction, Stress and types, Strain, Tensile test on a mild steel bar, Hooke's Law and Poisson's ratio, Stress-Strain relation for cast iron and non-ferrous materials, Extension / Shortening of bars — uniform cross section, with cross sections varying in steps, with continuously varying cross sections (circular and rectangular), Principle of superposition, Elongation due to self weight. Volumetric strain, expressions for volumetric strain for bars with uniform circular and rectangular cross sections, Simple shear stress and shear strain, Elastic constants (No derivation for relationship between elastic constants), Temperature stresses (excluding compound bars). Simple numerical problems on tensile test and determining change in dimensions.

#### Module-2

**Principal stresses:**
Stresses in a tensile member, Stresses due to pure or simple shearing, mutually perpendicular direct stresses, Principal planes and stresses, Two-dimensional stress system, Graphical method (Mohr’s circle) for plane stresses.

**Thick and Thin Cylinder:**
Stresses in thin cylinders, change in dimensions of cylinder (diameter, length and volume). Thick cylinders - Lame's equations for radial and hoop stresses (compound cylinders and spherical shells not included).

**Torsion of Circular Shafts:**
Introduction, Torsion equation — assumptions and derivation, Torsional rigidity / Stiffness of shafts. Power transmitted by solid and hollow circular shafts, Simple numerical problems.

**Columns:**
Introduction, End conditions, Assumptions in deriving Euler's equations, Sign conventions for bending moments, Euler’s

#### Module-3

**Bending Moment and Shear Force in Beams:**
Introduction - types of beams, loads and reactions, Shear force and bending moment, Sign conventions, Relationship between load intensity, shear force and bending moment; Shear force and Bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.

#### Module-4

**Bending Stresses in Beams:**
Moment of inertia and section modulus for different sections (I, T, rectangular, and circular —only formulas)
Introduction to theory of simple bending, assumptions in simple bending theory, Bending stress equation - relationship between bending stress and radius of curvature, relationship between bending moment and radius of curvature; Moment carrying capacity of a section. Simple problems on rectangular, symmetrical I (about NA) and T sections, (composite / notched beams not included).

#### Module-5

**Deflection of Beams:**
Introduction, Differential equation for deflection (flexure), Sign conventions and assumptions, Equations for deflection and slope - Double integration method and Macaulay's method for cantilever and simply supported beams for point load, uniformly distributed load, uniformly varying load, and couple.

### Course Outcomes:
At the end of the course the student will be able to:
- Explain the basic concepts of stress, strain, behaviour of engineering materials under different loading conditions.
- Calculate principal stresses using analytical and graphical methods, shear force and bending moments,
deflection and slope of beams, critical loads for different type of columns using Euler’s and Rankine’s equations
- Plot shear force and bending moment diagrams for beams carrying different types of loads, and various support conditions
- Determine deflection and slope of beams subjected to various type of loads
- Compare solid and hollow shafts subjected to torque.

**Question paper pattern:**
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

BASIC THERMODYNAMICS

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Course Learning Objectives:
- Define work, heat, and laws of thermodynamics.
- Evaluate thermal performance of refrigeration cycles.
- Demonstrate the calculation of efficiency of gas power and vapor power cycles.

Module-1

Fundamental Concepts & Definitions: Thermodynamics definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic ; Processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, fixed points and measurements.

Work and Heat: Definition of work and its limitations. Thermodynamic definition of work; examples, sign convention.

Module-2

Displacement work: as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law tonon - cyclic processes, energy, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat at constant pressure.

Module-3

APPLICATION OF FIRST LAW OF THERMODYNAMICS: Extension of the First law to control volume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as film and evacuation of vessels with and without heat transfer.
SECOND LAW OF THERMODYNAMICS — Qualitative difference between heat & work; Cyclic heat engine; Energy Reservoirs; Kelvin-Planck statement of the Second law of Thermodynamics; Clausius's statement of Second law of Thermodynamics; (Equivalence of two statements not included)

Module-4


Module-5


Course Outcomes:
At the end of the course the student will be able to:
- Define work, heat, and laws of thermodynamics.
- Evaluate thermal performance of refrigeration cycles.
- Demonstrate the calculation of efficiency of gas power and vapor power cycles

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<th>Edition and Year</th>
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<tr>
<td>1</td>
<td>Basic Engineering Thermodynamics</td>
<td>A. Venkatesh</td>
<td>Universities Press</td>
<td>2008</td>
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<td>Reference Books</td>
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<tr>
<td>4</td>
<td>Engineering Thermodynamics</td>
<td>J.B. Jones and</td>
<td>John Wiley and Sons</td>
<td></td>
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</table>
MECHANICAL MEASUREMENTS

Course Code: 18IP34  
CIE Marks: 40

Teaching Hours/Week (L:T:P): (2:2:0)  
SEE Marks: 60

Credits: 3  
Exam Hours: 3

Course Learning Objectives: To

- Explain significance of mechanical measurements, elements of a generalized measuring system, theory and working principle of measuring instruments for the measurement of force, torque, flow, temperature, pressure and strain
- Define Metrology, appreciate the objectives of Metrology, and explain the importance of standards.
- Interpret the limits specified, identify fits and explain the concept of tolerance
- Use comparators, screw and gear metrology

Module-1

Standards of measurement: Definition and Objectives of metrology, Standards of length International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M81, M-12), Numerical problems on building of slip gauges.

Module-2

System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS919-1963), geometrical tolerance, positional-tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges—plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

Comparators and Angular measurement: Introduction to comparators, characteristics, classification of comparators, mechanical comparators-Johnson Mikrokator, sigma comparators, dial indicator, optical comparators—principles, Zeiss ultra optimeter, electric and electronic comparators principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators. Angular measurements, bevel protractor, sine principle and use of sine bars, sine centre, use of angle gauges (numerical on building of angles), clinometers.

Module-3

Interferometer and screw thread, gear measurement: Interferometer, interferemetry, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear. to. terminology, use of gear tooth vernier caliper and micrometer.

Measurements and measurement systems: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers.

Module-4

Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers and telemetry. Terminating devices, mechanical, cathode ray oscilloscope, oscillographs, X-Y plotters

Module-5


Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermo couple, materials used for construction, pyrometer, optical pyrometer. Strain measurements, strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.

Course Outcomes:

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

- Explain significance of mechanical measurements, elements of a generalized measuring system, theory and working principle of measuring instruments for the measurement of force, torque, flow, temperature, pressure and strain
- Define Metrology, appreciate the objectives of Metrology, and explain the importance of standards.
- Interpret the limits specified, identify fits and explain the concept of tolerance
- Use comparators, screw and gear metrology
Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<td>Textbook/s</td>
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<td>1</td>
<td>Mechanical Measurements</td>
<td>Beckwith Marangoni and</td>
<td>Pearson Education</td>
<td>6th Ed., 2006. 2</td>
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<td>Reference Books</td>
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<tr>
<td>3</td>
<td>Engineering Metrology</td>
<td>I.C. Gupta</td>
<td>DhapatRai Publications,</td>
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<td>4</td>
<td>Mechanical Measurements,</td>
<td>R.K. Jain</td>
<td></td>
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<tr>
<td>5</td>
<td>Industrial Instrumentation</td>
<td>Alsutko, Jerry. D.</td>
<td>Thompson Asia Pvt. Ltd</td>
<td>2002</td>
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**B. E. INDUSTRIAL AND PRODUCTION ENGINEERING**  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
**SEMESTER - III**

### FLUID MECHANICS

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**Course Learning Objectives:** To

- Define fluid properties; describe Pascal’s law, Hydrostatic law.
- Calculate total pressure given point and between sections of pipe, Buoyancy and Stability of floating objects.
- Apply Bernoulli’s principle to solve fluid flow problems. Make dimensional analysis of fluid mechanics problems.
- Analyze various forces acting on submerged bodies.

**Module-1**

**Properties of Fluids:** Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitations

**Fluid Statics:** Fluid pressure at a point, Pascal’s law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.

**Module-2**

**Buoyancy and Fluid Kinematics:** Buoyancy, center of buoyancy, metacentre and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height theoretically.

**Kinematics:** Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration

**Module-3**

**Fluid Dynamics:** Introduction equation of motion, Euler’s equation of motion, Bernoulli’s equation from first principles and also from Euler’s equation, limitations of Bernoulli’s equation.

**Fluid Flow Measurements:** Venturimeter, orifice meter, pitot-tube, vertical orifice, V Notch and rectangular notches

**Module-4**

**Flow through pipes:** Minor losses through pipes. Darey’s and Chezy’s equation for loss of head due to friction in pipes. HGL and TEL (no problems).

**Flow past immersed bodies:** Drag, Lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness

**Module-5**

**Dimensional Analysis:** Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh’s method, Buckingham $\pi$ theorem, dimensionless numbers, similitude (theory and no problems)

**Introduction to compressible flow:** Velocity of sound in a fluid, Mach number, Mach cone, propagation of pressure waves in a compressible fluid on plates.

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

- Define fluid properties; describe Pascal’s law, Hydrostatic law.
- Calculate pressure given point and difference in pressure between sections of pipe, Buoyancy and Stability of floating objects.
- Apply Bernoulli’s principle to solve fluid flow problems.
- Make dimensional analysis of fluid mechanics problems
- Analyze various forces acting on submerged bodies

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

### Textbook/s

<table>
<thead>
<tr>
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<tr>
<td>2</td>
<td>Fluid Mechanics</td>
<td>Dr. Bansal</td>
<td>R.K.Lakshmi</td>
<td>2004</td>
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**Reference Books**
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<th>Publisher</th>
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<tr>
<td>3</td>
<td>Fluid Mechanics and hydraulics</td>
<td>Dr. Jagadishlal</td>
<td>Metropolitan Book Co Ltd.,</td>
<td>1997</td>
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B.E INDUSTRIAL AND PRODUCTING ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

MANUFACTURING PROCESS - I

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Course Learning Objectives: To
• Define various terms associated with casting processes
• Explain methods of construction of moulds.
• Select moulding machine and moulding process based on material type
• Select appropriate joining process, type of joints.
• Explain different non-destructive testing method

Module-1
CASTING PROCESS
Introduction: Concept of Manufacturing process, its importance. Classification of Manufacturing processes.
Introduction to Casting process & steps involved. Varieties of components produced by casting process.
Advantages & Limitations of casting process.
Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance.
Classification of patterns.
Sand Moulding: Types of base sand, requirement of base sand. Moulding sand mixture ingredients for different sand mixtures. Method used for sand moulding, such as Green sand, dry sand and skin dried moulds.
Binder: Definition, Types of binder used in moulding sand. Additives: Need, Types of additives used and their properties

Module-2
Cores: Definition, Need, Types. Method of making cores, Binders used, core sand moulding.
Concept of Gating & Risers: Principle and types. Fettling and cleaning of castings. Basic steps, Casting defects, Causes, features and remedies.
Moulding Machines: Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger.
Special moulding Process: Study of important moulding processes, No bake moulds, Flaskless moulds, Sweep mould, CO2 mould, Shell mould, Investment mould.

Module-3
Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes.
Melting Furnaces: Classification of furnaces. Constructional features & working principle of coke fired, oil fired and Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace

Module-4
WELDING
Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding.
Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW).
Gas Welding: Principle, Oxy – Acetylene welding, Chemical Reaction in Gas welding, Flame characteristics.
Gas torch construction & working, Forward and backward welding

Module-5
Inspection Methods: Methods used for Inspection of casting and welding. Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection

Course Outcomes:
At the end of the course the student will be able to:
• Define various terms associated with casting processes
• Explain methods of construction of moulds, different non-destructive testing methods.
• Select moulding machine and moulding process based on material type
• Select appropriate joining process and type of joints

Question paper pattern:
• The question paper will have ten full questions carrying equal marks. Each full question consisting of 16 marks.
• There will be two full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub question covering all the topics under a module.
• The students will have to answer five full questions, selecting one full question from each module.
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<td>1</td>
<td>Manufacturing Process-I</td>
<td>Dr. K. Radhakrishna</td>
<td>Sapna Book House</td>
<td>5th Revised Edition 2009</td>
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<td>4</td>
<td>Manufacturing Technology</td>
<td>Serope Kalpakjian, Steuen. R. Sechmid</td>
<td>Pearson Education Asia</td>
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SEMESTER - III

FOUNDRY AND FORGING LABORATORY

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<td>CIE Marks</td>
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**Course Learning Objectives: To**

- To apply knowledge of foundry and forging for the conduct of exercises in Foundry and Forging laboratory using standard working procedures
- To explain various foundry and forging tools and demonstrate their usage

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### Sl. No  | Exercises
---|---
1 | **PART- A**

**Testing of Moulding Sand and Core Sand:**
Preparation of sand specimens and conduction of the following tests:
- a) Compression, Shear and Tensile tests on Universal Sand Testing Machine.
- b) Permeability test
- c) Core hardness & Mould hardness tests.
- d) Sieve Analysis to find Grain Finest number of Base Sand
- e) Clay content determination in Base Sand

2 | **PART- B**

**Foundry Practice:**
- a) Use of foundry tools and other equipment.
- b) Preparation of molds using two molding boxes using patterns or without patterns. (Split pattern, Match plate)
- c) Preparation of one casting (Aluminium or cast iron-Demonstration only)

3 | **PART – C**

**Forging Operations:**
Calculation of length of the raw material required to do the model. Preparing minimum three forged models involving upsetting, drawing and bending operations.
Out of these three models, at least one model is to be prepared by using Power Hammer.

---

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

- To apply knowledge of foundry and forging for the conduct of experiments in Foundry and Forging laboratory using standard test procedures
- To explain various foundry and forging tools and demonstrate their usage

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**Question paper pattern:**

1. One question is to be set from Part-A (Procedure+ Execution): 5+25=30 marks
2. One question is to be set from either Part-B or Part-C (Marking/Calculation+ Model):(10+40)= 50 Marks
3. Viva – Voce: 20 marks
4. Total: (30+50+20) = 100 marks
B. E. INDUSTRIAL AND PRODUCTION ENGINEERING  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER - III  

METROLOGY AND MEASUREMENTS LABORATORY  

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18IPL38</th>
<th>CIE Marks</th>
<th>40</th>
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<tr>
<td>Teaching Hours/Week (L:T:P)</td>
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<td>SEE Marks</td>
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<td>Credits</td>
<td>02</td>
<td>Exam Hours</td>
<td>03</td>
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Course Learning Objectives:  To  
- Identify the measuring instrument and demonstrate its usage  
- Calibrate pressure sensor, thermocouple, LVDT and load cell  
- Explain the usage of slip gauges for calibration of vernier caliper, height gauge and micrometer  
- Determine the form tolerance (cylindricity and circularity)  
- Determine thread and gear parameters using standard tests  

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Experiments</th>
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<tr>
<td>1</td>
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<tr>
<td>PART-A: MECHANICAL MEASUREMENTS</td>
<td></td>
</tr>
<tr>
<td>1. Calibration of Pressure Gauge (Bourdon tube pressure gauge)</td>
<td></td>
</tr>
<tr>
<td>2. Calibration of Thermocouple</td>
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</tr>
<tr>
<td>3. Calibration of LVDT</td>
<td></td>
</tr>
<tr>
<td>4. Calibration of Load cell</td>
<td></td>
</tr>
<tr>
<td>5. Determination of modulus of elasticity of a mild steel specimen using Strain gauges.</td>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>PART-B: METROLOGY</td>
<td></td>
</tr>
<tr>
<td>1. Measurements using Optical Projector / Toolmaker Microscope.</td>
<td></td>
</tr>
<tr>
<td>2. Measurement of angle using Sine Center / Sine bar / bevel protractor</td>
<td></td>
</tr>
<tr>
<td>3. Measurement of alignment using Autocollimator / Roller set</td>
<td></td>
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</tbody>
</table>
| 4. Measurement of cutting tool forces using  
| a. Lathe tool Dynamometer |  
| b. Drill tool Dynamometer. |  
| 5. Measurement of Screw threads Parameters using Two wire or Three-wire method. |  
| 6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator |  
| 7. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer |  
| 8. Calibration of Micrometer using slip gauges |  
| 9. Measurement using Optical Flats |  

Course Outcomes: At the end of the course the student will be able to:  
- Identify the measuring instrument and demonstrate its usage  
- Calibrate pressure sensor, thermocouple, LVDT and load cell  
- Explain the usage of slip gauges for calibration of vernier caliper, height gauge and micrometer  
- Determine the form tolerance (cylindricity and circularity)  
- Determine thread and gear parameters using standard tests  

Conduct of Practical Examination:  
1. All laboratory experiments are to be included for practical examination.  
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.  
3. Students can pick one experiment from the questions lot prepared by the examiners.  
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.  

Scheme of Examination:  
ONE question from part -A: 30 Marks;  ONE question from part-B: 50 Marks;  Viva -Voice: 20 Marks; Total: 100 Marks
### Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>CIE Marks</td>
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<tr>
<td>Credits</td>
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#### Aadalitha Kannada

**Course Code**: 18KAK28/39/49  
**CIE Marks**: 100  
**Credits**: 01  

### Teaching Hours/Week (L:T:P)

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### Course Details

- **Course Code**: 18KAK28/39/49
- **CIE Marks**: 100
- **Credits**: 01

### Learning Outcomes

- **Objective 1**
- **Objective 2**
- **Objective 3**
- **Objective 4**
- **Objective 5**
- **Objective 6**
- **Objective 7**
- **Objective 8**
- **Objective 9**
- **Objective 10**

### Assessment

- **Internal Evaluation**: Internal Evaluation
- **Continuous Internal Evaluation**: Continuous Internal Evaluation
- **External Evaluation**: External Evaluation

### Notes

- **Note 1**: [Detailed information]
- **Note 2**: [Detailed information]
- **Note 3**: [Detailed information]
- **Note 4**: [Detailed information]
- **Note 5**: [Detailed information]
- **Note 6**: [Detailed information]
- **Note 7**: [Detailed information]
- **Note 8**: [Detailed information]
- **Note 9**: [Detailed information]
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### Vyavaharika Kannada

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<tr>
<td>CIE Marks</td>
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</table>

#### Course Learning Objectives:
The course will enable the students to understand Kannada and communicate in Kannada language.

#### Table of Contents:
- **Chapter - 1:** Vyavaharika kannada – Parichaya (Introduction to Vyavaharika Kannada).
- **Chapter - 2:** Kannada Aksharamale haagu uchcharane (Kannada Alphabets and Pronunciation).
- **Chapter - 3:** Sambhashanegaagi Kannada Padagalu (Kannada Vocabulary for Communication).
- **Chapter - 4:** Kannada Grammar in Conversations (Sambhashaneyalli Kannada Vyakarana).
- **Chapter - 5:** Activities in Kannada.

#### Course Outcomes:
At the end of the course, the student will be able to understand Kannada and communicate in Kannada language.
B. E. COMMON TO ALL PROGRAMMES
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)

<table>
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<tr>
<td>Credits</td>
<td>01</td>
<td>Exam Hours</td>
<td>02</td>
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</table>

Course Learning Objectives: To
- know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens
- Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
- Know about the cybercrimes and cyber laws for cyber safety measures.

Module-1


Module-2


Module-3


Constitutional special provisions: Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

Module-4


Module-5

Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.

Course Outcomes: On completion of this course, students will be able to,
- CO1: Have constitutional knowledge and legal literacy.
- CO2: Understand Engineering and Professional ethics and responsibilities of Engineers.
- CO3: Understand the cybercrimes and cyber laws for cyber safety measures.

Question paper pattern for SEE and CIE:
- The SEE question paper will be set for 100 marks and the marks scored by the students will proportionately be reduced to 60. The pattern of the question paper will be objective type (MCQ).
- For the award of 40 CIE marks, refer the University regulations 2018.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<tbody>
<tr>
<td>1</td>
<td>Constitution of India, Professional Ethics and Human Rights</td>
<td>Shubham Singles, Charles E. Haries, and et al</td>
<td>Cengage Learning India</td>
<td>2018</td>
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<tr>
<td>2</td>
<td>Cyber Security and Cyber Laws</td>
<td>Alfred Basta and et al</td>
<td>Cengage Learning India</td>
<td>2018</td>
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<tr>
<td>4</td>
<td>Engineering Ethics</td>
<td>M. Govindarajan, S. Natarajan, V. S. Senthilkumar</td>
<td>Prentice – Hall,</td>
<td>2004</td>
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</tbody>
</table>
B. E. Common to all Programmes
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III
ADDITIONAL MATHEMATICS – I
(Mandatory Learning Course: Common to All Programmes)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech. programmes)

Course Code: 18MATDIP31
CIE Marks: 40
SEE Marks: 60
Credits: 0
Exam Hours: 03

Course Learning Objectives:
- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE’s.

Module-1
Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand’s diagram, De-Moivre’s theorem (without proof).

Module-2

Module-3

Module-4
Integral Calculus: Review of elementary integral calculus. Statement of reduction formulae for $\sin^n x, \cos^n x$, and $\sin^n x \times \cos^n x$ and evaluation of these with standard limits-Examples. Double and triple integrals, problems.

Module-5

Course Outcomes: At the end of the course the student will be able to:
- CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions. CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first order ordinary differential equations.

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.

<table>
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<tr>
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</tr>
</thead>
</table>
Course Learning Objectives:

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

Module-1

Construction of analytic functions: Milne-Thomson method-Problems.

Module-2
Conformal transformations: Introduction. Discussion of transformations: \(w = z^2, w = e^z, w = z + \frac{1}{z}, (z \neq 0)\). Bilinear transformations- Problems.

Complex integration: Line integral of a complex function-Cauchy’s theorem and Cauchy’s integral formula and problems.

Module-3
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

Module-4

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form-

\[ y = ax + b, y = ax^b \] and

\[ y = ax^2 + bx + c. \]

Module-5
Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student’s t-distribution, Chi-square distribution as a test of goodness of fit.

Course Outcomes: At the end of the course the student will be able to:

- Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.

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<td>Textbooks</td>
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<p>| Reference Books |</p>
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<th></th>
<th>Title</th>
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<th>Publisher</th>
<th>Edition</th>
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</table>

**Web links and Video Lectures:**
1. [http://nptel.ac.in/courses.php?disciplineID=111](http://nptel.ac.in/courses.php?disciplineID=111)
2. [http://www.class-central.com/subject/math(MOOCs)](http://www.class-central.com/subject/math(MOOCs))
4. [VTU EDUSAT PROGRAMME - 20](http://vtucourses.nic.in/VTU_EDUSAT_Prog)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - IV

18IP42 COMPUTER AIDED MACHINE DRAWING

Course Code 18IP42  CIE Marks 40
Teaching Hours/Week (L:T:P) (2:0:4)  SEE Marks 60
Credits 04  Exam Hours 03

Course Learning Objectives: To
• Use tools of drafting and modeling software
• Draw the sections of solids, orthographic views of simple machine parts using software
• Sketch and explain various thread forms and their application.
• Calculate parameters related to riveted joints and sketch them.
• Create solid models and draw the sectional views of automotive systems.

PART-A

Module-1


Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections.

Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.

Module-2


Fasteners: Hexagonal headed bolt and nut with washer (assembly), square-headed bolt and nut with washer (assembly). Types of Bolt heads, special types of nuts, locking of nuts, Studs, set screws, grub screws.

PART-B

Module-3

Keys, cotter and knuckle joints: Types of Keys, Cotter and knuckle Joints

Riveted Joints: lap joints- single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets).

Module-4

Couplings: Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)

PART-C

Module-5

Assembly drawing of following machine parts (3D parts to be created and assembled and then getting 2D drawing with required views, along with 3D part drawings).

1. Plummer block (Pedestal Bearing)
2. Screw jack (Bottle type)
3. Machine vice
4. Tool Post (Square Shape) of a Lathe

Course Outcomes: At the end of the course the student will be able to:
• Use tools of drafting and modeling software
• Draw the sections of solids, orthographic views of simple machine parts using software
• Sketch and explain various thread forms and their application.
• Calculate parameters related to riveted joints and sketch them.
• Prepare assembly drawing from the list of components.
• Create solid models and draw the sectional views of automotive systems.

• Internal assessment (CIE): 40 Marks
All the sheets should be drawn in the class using software. Sheet sizes should be A3/A4. All sheets must be submitted at the end of the class by taking printouts.

• Scheme of Examination (SEE): Two questions each are to be set from Parts A, B, and C. Student has to answer one question from each Part. Marks Allotment shall be as follows:
  PART-A: 1x20 = 20Marks; PART-B: 1x30 = 30Marks; PART-C: 1x50 = 50 Marks; Total = 100 Marks
<table>
<thead>
<tr>
<th>Textbook/s</th>
<th>Reference Books</th>
</tr>
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<tbody>
<tr>
<td><strong>2</strong></td>
<td>A Primer on Computer Aided Machine Drawing</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>Machine Drawing with Auto CAD</td>
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</tbody>
</table>
### Course Learning Objectives:
- Define and explain the basic terms such as kinematic chain, kinematic pair, degree of freedom etc. associated with kinematics of machinery, inversions of four bar mechanism, single slider crank mechanism and double slider crank mechanism.
- Determine the mobility of given mechanisms.
- Determine the velocity and acceleration of links using graphical as well as analytical methods.
- Plot cam profiles using displacement diagram for various types of motions.
- Define gear terminology and determine the velocity ratio in different gear trains.

### Module-1
**Introduction:** Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversion, Machine. Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

### Module-2
**Mechanisms:** Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. Toggle

### Module-3
**Velocity and acceleration analysis of mechanisms:** Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons: Relative velocity and acceleration of particles .in a common link, relative velocity and accelerations of coincident Particles on separate links- Coriolis component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

### Module-4

### Module-5
**Cams:** Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-face follower. Disc cam with oscillating roller follower. Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

### Course Outcomes
At the end of the course the student will be able to:
- Define and explain the basic terms such as kinematic chain, kinematic pair, degree of freedom etc. associated with kinematics of machinery, inversions of four bar mechanism, single slider crank mechanism and double slider crank mechanism.
- Determine the mobility of given mechanisms.
- Determine the velocity and acceleration of links using graphical an analytical methods.
- Plot cam profiles using displacement diagram for various types of motions.
- Define gear terminology and determine the velocity ratio in different gear trains.

### Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
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**Reference Books**

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<tr>
<td>4</td>
<td>Mechanism and Machine theory</td>
<td>Ambakar,</td>
<td>PHI</td>
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Course Code: 18IP44

Teaching Hours/Week (L:T:P): (2:2:0)

Credits: 03

Exam Hours: 03

Course Learning Objectives:

• Explain the nomenclature of single point cutting tool, mechanics of chip formation, tool failure criteria and to solve problems on evaluation of tool life
• Construction and working of various systems in a Lathe, Shaper, Planeing and Drilling machine
• Classify grinding and milling machines and explain their construction
• Explain the principles of broaching
• Select non-traditional machining process for given application

Module-1
Classification of metal removal process and machines: Concept of orthogonal and oblique cutting Geometry of single point cutting tool and tool angles, tool nomenclature.
Mechanism of Chip Formation: Type of chips. Mechanics of metal cutting, Merchants circle diagram and analysis, Ernst Merchant’s solution, shear angle relationship, Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor’s Tool Life equation

Module-2

Turning (Lathe), Shaping Machines: Classification, constructional features of Turret and Capstan Lathe. Tool Layout, shapingMachine. Different operations on lathe, shaping machine

Module-3
Drilling machines: drilling & related operations, Classification of drilling machine, constructional features and working principle of Radial, multi spindle, Gang, Deep hole and automatic drilling machine. Types of drill & drill bit nomenclature.

Milling machines: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations.

Indexing: Simple, compound, differential and angular indexing calculations. Simple problems on simple and compound indexing

Module-4
Grinding machines: Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding machines (Center less, cylindrical and surface grinding).


Module-5
Finishing and other Processes: Lapping and Honing operations Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

Non-traditional machining processes: Need for non-traditional machining. Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.

Course Outcomes: At the end of the course the student will be able to:

• Explain the nomenclature of single point cutting tool, mechanics of chip formation, tool failure criteria and to solve problems on evaluation of tool life
• Construction and working of various systems in a Lathe, Shaper, Planeing and Drilling machine
• Classify grinding and milling machines and explain their construction
• Explain the principles of broaching
• Select non-traditional machining process for given application

Question paper pattern:

• The question paper will have ten full questions carrying equal marks.
• Each full question will be for 20 marks.
• There will be two full questions (with a maximum of four sub- questions) from each module.
• Each full question will have sub- question covering all the topics under a module.
• The students will have to answer five full questions, selecting one full question from each module.
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<tr>
<td>2</td>
<td>Production Technology</td>
<td>R. K. Jain</td>
<td>Khanna Publications</td>
<td>2003</td>
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<td><strong>Reference Books</strong></td>
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<tr>
<td>3</td>
<td>Manufacturing Science</td>
<td>Amitabh Ghosh and Mallik</td>
<td>affiliated East West Press</td>
<td>2003</td>
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<td>Production Technology</td>
<td>HMT</td>
<td>Tata MacGraw Hill</td>
<td>2001</td>
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</table>
### Course Learning Objectives:

- The foundation for understanding the structure and behavior of materials common in mechanical engineering.
- Topics to explore the mechanical properties of metals and their alloys, polymers, ceramics, smart materials and composites.
- To understand modifications of material properties by heat treatment processes.
- Selections of different materials for various applications are highlighted.
- Impart knowledge of various failure modes of materials.

### Module-1

**Crystal Structure**
Unit Cells, Crystal systems, BCC, FCC, and HCP structures, Coordination number and atomic packing factors.

**Crystal Imperfection**
Point, line and surface imperfections.

**Atomic Diffusion**
- Fick's laws of diffusion, Factors affecting Diffusion, Steady and non-steady state diffusions.

### Module-2

**Dislocation**
Characteristics of dislocations, slip systems, slip in single crystals, Plastic deformation of polycrystalline materials, Deformation by twinning.

**Fracture**
Types of fracture, ductile and brittle fracture, Ductile to brittle transition temperature.

**Fatigue and creep**
Cyclic stresses, SN curves, crack initiation and propagation, Factors.

### Module-3

**Phase Diagrams**
Solid solutions, Hume Rothary rules-substitutional, and interstitial solid solutions, Intermediate phases, Gibbs phase rule, Construction of equilibrium diagrams, lever rule Iron carbon equilibrium diagram Description of phases, Solidification of steels and cast irons, Invariant reactions, TTT curves, Continuous cooling curves.

### Module-4

**Heat Treatment of Metals**
Annealing and its types, normalizing, Hardening, tempering, Martempering, Austempering, Hardenability, surface hardening methods like carburizing, cyaniding, Nitriding, Flame hardening and induction hardening.

**Recrystallization and Grain Growth**
Recrystallization temperature, Annealing temperature v/s cold-worked and recovered grains, Direction of grain boundary motion, time v/s grain diameter.

### Module-5

**Steels and cast irons**
Ferrous alloys, steels – low medium and high carbon, AISI designation steels, Cast irons – types and properties.

**Composites and ceramics**

### Course Outcomes:

- Understand the mechanical properties of metals and their alloys.
- Analyze the various modes of failure and understand the microstructures of ferrous and nonferrous materials.
- Describe the processes of heat treatment of various alloys.
- Acquire the Knowledge of composite materials and their production process as well as applications.
- Understand the properties and potentialities of various materials available and material selection procedures.
Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Sl. No</th>
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<th>Name of the Author/s</th>
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Reference Books

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</table>
B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - IV

CAD/CAM

Course Code  18IP46  CIE Marks  40
Teaching Hours/Week (L:T:P)  (2:2:0)  SEE Marks  60
Credits  03  Exam Hours  03

Course Learning Objectives:
• know the fundamentals of CAD
• Information regarding various CAD hardware
• Understand the fundamentals of CAM
• Programming concepts in CNC
• Robotics and their applications

Module-1
INTRODUCTION: Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment. Introduction to CAD, Introduction to CAM. Advantages and disadvantages of CAD and CAM.

HARDWARE IN CAD: Basic Hardware structure, working principles, usage and types of hardware for CAD - input and output Devices, memory, CPU, hardcopy and Storage devices.

Module-2
COMPUTER GRAPHICS: Software configuration of a graphic system, function of a Graphics package, construction of geometry, wire frame and solid modelling, CAD/CAM integration. Describe modelling facilities. Introduction to exchange of modeling data – Basic features of IGES, STEP, DXF, DMIS.

NC, CNC, DNC TECHNOLOGY: NC, CNC, DNC modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC.

Module-3
CNC TOOLING: Turning tools geometry, milling tooling systems, tool presetting, ATC work holding.
CAM PROGRAMMING: Overview of different CNC machining centers, CNC turning centers, high speed machine tools, MCE.

Module-4

Module-5

Course Outcomes: At the end of the course the student will be able to:
• Understand the concepts of CAD and the required hardware
• Understand CAM and CNC machines
• Program CNC machines
• Understand and program the robot

Question paper pattern:
• The question paper will have ten full questions carrying equal marks.
• Each full question will be for 20 marks.
• There will be two full questions (with a maximum of four sub-questions) from each module.
• Each full question will have sub-question covering all the topics under a module.
• The students will have to answer five full questions, selecting one full question from each module.

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<th>Edition and Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAD / CAM Principles and</td>
<td>P.N.Rao</td>
<td>TMH, New Delhi</td>
<td>2002</td>
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<tr>
<td>2</td>
<td>CAD/CAM</td>
<td>Mikelli P-groover, Emory W. Zimnners</td>
<td>Jr Pearson Education inc</td>
<td>2003</td>
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<td>3</td>
<td>CAD-CAM</td>
<td>Chris McMahon &amp; Jemaine Browne</td>
<td>Pearson education Asia</td>
<td>2001</td>
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B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - IV
MACHINE SHOP

<table>
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<tr>
<th>Course Code</th>
<th>18IPL47</th>
<th>CIE Marks</th>
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<td>Teaching Hours/Week (L:T:P)</td>
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<tr>
<td>Credits</td>
<td>02</td>
<td>Exam Hours</td>
<td>03</td>
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</table>

Course Learning Objectives:
- To provide an insight to different machine tools, accessories and attachments.
- To train students into fitting machining operations to enrich their practical skills.
- To inculcate team qualities and expose students to shop floor activities.
- To educate students about ethical, environmental and safety standards.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Experiments</th>
</tr>
</thead>
</table>
| 1 | PART – A
Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning. |
| 2 | PART – B
Cutting of V Groove/ dovetail / Rectangular groove using a shaper.
Cutting of Gear Teeth using Milling Machine. |

Course Outcomes: At the end of the course the student will be able to:
- Understand integral parts of lathe, shaping and milling machines and various accessories and attachments used thereof.
- Select cutting parameters like cutting speed, feed, depth of cut, and tooling for various machining operations.
- Perform cylindrical turning operations such as plain turning, taper turning, step turning, thread Cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time.
- Perform machining operations such as plain shaping, inclined shaping, keyway cutting, Indexing and Gear cutting and estimate cutting time.

Conduct of Practical Examination:
1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Scheme of Examination: (Model: 80 Marks; Viva-voce: 20 Marks; Total: 100 Marks)
# Course Learning Objectives:
- To learn the concept of the preparation of samples to perform characterization such as microstructure, volume fraction of phases and grain size.
- To understand mechanical behavior of various engineering materials by conducting standard tests.
- To learn material failure modes and the different loads causing failure.
- To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Experiments</th>
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<tbody>
<tr>
<td>Part-A</td>
<td></td>
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<tr>
<td>2</td>
<td>Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of Heat treated samples</td>
</tr>
<tr>
<td>3</td>
<td>To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.</td>
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<tr>
<td>4</td>
<td>Non-destructive test experiments like, (a). Ultrasonic Flaw detection (b).Magnetic crack detection (c). Dye- Penetration testing. To study the defects of Cast and Welded specimens</td>
</tr>
<tr>
<td>Part-B</td>
<td></td>
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<tr>
<td>5</td>
<td>Tensile, shear and compression tests of metallic and non metallic specimens using Universal Testing Machine</td>
</tr>
<tr>
<td>6</td>
<td>Torsion Test</td>
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<tr>
<td>7</td>
<td>Bending Test on metallic and nonmetallic specimens</td>
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<tr>
<td>8</td>
<td>Izod and Charpy Tests on M.S.C.I Specimen</td>
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<tr>
<td>9</td>
<td>Brinell, Rockwell and Vickers's Hardness test.</td>
</tr>
<tr>
<td>10</td>
<td>Fatigue Test (Demonstration only)</td>
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</tbody>
</table>

Course Outcomes: At the end of the course the student will be able to:
- Acquire experimentation skills in the field of material testing.
- Develop theoretical understanding of the mechanical properties of materials by performing experiments.
- Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
- Apply the knowledge of testing methods in related areas.
- Understand how to improve structure/behavior of materials for various industrial applications.

Conduct of Practical Examination:
1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
5. Scheme of Examination:
   ONE question from part -A: 30 Marks; ONE question from part -B: 50 Marks; Viva –Voice: 20 Marks; Total: 100 Marks.
B. E. COMMON TO ALL PROGRAMMES
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - IV

ADDITIONAL MATHEMATICS – II
(Mandatory Learning Course: Common to All Branches)

(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech programmes)

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<td>Exam Hours</td>
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**Course Learning Objectives:**

- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.
- To provide an insight into elementary probability theory and numerical methods.

**Module-1**


**Module-2**

**Numerical Methods:** Finite differences. Interpolation/extrapolation using Newton’s forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson’s one third rule and Weddle’s rule (without proof) Problems.

**Module-3**

**Higher order ODE’s:** Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators.[Particular Integral restricted to $R(x) = e^{\alpha x} \frac{\sin \alpha x}{\cos \alpha x}, x^n$ for $f(D)y = R(x)$.

**Module-4**

**Partial Differential Equations (PDE’s):** Formation of PDE’s by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

**Module-5**

**Probability:** Introduction. Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes’s theorem, problems.

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

- Solve systems of linear equations using matrix algebra.
- Apply the knowledge of numerical methods in modelling and solving of engineering problems.
- Apply the knowledge of numerical methods in modelling and solving of engineering problems.
- Classify partial differential equations and solve them by exact methods.
- Apply elementary probability theory and solve related problems.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.

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<td><strong>Textbook</strong></td>
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B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - V

MANAGEMENT AND ENTREPRENEURSHIP

Course Code: 18IP51
CIE Marks: 40
Teaching Hours/Week (L:T:P): (2:2:0)
SEE Marks: 60
Credits: 03
Exam Hours: 03

Course Learning Objectives:
- Understand the basic concepts of management, planning, organizing and staffing.
- Acquire the knowledge to become entrepreneur.
- Comprehend the requirements towards the small-scale industries and project preparation.

Module-1
PLANNING: Nature, importance and purpose of planning process Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans

Module-2
DIRECTING & CONTROLLING: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control.

Module-3
ENTREPRENEUR: Meaning of Entrepreneur; Evolution of .the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development t; Entrepreneurship in India; Entrepreneurship – its Barriers.

Module-4
SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry

Module-5
INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SIS; NSIC; SIDBI; KSFC.
PREPARATION OF PROJECT: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; ProjectAppraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Course Outcomes: At the end of the course the student will be able to:
- Explain about the management and planning.
- Apply the knowledge on planning, organizing, staffing, directing and controlling.
- Describe the requirements towards the small-scale industries and project preparation.

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<td>1</td>
<td>Principles of Management</td>
<td>P. C.Tripathi, P.N. Reddy</td>
<td>Tata McGraw Hill,</td>
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<td>2</td>
<td>Dynamics of Entrepreneurial Development &amp; Management</td>
<td>Vasant Desai</td>
<td>Publishing House</td>
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<td>3</td>
<td>Entrepreneurship Development</td>
<td>Poornima. M. Charantimath</td>
<td>Small Business Enterprises - Pearson</td>
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<td>2006 (2 &amp; 4)</td>
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<td>4</td>
<td>Management Fundamentals- Concepts, Application, Skill</td>
<td>RobersLusier - Thomson</td>
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<td>5</td>
<td>Entrepreneurship Development</td>
<td>S.S.Khanka</td>
<td>S.Chand&amp; Co</td>
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<td>6</td>
<td>Management</td>
<td>Stephen Robbins</td>
<td>Pearson Education/PHI</td>
<td>2003</td>
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</tbody>
</table>
### Course Learning Objectives:

**Module-1**

**DESIGN FOR STATIC STRENGTH:** Design considerations; Codes and Standards, static loads and factor of safety. Theories of failure: Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion energy theory. Failure of Brittle and Ductile materials. Stress concentration. Determination of stress concentration factor.

**Module-2**

**DESIGN FOR FATIGUE STRENGTH:** S – N Diagram, low cycle and High cycle fatigue. Endurance limit. Modifying factors: Load, Size and Surface finish effects. Fatigue stress concentration factor. Fluctuating stresses. Goodman and Soderberg Relationship. Stresses due combined loading. Cumulative fatigue damage

**Module-3**

**DESIGN OF SHAFTS:** Design of shafts subjected to torsion, bending moment and combined torsion moment and axial loading. ASME and BIS Codes for design of transmission shafting. Design for strength and rigidity. Shafts under fluctuating loads and combined loads.

**Module-4**

**DESIGN OF GEARS:** Introduction to Spur, Helical and Bevel Gears. Design of Spur gear, Lewis equation, form factor, stresses in gear tooth, Dynamic load and wear load.

**Module-5**

**RIVETED JOINTS AND WELDED JOINTS:** Types of riveted joints, failures of riveted joints, Boiler joint, Efficiency. Types of welded joints, Strength of butt and fillet welds, eccentrically loaded welds.

**DESIGN OF SPRINGS:** Types of springs, Stresses in Coil springs of circular and non-circular cross-sections. Tension and compression springs. Stresses in Leaf springs.

### Course Outcomes:

- After completing the course a student
  1. able to understand various forces acting on a body
  2. will be able to design shafts, gears, springs
  3. will be able to design various kind of joints
  4. will be able to put together all the above and design a complex machine

### Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<tr>
<td>2</td>
<td>Machine Design</td>
<td>VL. Maleev and Hartman</td>
<td>CBS Publishers and Distributors Delhi -</td>
<td>1983</td>
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</table>
**Course Code**: 18IP53  
**CIE Marks**: 40  
**SEE Marks**: 60  
**Credits**: 04  
**Exam Hours**: 03

**Course Learning Objectives:**
- To understand the fundamentals of Quality tools and techniques
- To apply the quality and reliability tools and techniques to real world problems
- To Interpret the results of quality and reliability study for decision making

**Module-1**
**Introduction**: Definition of Quality, Quality function, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs. Brief discussion on sporadic and chronic quality problems.
**Quality Assurance**: Definition and concept of quality assurance, departmental assurance activities. Quality audit concept, audit approach etc. Structuring the audit program, planning and performing audit activities, audit reporting, ingredients of a quality program.

**Module-2**
**Statistical Process Control**: Introduction to statistical process control – chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Case Studies on application of SPC. Process capability – Basic definition, standardized formula.
**Control Charts for Attributes**: Controls chart for defectives (‘p’ and ‘np’ charts) and defects (‘c’ and ‘u’)

**Module-3**
**Control Charts for Variables**: Controls charts for X bar and Range, statistical basis of the charts, development and use of X bar and R charts, interpretation of charts. Control charts for X bar and standard deviation (S), development and use of X bar and S chart. Brief discussion on – Pre control Xbar and S control charts with variable sample size, control charts for individual measurements, cusum chart, moving-range charts

**Module-4**
**Sampling Inspection**: Concept of accepting sampling, economics of inspection. Acceptance plans – single, double and multiple sampling. Operating characteristic curves – construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans

**Module-5**
**Statistical Theory of Tolerances**: Application of statistical theory of tolerances to design of tolerances in random assemblies and application in other areas.
**Reliability and Life Testing**: Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations

**Course Outcomes**: At the end of the course the student will be able to:
- Understand the fundamentals of Quality tools and techniques
- Apply the quality and reliability tools and techniques to real world problems
- Interpret the results of quality and reliability study for decision making

**Question paper pattern:**
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<tbody>
<tr>
<td>1</td>
<td>Introduction to statistical Quality Control</td>
<td>D C Montgomery</td>
<td>John Wiley and Sons</td>
<td>3rd Edition</td>
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<td>Statistical Quality Control</td>
<td>Grant and Leavenworth,</td>
<td>McGraw Hill</td>
<td>6th</td>
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<tr>
<td>6</td>
<td>ISO 9000 a Manual for Total Quality</td>
<td>Suresh Dalela and Saurabh</td>
<td>S. Chand and Co.</td>
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<td>Management</td>
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B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - V
HYDRAULICS AND PNEUMATICS

Course Code 18IP54  CIE Marks 40
Teaching Hours/Week (L:T:P) (2:2:0)  SEE Marks 60
Credits 03  Exam Hours 03

Course Learning Objectives:
• To Study the fundamentals of Hydraulic Power Pumps, Actuators and Motors.
• To develop a sound knowledge of control components in Hydraulic Systems.
• To have basic skills to design Hydraulic Circuits and analyze them.
• To acquire the fundamental knowledge on pneumatic control.
• To develop skill sets to handle Pneumatic Actuators, Valves, Pneumatic circuits and logic circuits

Module-1
Introduction to Hydraulic Power and Pumps: review of fluid mechanics, Pascal’s Law, structure of hydraulic control system, pumps: pumping theory, pump classification, gear pumps- external and internal type, vane pumps- simple, balanced, pressure compensated types, piston pumps- radial and axial (both swash plate and bent axis type), pump performance.

Hydraulic Actuators and Motors: Linear hydraulic actuators - single acting, double acting, tandem cylinder, telescopic rod cylinder, mechanics of hydraulic cylinder loading, cylinder cushioning, hydraulic rotary actuators,

Module-2
Control Components in Hydraulic Systems: directional control valves (DCV), constructional features, 2/2, 3/2, 4/3 DCV, center configuration in 4/3 DCV- open, closed, tandem, regenerative, floating centre configuration, actuation of DCVs- manual, mechanical, solenoid, and indirect actuation, relays for the solenoid operation, check valve, pilot check valve, pressure control valves – direct and pilot operated types, pressure reducing valve, flow control valves - fixed throttle, and variable throttle, throttle check valve, pressure

Module-3
Hydraulic Circuit Design and Analysis: control of single and double acting hydraulic cylinder, regenerative circuit, counter balance valve application, cylinder sequencing circuits, cylinder synchronizing circuits, speed control of hydraulic cylinder – meter in and meter out, speed control of hydraulic motors, relay circuit design for the operation of solenoid directional control valve- single and double solenoid relay circuit

Module-4
Introduction To Pneumatic Control: choice of working medium, characteristics of compressed air, structure of pneumatic control system, supply, signal generators, signal processor, final control elements, actuators, production of compressed air – compressors - reciprocating and rotary type, preparation of compressed air – driers, filters, regulators,

Module-5
Pneumatic Actuators, Valves: linear cylinder – types, conventional type of cylinder – working, directional control valve, shuttle valve, quick exhaust value, twin pressure valve, direct and indirect actuation of pneumatic cylinder, memory valve, time delay valve.
Pneumatic circuits and logic circuits: supply air and exhaust air throttling, will dependent circuits, travel dependent controls – types – construction – practical applications, cylinder sequencing circuits, travel step diagrams, practical examples involving two or three cylinders, use of logic functions – OR, AND, NOR, NAND, YES, NOT functions in pneumatic applications, practical examples involving the use of logic functions

Course Outcomes: At the end of the course the student will be able to:
• Recall the basic concept of fluid mechanics; identify different components of hydraulic system
• Analyze the requirement of control components and their selection

Question paper pattern:
• The question paper will have ten full questions carrying equal marks.
• Each full question will be for 20 marks.
• There will be two full questions (with a maximum of four sub-questions) from each module.
• Each full question will have sub-question covering all the topics under a module.
• The students will have to answer five full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
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<th>Edition and Year</th>
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<tbody>
<tr>
<td>1</td>
<td>Fluid Power with applications</td>
<td>Anthony Esposito</td>
<td>Pearson edition</td>
<td>2000</td>
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<tr>
<td>2</td>
<td>Oil Hydraulics</td>
<td>Majumdar S.R.,</td>
<td>TataMcGRawHill,</td>
<td>2002</td>
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<td>Reference Books</td>
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<tr>
<td>3</td>
<td>Pneumatic systems- “Principles and Maintenance” Majumdar S.R ata McGraw-Hill, New Delhi 2005</td>
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<tr>
<td>4</td>
<td>Hydraulics and pneumatics Andrew Par Jaico Publishing House 2005</td>
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<tr>
<td>6</td>
<td>Hydraulic Control Systems Herbert E. Merritt John Wiley and Sons, Inc</td>
<td></td>
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</tbody>
</table>
# Course Code 18IP55
## CIE Marks 40
## SEE Marks 60
## Credits 03
## Exam Hours 03

### Course Learning Objectives:
- To develop concepts related to principles of productivity & work study as a tool for increasing the efficiency and effectiveness in organizational systems.
- To study the existing method, compare and propose a new method.
- To provide the usage of the various tools and techniques used in work measurement.
- To develop basic ideas of ergonomics and its design.
- To develop concepts related Man-Machine Interfaces and Design of Displays and controls

### Module-1
#### Productivity and Work Study:
Definition of productivity, task of management, productivity of materials, land, building, machine and power, factors affecting the productivity, work content, basic work content, excess work content, how manufacturing job is made up, work content due to excess product and process, ineffective time due to short comings on part of the management.

#### Definition, Objective and scope of Work Study:
Work study and management, work study and worker

### Module-2
#### Method Study:
Definition, objective and scope of method study, activity recording and tools,

**Recording tools:**
- Out Line Process Chart
- Flow Process Chart
- Flow diagram
- String Diagram
- Travel Chart
- Multiple Activity Chart
- Two- Handed process chart

#### Principles of Motion Economy:
Introduction, Classification of movements. Two- hand process chart, Micro motion study, Therbligs, SIMO Chart. Special Charts: Cyclegraph and Chronocycle graph - development, definition and installation of the improved method.

#### Work Measurement:
Definition, objectives, and work measurement techniques.

#### Work sampling
- Need, confidence levels, and sample size determination, conducting study with problems

### Module-3
#### Time study
Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information.

#### Rating
Systems of rating, standard rating, standard performance, scales of rating.

#### Allowances
Standard time determination, predetermined motion time study (PMTS), factors affecting rate of working, problems on allowances.

### Module-4
#### Introduction to Ergonomics:
Human factors and ergonomics, psychology, engineering, bio mechanics, industrial design, graphics design, statistics, operation research and anthropometry Morphology of design and its relationship with cognitive abilities of human being.

#### Physical Ergonomics:
human anatomy, and some of the anthropometric, physiological and bio mechanical characteristics as they relate to physical activity. Cognitive: mental processes, such as perception, memory, reasoning, and motor response, mental workload, and decision-making. Organizational ergonomics: optimization of socio-technical systems, including their organizational structures, policies, processes. Communication, work design, design of working times, teamwork, cooperative work, and new work programs. Environmental ergonomics: human interaction with the environment- characterized by climate, temperature, pressure, vibration, light.

### Module-5
#### Man-Machine Interaction:
Man-Machine interaction cycle, Man-machine interfaces, Displays : factors that control choice of display, visual displays qualitative displays; moving pointer displays, moving scale displays, digital displays Indicators, auditory displays, tactile displays. Factors affecting effectiveness of displays. Quantitative displays, check- reading displays, representational displays. Types of controls and their integration with displays.

#### Design guidelines for displays and controls:
viewing distance, Illumination, angle of view, reach etc., general design checklist for displays and controls. Standards for ergonomics in engineering and design, displays and controls.

### Course Outcomes:
At the end of the course the student will be able to:
- Recollect the basic concepts of productivity, work content and work study and define the objective and scope of Work Study.
- Define the various charts and to construct the charts on the basis of present method and develop a new / proposed method and identify the unnecessary movements.
- Explain the basic work measurement techniques and to gain knowledge of measurement of work, rating and imbibe the concept of allowance in estimating Standard Time.
• Determine the basic concepts of Ergonomics and demonstrate a sound knowledge of Ergonomics in engineering applications.
• Demonstrate a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems

Question paper pattern:
• The question paper will have ten full questions carrying equal marks.
• Each full question will be for 20 marks.
• There will be two full questions (with a maximum of four sub-questions) from each module.
• Each full question will have sub-question covering all the topics under a module.
• The students will have to answer five full questions, selecting one full question from each module.

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<tr>
<td>1</td>
<td>Introduction to Work Study</td>
<td>ILO,</td>
<td></td>
<td>4th edition 1992</td>
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<td></td>
<td>Textbook/s</td>
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<tr>
<td>3</td>
<td>Work Study and Ergonomics</td>
<td>S. Dalela and Sourabh</td>
<td>Standard publishers</td>
<td>2013</td>
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<tr>
<td>5</td>
<td>Motion and Time Study</td>
<td>Ralph M. Barnes</td>
<td>Wiley International</td>
<td>7th Edition.</td>
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<td>3</td>
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</table>
Course Learning Objectives:

Module-1
Introduction to composite materials
Definition, classification and characteristics of composite materials: Fibrous, laminate, particulate, flake composites. Properties and types of reinforcement and matrix materials. Fibre reinforced plastic processing: basic steps in manufacturing of a composite, impregnation, lay-up, consolidation and solidification. Open and closed mould process, hand lay-up techniques, structural laminate vacuum bag and autoclave processing, filament winding, pultrusion, pulforming, thermo-forming, injection molding, resin transfer molding.

Module-2
Fabrication of composites

Module-3
Structural application of composites

Module-4
Study properties of MMC’s
Physical Mechanical, wear, machinability and other properties. Effect of size, shape and distribution of particulate on properties. Advanced composites such as Polymer based Sandwich structures. Introduction to shape memory alloys.

Module-5
Study of composite materials from natural resources

Course Outcomes:
At the end of the course the student will be able to:
- Understand the composite materials
- Find properties of composite materials and its impact
- Will be able to fabricate composite material

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<td>1</td>
<td>Composite Science and Engineering</td>
<td>K.K. Chawla</td>
<td>Springer Verlag</td>
<td>1998</td>
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<td></td>
<td>Title</td>
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<td>5</td>
<td>Forming Metal hand book</td>
<td></td>
<td>ASM handbook</td>
<td>1988</td>
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<td>6</td>
<td>Mechanics of composites</td>
<td>Autar K kaw</td>
<td>CRC Press</td>
<td>2002</td>
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<tr>
<td>Course Code</td>
<td>18IPL57</td>
<td>CIE Marks</td>
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<td>Teaching Hours/Week (L:T:P)</td>
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<td>SEE Marks</td>
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<td>Credits</td>
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<td>Exam Hours</td>
<td>03</td>
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<thead>
<tr>
<th>Sl. No</th>
<th>Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART-A (FLUID POWER LAB)</td>
<td></td>
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</tbody>
</table>
| 1 | a) Study of components of Hydraulic circuit.  
b) Study of symbols for components in hydraulic circuits |
| 2 | Testing of Pump |
| 3 | Testing of Flow Control Valve |
| 4 | Speed control of Piston in Forward and Return stroke with Meter in Meter out circuit |
| 5 | Study of Regenerative circuit and study of Bleed of circuit |
| 6 | Study of Variation of Flow with pressure and with throttle |
| 7 | Building of Circuits using different kinds of Valves |
| PART-B (MECHANICAL ENGINEERING LAB) (At least Four experiments) |
| 8 | Determination of viscosity of lubricating oil using Redwoods and Saybolt – Viscometers |
| 9 | Flash and Fire point of given oil |
| 10 | Performance Tests on Four stroke Petrol and Diesel Engines, Calculations of IP, BP, thermal efficiencies, SFC, FP and heat balance sheet |
| 11 | Multi cylinder petrol / diesel engine (Morse test). |
| 12 | Performance test on Centrifugal or Reciprocating pumps |
| 13 | Study of flow through pipes for fluid transport |

**Course Outcomes:** At the end of the course the student will be able to:
- Understand the properties of a fluid.
- Will be able to handle and design complex hydraulic circuits
- Understand the various parameters affecting a engine

**Conduct of Practical Examination:**
1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
5. Scheme of Examination: experiments from Parts A and B = 80 Marks; Viva-voce =20 Marks
## WORK STUDY AND ERGONOMICS LAB

<table>
<thead>
<tr>
<th>Sl. No</th>
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<tbody>
<tr>
<td></td>
<td>PART – A (METHOD STUDY)</td>
</tr>
<tr>
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<td>Recording Techniques: Preparing the following charts and diagrams (Minimum 3 Charts)</td>
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<tr>
<td></td>
<td>Outline process chart</td>
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<td>Multiple Activity Chart</td>
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<td></td>
<td>Flow process chart and Flow diagram</td>
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<td>String diagram,</td>
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<td>PART – B (WORK MEASUREMENT)</td>
</tr>
<tr>
<td>1</td>
<td>Rating practice using: walking simulator, pin board assembly, dealing a deck of cards and marble collection activity</td>
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<tr>
<td>2</td>
<td>Determining the standard time for simple operations using stopwatch time study</td>
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<tr>
<td>3</td>
<td>Exercises on estimating standard time using PMTS</td>
</tr>
<tr>
<td>4</td>
<td>Determination of standard time using PDA device and time study software</td>
</tr>
<tr>
<td>5</td>
<td>Measurement of parameters (heart beat rate, calorie consumption) using walking simulator</td>
</tr>
<tr>
<td>6</td>
<td>Measurement of parameters (heart beat rate, calorie consumption, revolutions per minute) using ergometer</td>
</tr>
<tr>
<td>7</td>
<td>Effect of Noise, Light, Heat on human efficiency in work environments.</td>
</tr>
</tbody>
</table>

**Course Outcomes:** Course Outcomes Missing

**Conduct of Practical Examination:**
1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
5. Scheme of Examination: experiments from Parts A and B = 80 Marks; Viva-voce =20 Marks
B. E. COMMON TO ALL PROGRAMMES
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – V

ENVIRONMENTAL STUDIES

Course Code 18CIV59  CIE Marks 40
Teaching Hours / Week (L:T:P) (1:0:0)  SEE Marks 60
Credits 01  Exam Hours 02

Module - 1

Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Module - 2

Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Module - 3

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module - 4

Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module - 5


Field work: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

Course Outcomes: At the end of the course, students will be able to:
• CO1: Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
• CO2: Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
• CO3: Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
• CO4: Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Question paper pattern:
• The Question paper will have 100 objective questions.
• Each question will be for 01 marks
• Student will have to answer all the questions in an OMR Sheet.
• The Duration of Exam will be 2 hours.

<table>
<thead>
<tr>
<th>Sl. No.</th>
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<tr>
<td>2</td>
<td>Environmental Studies</td>
<td>S M Prakash</td>
<td>Pristine Publishing House, Mangalore</td>
<td>3rd Edition 2018</td>
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<td>3</td>
<td>Environmental Studies – From Crisis to Cure</td>
<td>R Rajagopalan</td>
<td>Oxford Publisher</td>
<td>2005</td>
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<tr>
<td>1</td>
<td>Principals of Environmental Science and Engineering</td>
<td>Raman Sivakumar</td>
<td>Cengage learning, Singapur.</td>
<td>2nd Edition, 2005</td>
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</tbody>
</table>
B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

COMPUTER INTEGRATED MANUFACTURING

Course Code 18IP61  CIE Marks 40
Teaching Hours/Week (L:T:P) (3:2:0)  SEE Marks 60
Credits 04  Exam Hours 03

Course Learning Objectives:
• To learn the basic concepts of Computer Integrated Manufacturing and the benefits that can be achieved by integrating technology with manufacturing systems.
• To have a fundamental knowledge of CNC Machine Tools.
• To imbibe the basic knowledge of Robotics and their application to production
• To develop the fundamental skill sets in CNC Programming
• To inculcate the fundamental knowledge CIM, Group Technology and Flexible Manufacturing

Module-1
Introduction: Role of computers in design and manufacturing, influence of computers in manufacturing environment, product cycle in conventional and computerized manufacturing environment, introduction to CAD/CAM/CIM,
NC Technology: NC, CNC, DNC modes, NC elements, advantages and limitations of NC and CNC.

Module-2
CNC Machine Tools: Turning tool geometry, milling tooling systems, tool presetting, ATC, work holding, CNC machine tools, overview of different CNC machining centers, CNC turning centers.

Module-3
Introduction to Robotics: Introduction, robot configuration, robot motions, programming the robots, robot programming languages, end effectors, work cell, control and interlock, robot sensor

Module-4
CNC Programming: Steps involved in development of a part program, manual part programming-milling and turning, ISO programming in drilling, milling and turning with numerical problems.

Module-5
CIM: Computer aided process planning, computer integrated production planning system, material requirements planning, capacity planning, shop floor control.
Group Technology and Flexible Manufacturing: Part families, part classification and coding, machine cell design and benefits of group technology, FMS work stations, planning the FMS, FMS layout configuration

Course Outcomes: At the end of the course the student will be able to:
• Outline the use of computers and NC technology in CIM systems.
• Understand the concepts of CNC machine tool technology.
• Comprehend the applications of robots in CIM.
• Develop CNC programs for turning and milling operations.
• Plan and control the CIM systems effectively. Apply the GT and FMS in actual manufacturing practice

Question paper pattern:
• The question paper will have ten full questions carrying equal marks.
• Each full question will be for 20 marks.
• There will be two full questions (with a maximum of four sub-questions) from each module.
• Each full question will have sub- question covering all the topics under a module.
• The students will have to answer five full questions, selecting one full question from each module.

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<td>1</td>
<td>CAD/CAM Principles and Applications</td>
<td>P.N. Rao</td>
<td>TMH, New Delhi</td>
<td>2002</td>
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<tr>
<td>2</td>
<td>CAD/CAM</td>
<td>Mikell P-groover, Emory W.Zimrners</td>
<td>Jr Pearson Education inc,</td>
<td>2003</td>
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<tr>
<td>5</td>
<td>CAD/CAM</td>
<td>Ibrahim Zeid</td>
<td>Tata McGraw Hill</td>
<td>1999</td>
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<td>Book Number</td>
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<td>Author</td>
<td>Publisher</td>
<td>Year</td>
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<tr>
<td>7</td>
<td>An Introduction to NC/CNC machines</td>
<td>S. Vishal</td>
<td>S.K. Kataria and Sons</td>
<td>2nd edition, 2010</td>
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Course Code: 18IP62  
CIE Marks: 40  
Teaching Hours/Week (L:T:P): (3:2:0)  
SEE Marks: 60  
Credits: 04  
Exam Hours: 03  

Course Learning Objectives:
- To enable the students to understand the scientific methods of providing various departments of an organization with a quantitative basis of decision making.
- To enable the students to understand the importance of various tools and techniques in finding optimal solutions to problems involving limited resources in the form of Men, Materials and machinery.

Module-1

**Introduction:** Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method.

**Solution of Linear Programming Problems:** The simplex method, canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.

Module-2

**Transportation Problem:** Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases. Least Time Transportation Problems.

**Assignment Problem:** Formulation, types, application to maximization cases and Travelling Salesman Problem, flight scheduling problem.

Module-3

**Project Management using Network Techniques:** Introduction, network construction - rules, Fulkerson’s rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects (network construction by AOA approach can be used for all the cases).

Module-4

**Queuing Theory:** Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models (no derivations) and their steady state performance analysis.

**Game Theory:** Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.

Module-5

**Sequencing:** Basic assumptions, sequencing ‘n’ jobs on single machine using priority rules, sequencing using Johnson’s rule-’n’ jobs on 2 machines, ‘n’ jobs on 3 machines, ‘n’ jobs on ‘m’ machines. Sequencing 2 jobs on ‘m’ machines.

Course Outcomes: At the end of the course the student will be able to:
- Understand the meaning, definitions, scope, need, phases and techniques of operations research.
- Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.
- Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems.
- Solve problems on game theory for pure and mixed strategy under competitive environment.
- Solve waiting line problems for M/M/1 and M/M/C queuing models including crashing of Networks.
- Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3 machines, n jobs- m machines and 2 jobs-n machines using Johnson’s algorithm.

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<td>Reference Books</td>
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<td>1</td>
<td>Operations Research - Theory and Applications -</td>
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<td></td>
<td>J K Sharma</td>
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<td>Pearson Education Pvt Ltd</td>
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<td>Recent edition</td>
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<td></td>
<td>P K Gupta and D S Hira</td>
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<td></td>
<td>S Chand Publications, New Delhi</td>
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<td>Recent edition</td>
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</table>

|   | Introduction to Operation Research                                            |
|   | Taha H A                                                                       |
|   | PHI / Pearson Publications                                                     |
| 3 | Operations Research                                                            |
|   | Paneerselvan,                                                                  |
|   | PHI / Pearson Publications                                                     |
| 4 | Operations Research                                                            |
|   | S.D. Sharma                                                                    |
|   | Kedarnath, Ramnath& Co                                                          |
| 5 | Recent edition                                                                 |
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
SEMESTER - VI

TOOL ENGINEERING AND DESIGN

Course Code 18IP63
CIE Marks 40
Teaching Hours/Week (L:T:P) (3:2:0) SEE Marks 60
Credits 04 Exam Hours 03

Course Learning Objectives:
• To develop capability to design and select single point and multipoint cutting tools for various machining operations.
• Exposure to variety of locating and clamping methods available
• To enable the students to design jigs and fixtures for simple components
• To expose the students to the design/selection procedure of press tools and die casting dies.

Module-1
Introduction: Concept, meaning and definitions of tool, tool design and tool engineering. Tools-types, classification, features & applications.

Design of Single Point Tool: Tool Signature, Selection of Tool Angles, Design of Shank section for single point tool to account for strength and rigidity. Design of Multi Point Tools – Drill, Reamers.

Module-2
Design of peripheral Milling cutters, Design of Broach.

Location and Clamping: General principles of location, 3-2-1 Principle of Location, Principle of Radial location, General study of locating devices. General principles of clamping, Study of various Clamping devices.

Module-3
Design of Fixtures: Difference between a Jig and a Fixture, Design of Milling fixture, Study of other fixtures like Lathe fixture, Inspection fixture. Study of different types of Drill jigs.

Design of Gauges: Types of gauges. Factors to be considered in the design of gauges, Design of Plug gauge, Design of Snap gauge.

Module-4

Module-5
Design of Forming Dies: Study of Drawing and Bending process, Design of Drawing Die, Design of Bending Die

Tool Layout and Cam Design of Single Spindle Automats: Classification of Automats and their applications. Tool layout and Cam design for automatic screw cutting machine.

Course Outcomes: At the end of the course the student will be able to:
• Select appropriate cutting tools required for producing a component.
• Understand and interpret cutting tool and tool holder designation systems
• Select suitable locating and clamping devices for a given component for various operations.
• Analyze and design a jig/fixture for a given simple component.
• Understand various press tools and press tool operations.
• Classify and explain various die casting and injection moulding dies.

Question paper pattern:
• The question paper will have ten full questions carrying equal marks.
• Each full question will be for 20 marks.
• There will be two full questions (with a maximum of four sub-questions) from each module.
• Each full question will have sub-question covering all the topics under a module.
• The students will have to answer five full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<tbody>
<tr>
<td>1</td>
<td>Text book of Production Engineering</td>
<td>P. C. Sharma</td>
<td>Chorotar Publishing house</td>
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<tr>
<td>2</td>
<td>Tool Design</td>
<td>Donaldson and Golding</td>
<td>Tata McGraw Hill, New Delhi</td>
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<tr>
<td>3</td>
<td>An introduction to Jig and Tool design</td>
<td>Kempester M.H.A.,</td>
<td>VIVA Books Pvt.Ltd</td>
<td>2004</td>
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</table>

Reference Books
1 Fundamentals of Tool Design | ASTME
3 An introduction to Jig and Tool design | VIVA Books Pvt.Ltd 2004
|   | Fundamentals of Tool Design  | Frank | PHI publications. |
Course Code: 18IP641
CIE Marks: 40
Teaching Hours/Week (L:T:P): (2:2:0)
SEE Marks: 60
Credits: 3
Exam Hours: 3

Course Learning Objectives:

Module-1
Basics of plastic deformation & Introduction to metal forming process

Module-2
Forging & Rolling Processes

Module-3
Extrusion & drawing of rods, wires and tubes

Module-4
Sheet metal working, sheet metal drawing

Module-5
High Energy Rate Forming (HERF)

Course Outcomes: At the end of the course the student will be able to:
- Understand various metal forming process
- Analyze various forces acting on the products
- Analyze the energy requirements

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

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<tr>
<td>1</td>
<td>Mechanical Metallurgy</td>
<td>Dieter G.E</td>
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<td>2</td>
<td>Fundamentals of Metal Forming Processes</td>
<td>Juneja B.L</td>
<td>New age International</td>
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<tr>
<td>3</td>
<td>Principle of Industrial Metal Working Processes</td>
<td>Rowe Edward</td>
<td>CBS Publication</td>
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<td>1</td>
<td>Materials and Processes in Manufacturing</td>
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<td></td>
<td>E.Paul, DeGarmo et al.</td>
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<td>PHI publication</td>
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<tr>
<td>2</td>
<td>Fundamentals of Working of Metals</td>
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<td></td>
<td>Sach G.</td>
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<td>Pergamon press</td>
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<td>3</td>
<td>Mechanics of sheet metal forming</td>
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<td></td>
<td>Z. Marciniak, J. L. Duncan and S. J. Hu</td>
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<td></td>
<td>Elsevier-Butterworth-Heinemann-2006</td>
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B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

ENGINEERING ECONOMY

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<tr>
<td>Credits</td>
<td>03</td>
<td>Exam Hours</td>
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</table>

**Course Learning Objectives:**
- To acquire a clear understanding of the fundamentals of engineering economics.
- To learn the concepts of decision making, problem solving, and comparison of the alternatives and elements of cost.
- To inculcate an understanding of concept of money and its importance in the evaluation of projects.
- To illustrate concept of money and its importance in evaluating the projects.
- To evaluate the alternatives based on the present annual worth and equivalent annual worth methods

**Module-1**

**Introduction:** engineering decision – makers, engineering and economics, problem solving, intuition and analysis, tactics and strategy with an example.

**Interest and Interest Factors:** Interest rate, simple interest compound interest, interest formulae, time value equivalence exercises, problems and discussion

**Module-2**

**Present Worth Comparison:** Conditions for present worth comparisons, rule 72, and basic present worth comparisons, present worth equivalence, net present worth, assets with equal and unequal lives, comparison of assets assume to have infinite lives, exercises and problems.

**Equivalent Annual Worth Comparisons:** Situations for equivalent annual worth comparison, net annual worth of a single project, comparison of net annual worth’s, definitions of asset life, comparison of assets with equal and unequal lives, exercises and problems.

**Module-3**

**Depreciation:** Introduction, Reasons for Depreciation, Various methods of depreciation, Numerical Problems on all the methods of Depreciation

**Module-4**


**Module-5**

**Estimating and Costing:** components of costs such as direct material cost, direct labour cost, Fixed, over – heads, factory costs, administrative – over heads, first cost, selling price, calculation of the total cost of various components, mensuration, estimation of simple components.

**Course Outcomes:** At the end of the course the student will be able to:
- Recall the basic concepts of decision making, problem solving, tactics and strategy.
- Defining the time value of money concept, interest formulae.
- Explain the comparison by present worth method for different lives of the asset. Compare the asset on the basis of EAW comparison.
- Explain the concepts of depreciation and replacement criteria.
- Calculate the total cost of a component and explain the process for estimating simple components

**Question paper pattern:**
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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</thead>
</table>
| Textbook/s
| 1     | Engineering economy        | Riggs J.L.                    | McGraw Hill                   | 2002             |
| 2     | Engineering economy        | Paul Degarmo                  | Macmillan Pub, Co.            | 2001             |

**Reference Books**
- Engineering Economy by NVR. Naidu, KM Babu, New Age International Pvt. Ltd, 2006
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Author</th>
<th>Publisher</th>
<th>Year</th>
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<tr>
<td>2</td>
<td>Industrial Engineering and Management</td>
<td>O.P Khanna</td>
<td>DhanpatRai and Sons</td>
<td>2000</td>
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<tr>
<td>4</td>
<td>Engineering Economy</td>
<td>Theusen G.</td>
<td>PHI</td>
<td>2000</td>
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</table>
## Course Learning Objectives:
- Understand various approaches to TQM
- Understand the characteristics of quality leader and his role.
- Develop feedback and suggestion systems for quality management.
- Enhance the knowledge in Tools and Techniques of quality management.

### Module-1
**Principles and Practice:** Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM. Quality Management Systems: Introduction, benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements.

### Module-2
**Leadership:** Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making.

### Module-3
**Customer Satisfaction and Customer Involvement:** Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, case studies. Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, Performance appraisal, unions and employee involvement, case studies.

### Module-4
**Continuous Process Improvement:** process, the Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies.

**Statistical Process Control:** Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.

### Module-5
**Tools and Techniques:** Bench marking, information technology, quality management systems, environmental management system, and quality function deployment, quality by design, failure mode and effect analysis, product liability, total productive maintenance.

### Course Outcomes:
- Explain the various approaches of TQM
- Infer the customer perception of quality
- Analyze customer needs and perceptions to design feedback systems.
- Apply statistical tools for continuous improvement of systems
- Apply the tools and technique for effective implementation of TQM.

### Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

### Sl. No | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year
---|---|---|---|---
2 | Total Quality Management for Engineers | M. Zairi head | Publishing | SBN:1855730243

### Reference Books
- Managing for Quality and Performance Excellence: James R. Evans and W M
- A New American TQM, four revolutions in management: Shoji Shiba, Alan Graham.
<table>
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<tr>
<th></th>
<th>Title</th>
<th>Author(s)</th>
<th>Publisher</th>
<th>Year</th>
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<tr>
<td>3</td>
<td>Organizational Excellence through TQM.</td>
<td>H. Lal</td>
<td>New age Publications</td>
<td>2008</td>
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</table>
Module-1

INTRODUCTION TO VALUE ANALYSIS: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, Applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

TYPE OF VALUES: Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation. Detailed case studies of simple products.

Module-2


PROBLEM SETTING & SOLVING SYSTEM: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

Module-3

VALUE ENGINEERING JOB PLAN: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgment phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

Module-4

VALUE ENGINEERING TECHNIQUES: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the Techniques.

ADVANCED VALUE ANALYSIS TECHNIQUES: Functional analysis system technique and case studies, Value analysis of Management practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

TOTAL VALUE ENGINEERING: Concepts, need, Methodology and benefits.

Module-5

APPLICATION OF VALUE ANALYSIS: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

Course Outcomes: After the completion of the course, a student will
1. Able to understand the importance of value of a product
2. Find out unnecessary cost/ function involved in the product
3. Conduct value engineering methodology
4. Do value analysis using advanced value engineering techniques
5. Become a certified value engineer with additional course /training

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<th>Sl. No</th>
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<th>Edition and Year</th>
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<tr>
<td>2</td>
<td>Value engineering for Cost Reduction and Product</td>
<td>M.S. Vittal</td>
<td>Systems Consultancy Services Edn</td>
<td>1991</td>
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<td></td>
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<td>Value Engineering Way)</td>
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Course Learning Objectives:
- To learn the fundamental concepts of Non-Traditional Machining and their Mechanical Processes
- To have a good knowledge of Abrasive Jet Machining and its application
- To learn the fundamental principles of Electrochemical Machining Process (ECM)
- To have basic exposure to Chemical Machining (CHM) and Chemical Milling
- To imbibe a the basic principles of Thermal Metal Removal Processes, Plasma Arc Machining (PAM) and Laser Beam Machining (LBM)

Module-1
Introduction: History, need for non-traditional machining processes, classification, process selection.
Mechanical Process: Ultrasonic Machining (USM): Introduction, equipment, tool material and tool size, abrasive slurry, Magnetostriction assembly, tool cone (concentrator), exponential concentrator of circular cross section and rectangular cross sections, effect of parameters, amplitude, frequency, grain diameter, applied static load and slurry, tool and work material. USM process characteristics: material removal rate, tool wear, accuracy, surface finish, applications, advantages and disadvantages of USM.

Module-2
Abrasive Jet Machining (AJM): Introduction, equipment, variables in AJM: carrier gas, size of abrasive grain, velocity of the abrasive jet, mean no. abrasive particles per unit volume of the carrier gas, work material, stand-off distance (SOD), process characteristics-material removal rate. Nozzle wear, Accuracy and surface finish. Applications, advantages and disadvantages of AJM.

Module-3
Electrochemical Machining Process (ECM): Introduction, elements of ECM process: Cathode tool, anode work piece, source of DC power, electrolyte, chemistry of the process, ECM process characteristics - material removal rate, accuracy, surface finish, tool and insulation materials, tool size, electrolyte flow arrangement, applications, simple problems.

Module-4
Chemical Machining (CHM): Introduction, elements of the process, chemical blanking process: preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking.
Chemical Milling (Contour machining): Process steps-masking, etching, etc. process characteristics of CHM: - material removal rate, accuracy, surface finish, application of CHM.

Module-5
Thermal Metal Removal Processes: Electrical Discharge Machining (EDM) - Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tool (electrode), electrode material selection, machining time, flushing: suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish, heat affected zone, machine tool selection, applications, electric discharge grinding, travelling wire EDM.
Plasma Arc Machining (PAM): Principle of generation of plasma, equipment, non-thermal generation of plasma, selection of gas, mechanism of metal removal, PAM parameters, process characteristics.
Laser Beam Machining (LBM): Principle of generation of lasers, equipment and machining procedure, types of lasers, process characteristics, applications

Course Outcomes: At the end of the course the student will be able to:
- Understand the need for advanced manufacturing process and explain the principle of operation of ultrasonic machining process.
- Explain the characteristic features of Abrasive Jet Machining (AJM)
- Define the process parameters influence the material removal rate with the help of characteristics curves.
- Explain the principle of chemical machining and chemical milling process.
- Summarize the various aspects of Electric discharge machining (EDM). Explain the principle of generation plasma and laser and their application in machining.
**Question paper pattern:**
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<th>Sl. No</th>
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<tr>
<td>1</td>
<td>Modern Machining Process</td>
<td>P C Pandey and H S Shan</td>
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<td>2</td>
<td>New Technology</td>
<td>Bhattacharaya</td>
<td>Institution of Engineering Publication</td>
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**Reference Books**

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<td>Modern Machining Methods</td>
<td>Dr. M. Adithan</td>
<td>Khanna Publishers</td>
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<td>5</td>
<td>Non-conventional Machining</td>
<td>P K Mishra, Narosa publishing House, New – Delhi.</td>
<td>2006</td>
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**B. E. INDUSTRIAL AND PRODUCTION ENGINEERING**  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER - VI  

**OPEN ELECTIVE - A**  
MANAGEMENT INFORMATION SYSTEMS

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<td>Exam Hours</td>
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**Course Learning Objectives:**
- To elevate students’ awareness of information Technology and develop an in-depth and systematic understanding of key aspects of IT management.
- To help students gain a strategic perspective on business.
- To evaluate the value of emerging technologies and their competitive advantage.

**Module-1**  
**Fundamentals of Information Systems:** Information systems in business, fundamentals of information systems solving business problems with information systems.

**Module-2**  
**Information Systems for Business Operations:** Business information systems, Transaction processing systems, management, information systems and decision support systems. Artificial intelligence technologies in business, information system for strategic applications and issues in information technology.

**Module-3**  
**Issues in Managing Information Technology:** Managing information resources and technologies global information technology, management, planning and implementing change, integrating business change with IT, security and ethical challenges in managing IT, social challenges of information technology.

**Module-4**  

**Module-5**  
**Consumer Oriented E-Commerce:** Consumer oriented Application: Finance and Home Banking, Home shopping, Home Entertainment, Mercantile Process Models, Consumers perspective, Merchants perspective.  
**Electronic Data Interchange (EDI):** EDI Concepts, Applications in business – components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing using EDI, Digital Signatures and EDI.

**Course Outcomes:** At the end of the course the student will be able to:
- Understand the awareness of information Technology and develop an in-depth and systematic understanding of key aspects of IT management.
- Explain the gain a strategic perspective on business.
- Evaluate the value of emerging technologies and their competitive advantage.

**Question paper pattern:**
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
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<tr>
<td>2</td>
<td>Management Information Systems</td>
<td>Llaudon&amp;Laudo</td>
<td>PHI</td>
<td>ISBN 81-203-1282-</td>
</tr>
</tbody>
</table>
## B. E. INDUSTRIAL AND PRODUCTION ENGINEERING
### Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
#### SEMESTER - VI

**CAD/CAM LAB**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>PART-A</strong></td>
</tr>
<tr>
<td></td>
<td>Modeling of simple machine parts using Graphics Package</td>
</tr>
<tr>
<td></td>
<td>Study of Finite Element Analysis Package - 1D, 2D, Structural problems, Evaluation of displacement (Strain) and Stress. Problems involving Beams and Trusses</td>
</tr>
<tr>
<td></td>
<td><strong>PART-B</strong></td>
</tr>
<tr>
<td></td>
<td>Modeling and Simulation of Machining process of simple machine parts using CAM packages.</td>
</tr>
<tr>
<td></td>
<td>Suggested Software Packages: Solid Works/ Uni Graphics/Catia and MASTER CAM or any other similar packages</td>
</tr>
</tbody>
</table>

**Conduct of Practical Examination:**
1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero
5. Scheme of Examination: Exercises from Parts A and B = 80 Marks; Viva-voce =20 Marks.
# MACHINE TOOL LAB

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18IPL67</th>
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<tbody>
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<td>CIE Marks</td>
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<tr>
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<td>(0:2:2)</td>
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<tr>
<td>SEE Marks</td>
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</tr>
<tr>
<td>Credits</td>
<td>02</td>
</tr>
<tr>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

## Sl. No | Exercises
---|---
1 | Machining of T-slot or L-slot on milling machine and Checking
   a. Parallelism between the surfaces.
   b. Perpendicularity between surfaces
2 | Exercise on Spur Gear cutting and Measurement of all the parameters of the gear.
3 | Machining of Spiral slots on milling machine.
4 | Measurement of Cutting forces, Determination of Shear angle, Chip Thickness Ratio and Verification of Merchants Angle Relationship in Turning Operation.
5 | Study the variation of Axial force and Torque in Drilling with respect to cutting speed and feed

## PART-A

1. Machining of T-slot or L-slot on milling machine and Checking
   a. Parallelism between the surfaces.
   b. Perpendicularity between surfaces
2. Exercise on Spur Gear cutting and Measurement of all the parameters of the gear.
3. Machining of Spiral slots on milling machine.
5. Study the variation of Axial force and Torque in Drilling with respect to cutting speed and feed

## PART-B

1. A General study of Acceptance test of commonly used machine tool (Theory).
2. Test for True running of the main spindle of Lathe
3. Test for True running of the main spindle of Drill
4. Alignment of centers in Vertical plane in Lathe
5. Testing for true running of Headstock center of a Lathe
6. Disassembly of
   a) Lathe Tail Stock
   b) Tool Head of a Shaper and measurement of component dimension

## Conduct of Practical Examination:
1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero
5. Scheme of Examination: Exercises from Parts A and B = 80 Marks; Viva-voce =20 Marks.
# B.E INDUSTRIAL AND PRODUCTION ENGINEERING

## Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

### SEMESTER -VI

## MINI PROJECT

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18IPMP68</th>
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<td>CIE Marks</td>
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<td>SEE Marks</td>
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<tr>
<td>Credits</td>
<td>02</td>
</tr>
<tr>
<td>Exam Hours/Batch</td>
<td>03</td>
</tr>
</tbody>
</table>

### Course Learning Objectives:
- To support independent learning and innovative attitude
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgment, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

### Mini-Project:
Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

### Course Outcomes:
At the end of the course the student will be able to:
- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

### CIE procedure for Mini - Project:
The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25. The marks awarded for Mini - Project report shall be the same for all the batch mates.

### Semester End Examination
SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.
All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail and shall have to complete during subsequent University examinations after satisfying the internship requirements.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Refer to VIII semester scheme (18IP85)</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Credit</th>
<th>Exam Hours/ Batch</th>
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<tr>
<td>Duration of internship</td>
<td>04 weeks</td>
<td>SEE Marks</td>
<td>60</td>
<td>02</td>
<td>03</td>
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</table>

**Course Learning Objectives:**
Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,
- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently.

**Internship:** Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

**Seminar:** Each student, is required to
- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Course Outcomes:** At the end of the course the student will be able to:
- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learnt to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

**Continuous Internal Evaluation**
CIE marks for the Internship shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairman.

The CIE marks awarded shall be based on the evaluation of Internship Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

**Semester End Examination**
SEE marks for the Internship shall be awarded based on the evaluation of Internship Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.
Course Learning Objectives:

Module-1


OPERATIONS DECISION MAKING: Introduction, Management as a science, Characteristics of decisions, and Framework for decision making, Decision methodology, Decision support systems, Economic models, and Statistical models.

Module-2

FORECASTING DEMAND: Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, Time series methods, Exponential smoothing, Regression and correlation methods, Application and control of forecasts.

Module-3

AGGREGATE PLANNING AND MASTER SCHEDULING: Introduction- planning and scheduling, Objectives of aggregate planning, Aggregate planning methods, Master scheduling objectives, Master scheduling methods.

Module-4

MATERIAL AND CAPACITY REQUIREMENTS PLANNING: Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities.

SCHEDULING AND CONTROLLING PRODUCTION ACTIVITIES: Introduction, PAC, Objectives and Data requirements, Scheduling strategy and guidelines, Scheduling methodology, priority control, capacity control.

Module-5

SINGLE MACHINE SCHEDULING: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule, minimizing the number of tardy jobs.

FLOW-SHOP SCHEDULING: Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS heuristic.

JOB-SHOP SCHEDULING: Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm' machines.

Course Outcomes:

- Apply the concepts of operations management by knowing the Historical development, Physical and information flows in a production system, and contribution of James Watt, Charles Babbage, Robert Owen, Thomas Alva Edition, Frederick Winslow Taylor, Henry Ford in development of production systems.
- Solve problems using appropriate techniques of forecast.
- Apply models used in decision making, Recognize and apply basic appropriate analytical

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
</tr>
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<tr>
<td>Textbook/s</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>An introductory book on lean systems</td>
<td>TPS, Yasuhiro Monden</td>
<td></td>
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<tr>
<td>Reference Books</td>
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<tr>
<td>6</td>
<td>Production and Operations Management</td>
<td>Adam &amp; Ebert</td>
<td>PHI</td>
<td>5th edition.</td>
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</table>
Course Code: 18IP72
CIE Marks: 40
Teaching Hours/Week (L:T:P): (2:2:0)
SEE Marks: 60
Credits: 03
Exam Hours: 03

Course Learning Objectives:
- To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
- To understand the evolution and development of Mechatronics as a discipline.
- To substantiate the need for interdisciplinary study in technology education.
- Understand the applications of microprocessors in various systems and to know the functions of each element.
- To demonstrate the integration philosophy in view of Mechatronics technology.
- To be able to work efficiently in multidisciplinary teams.

Module-1


Module-2


Module-3


PLC: Programmable Logic Controllers, Basic Structure, Input/Output Processing, Programming, Mnemonics, Timers, Internal Relays and Counters, Shift Registers, Master and Jump controls, Data handling, Analogue input/output, Selection of a PLC.

Module-4

ACTUATORS: Definition, Classification of Actuators, Brief survey of Electromechanical actuators, Drive requirements for cutting movements, Requirements of feed drives, Calculation of drive requirements on feed motor shaft, DC motors & Control of DC motors, AC motors, DC & AC servomotors, Stepper motors- types, Characteristics, advantages, limitations and applications.

Module-5

SYSTEM MODELS: Mathematical models, Mechanical system building blocks, Electrical system building blocks, Fluid system building blocks, Thermal system building blocks.

Course Outcomes: At the end of the course the student will be able to:
- Illustrate various components of Mechatronics systems.
- Assess various control systems used in automation.
- Develop mechanical, hydraulic, pneumatic and electrical control systems.
- Design and conduct experiments to evaluate the performance of a Mechatronics system or component with respect to specifications, as well as to analyze and interpret data.
- Function effectively as members of multidisciplinary teams.
Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<td>Textbook/s</td>
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<tr>
<td>2</td>
<td>Fundamentals of Microprocessor and Micro Computer</td>
<td>B. Ram</td>
<td>Dhanpat Rai and Sons</td>
<td>4th Revised Edition</td>
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<td>Reference Books</td>
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<tr>
<td>4</td>
<td>Mechatronics</td>
<td>HMT</td>
<td>TMH</td>
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</tbody>
</table>
Module-1
INTRODUCTION: Historical development of marketing management, Definition of Marketing, Core marketing concepts, Marketing Management philosophies, Micro and Macro Environment, importance of marketing in the India Socio-economic system.
CONSUMER MARKETS AND BUYING BEHAVIOR: Characteristics affecting consumer behaviour, Types of buying decisions, Buying decision process, Classification of consumer products, Market segmentation.

Module-2
MARKETING INFORMATION SYSTEMS AND RESEARCH: Components of marketing information system–benefits & uses marketing research system, marketing research procedure, measurement of market demand.
MARKETING OF INDUSTRIAL GOODS: Nature and importance of the Industrial market, classification of industrial products, participants in the industrial buying process, major factors influencing industrial buying behaviour, characteristics of industrial market demand. Determinants of industrial market demand. Buying

Module-3
BRANDING, LABELLING AND PACKAGING: Branding, Reasons for branding, functions of branding, features and types of brands, kinds of brand name.
LABELLING: Types, functions, advantages and disadvantages
PACKAGING: Meaning, growth of packaging, function of packaging, kinds of packaging

Module-4
PRICING: Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions.
DISTRIBUTION: Marketing channels – functions, types of channels of distribution, number of channel levels. Physical distribution – importance, total systems concept, strategy, use of physical distribution.

Module-5
PERSONAL SELLING: Objectives of personal selling, establishing the Sales force objectives, sales – force strategy, sales force structure and size, salesmanship, qualities of good salesman, types of salesman, major steps in effective selling.

Course Outcomes:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Principles of Marketing</td>
<td>Philip Kotler</td>
<td>Prentice Hall</td>
<td>11th Edn.</td>
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</table>

Reference Books

AUTOMOBILE ENGINEERING

Course Code  18IP732
CIE Marks  40
Teaching Hours/Week (L:T:P)  (2:2:0)
SEE Marks  60
Credits  03
Exam Hours  03

Course Learning Objectives:

- To identify and name the various parts of an automobile.
- To recognize the effects and types of Superchargers and Turbochargers.
- To identify the various components of an Ignition System and know their functions.
- To describe the Transmission system and know the use.
- To explain the modes of power transmission and indicate the types of braking.

Module-1

Engine Components and Cooling & Lubrication systems: cylinder - arrangements and their relatives merits, cylinder Liners, Piston rings, connecting rod, crankshaft, valves, cooling requirements, Methods of cooling-lubrication system and Different lubrication methods.

Module-2


Module-3

Ignition Systems: Introduction, Requirements of an ignition system, Battery Ignition systems components of Battery Ignition systems, magneto Ignition system rotating armature type, rotating magnet type, Electronic Ignition system.

Module-4


Module-5


Course Outcomes: At the end of the course the student will be able to:

- Explain functions of piston and piston rings, valves, cooling system and lubrication system.
- Differentiate between supercharger and turbocharger and their respective constructions.
- Understand the working principles of various ignition methods used and their operations.
- Develop the knowledge on different energy transmission systems and their applications.
- Develop the knowledge on steering types and different braking methods.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<tbody>
<tr>
<td>1</td>
<td>Automotive Mechanics</td>
<td>S. Srinivasan</td>
<td>Tata McGraw Hill</td>
<td>2003</td>
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<tr>
<td>2</td>
<td>Automobile engineering</td>
<td>Kirpal Singh.</td>
<td>Vol I and II 2002</td>
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<tr>
<td>3</td>
<td>A course in I.C. Engines</td>
<td>M.L. Mathur and R.P.</td>
<td></td>
<td>2001</td>
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</table>
B. E. INDUSTRIAL AND PRODUCTION ENGINEERING  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER - VII  
HUMAN RESOURCE MANAGEMENT  

Course Code: 18IP733  
CIE Marks: 40  
Teaching Hours/Week (L:T:P): (2:2:0)  
SEE Marks: 60  
Credits: 03  
Exam Hours: 03  

Course Learning Objectives:  
Course Learning Objectives Missing  

Module-1  
INTRODUCTION: Evolution of HRM, Objectives, Functions and Policies.  
HUMAN RESOURCE PLANNING: Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, job Description, Job Specification  

Module-2  
RECRUITMENT: Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process.  
SELECTION: Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion, exit interview. (Tutorial on written test, Group Discussion, Interviews)  

Module-3  
PERFORMANCE APPRAISAL: Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counselling based on Annual Confidential Reports.  

Module-4  
COUNSELLING AND HUMAN RESOURCE ACCOUNTING: Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting, Various methods of accounting.  

Module-5  
INDUSTRIAL RELATIONS: Indian trade union act, standing orders act, Indian factories act  

Course Outcomes:  
1. Synthesize information regarding the effectiveness of recruiting methods & selection procedures  
2. Identify the various training methods and design a training program  
3. Design a job description and job specification for various levels of employees.  
   List out the regulations governing employee benefit practices.  

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
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<th>Edition and Year</th>
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<tr>
<td>Textbook/s</td>
<td>1 Human Resources Management</td>
<td>Dr. K Ashwathappa</td>
<td>Tata McGraw Hill</td>
<td>Edition</td>
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<tr>
<td>2 Management of Human</td>
<td>CB Mamoria</td>
<td>Himalaya Publication</td>
<td>2003</td>
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<td>Reference Books</td>
<td>3 Personnel / Human resource Management</td>
<td>Decenoz and robins</td>
<td>PHI</td>
<td>2002</td>
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<tr>
<td>4 Industrial Relations</td>
<td>ArunMonappa</td>
<td>TMH</td>
<td>ISBN – 0-</td>
<td></td>
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<tr>
<td>5 Human Resources Management</td>
<td>VSP Rao</td>
<td></td>
<td></td>
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<tr>
<td>6 Human Resources Management</td>
<td>Ravi Dharma Rao</td>
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</table>
Course Code | 18IP741
Teaching Hours/Week (L:T:P) | (2:2:0)
Credits | 03
CIE Marks | 40
SEE Marks | 60
Exam Hours | 03

**Course Learning Objectives:**

- The course aims in identifying the classification of unconventional machining processes.
- To understand the principle, mechanism of metal removal of various unconventional machining processes.
- To study the various process parameters and their effect on the component machined on various unconventional machining processes.
- To understand the applications of different processes.

**Module-1**

**INTRODUCTION:**
History, Classification, Comparison between conventional and non conventional machining process selection.

**MECHANICAL PROCESS:**

**Module-2**

**ABRASIVE JET MACHINING (AJM):**
Introduction, Equipment, Variables in AJM: carrier Gas Type of abrasive, Size of abrasive grain, velocity of the abrasive jet, Mean No. abrasive particles per unit volume of the carrier gas, Work material, standoff distance (SOD) nozzle design shape of cut. Process characteristics – Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, Advantages & Disadvantages of AJM.

**ELECTROCHEMICAL AND CHEMICAL METAL REMOVAL PROCESS:**
Electrochemical machining (ECM): Introduction, Study of ECM machine, Elements of ECM process: Cathode tool, Anode work piece, source of DC power, Electrolyte, ECM process characteristics – Material removal rate, Accuracy, Surface finish.

**Module-3**

**ECM TOOLING:**
ECM tooling technique 7 example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug., Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.

**CHEMICAL MACHINING (CHM):**
Introduction, Elements of process Chemical blanking Process: - Preparation of work piece. Preparation of masters, masking with photo resists, etching for blanking, applications of chemical blanking, chemical milling (Contour machining) :- Process steps – masking, Etching, process characteristics of CHM :- material removal rate accuracy, surface finish, Hydrogen embrittlement, Advantages & application of CHM.

**Module-4**

**EDM PROCESS:**
Introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design : Choice of matching operation, electrode material selection, under sizing and length of electrode Machining time.

**EDM PROCESS CHARACTERISTICS:**
Flushing – Pressure flushing synchronized with electrode movement, EDM process characteristic: Metal removal rate, Heat affected Zone, Application: EDM accessories / applications.

**Module-5**

**PLASMA ARC MACHINING (PAM):**
Introduction, equipment, generation of plasma, Mechanism of Metal removal, PAM parameters, Process characteristics.

**LASER BEAM MACHINING & ION BEAM MACHINING:**
Introduction, metal removal mechanism, advantages and application

**Course Outcomes:**

- Will be able to understand various machining techniques
- Compare from conventional and non-conventional machines
- Understand various methods of non-conventional machining

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
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<th>Edition and Year</th>
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<tbody>
<tr>
<td>Textbook/s</td>
<td></td>
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<tr>
<td></td>
<td>Modern machining process</td>
<td>Pandey and Shah</td>
<td>TATA McGraw Hill</td>
<td>2000</td>
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**Reference Books**

<table>
<thead>
<tr>
<th></th>
<th>Production Technology</th>
<th>HMT</th>
<th>TATA McGraw Hill -</th>
<th>2001</th>
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<tbody>
<tr>
<td>3</td>
<td>Thermal Metal cutting processes</td>
<td>B G Ranganath</td>
<td>I K International Publishing house Pvt. Ltd</td>
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</tr>
</tbody>
</table>
Course Learning Objectives:

Course Learning Objectives Missing

Module-1


Module-2

Experimental Design: Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples.

Module-3

Analysis And Interpretation Methods: Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE’s algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.

Module-4


Module-5


Parameter And Tolerance Design: Parameter and tolerance design concepts, Taguchi’s inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples.

Course Outcomes: After completing this course, a student will be able to:
• Appreciate the advantages and disadvantages of a design for a particular experiment
• Construct optimal or good designs for a range of practical experiments
• Understand the potential practical problems in its implementation
• Describe how the analysis of the data from the experiment should be carried out

Sl. No Title of the Book Name of the Author/s Name of the Publisher Edition and Year

Textbook/s
2 Quality Engineering using Robust Design Madhav S. Phadke Prentice Hall PTR, Englewood Cliffs, New

Reference Books
3 Quality by Experimental Design Thomas B. Barker, Marcel Inc ASQC Quality Press, 1985
JUST IN TIME MANUFACTURING

Course Learning Objectives:
- To know the different types of welding and describe welding and cladding of dissimilar metals
- To distinguish the weldability of metals
- To identify the welding design principles and compute welding design parameters
- To illustrate the symbols used in welding practice and identify the adhesive bonding applications
- To Identify and use the welding inspection techniques and standards

Module-1

JIT - AN INTRODUCTION: Speed of JIT movement, the new production system research association of Japan, some definitions of JIT, core Japanese practices of JIT, enabling JIT to occur, basic element of JIT, benefits of JIT.

MODERN PRODUCTION SYSTEM: Key feature of Toyota’s production system, basic framework of Toyota production system.

KANBAN SYSTEM – other types of kanban’s, kanban rules, determining the number of kanban’s in Toyota production system.

Module-2

PRODUCTION SMOOTHING IN TOYOTA PRODUCTION SYSTEM: production planning, production smoothing, adaptability to demand fluctuations, sequencing method for the mixed model assembly line to realize smoothed production. EDP system for support of the Toyota Production system.

GLOBAL IMPLEMENTATION OF JIT: JIT in automotive industry, JIT in electronics, computer, telecommunication and instrumentation, JIT in process type industry, JIT in seasonal demand industry, other manufacturing industries, conclusion.

Module-3

JIT IMPLEMENTATION SURVEYS: JIT implementation in US manufacturing firms-analysis of survey results, just in time manufacturing industries, just in time production in West Germany, just in time production in Hong Kong electronics industry, conclusion.

DESIGN, DEVELOPMENT AND MANAGEMENT OF JIT MANUFACTURING SYSTEMS: plant configurations and flow analysis for JIT manufacturing, comparison of JIT’s “demand pull” system with conventional “push type” planning and control systems, quality management system for JIT, product design for JIT human resource management in JIT, flexible workforce system at Toyota.

Module-4

SUPPLY MANAGEMENT FOR JIT: JIT purchasing-the Japanese way, some studies in JIT purchasing, experience of implementation organizations, surveys of JIT purchasing, buyer-seller relationship in JIT purchasing, Quality certification of suppliers in JIT purchasing, some problems in implementation of JIT purchasing, reduction freight costs in JIT purchasing, monitoring supplier performance for JIT purchasing, audit in JIT purchasing, implementation of JIT to international sourcing.

Module-5

FRAMEWORK FOR IMPLEMENTATION OF JIT: Implementation risk, risks Due to inappropriate understanding of JIT, risks due to technical, operational and people problems, risks associated with kanban system, some important activities to be performed during implementation, steps in implementation, a project work to approach to implementation, conclusion.

Course Outcomes:

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year
--- | --- | --- | --- | ---
1 | Just In Time Manufacturing | M.G. Korgaonker | Macmillan India Ltd.- | 1992
Introduction: Definition of project, characteristics of projects, understand projects, types of projects, scalability of project tools, project roles Project Selection and Prioritization – Strategic planning process, Strategic analysis, strategic objectives, portfolio alignment – identifying potential projects, methods of selecting projects, financial mode / scoring models to select projects, prioritizing projects, securing and negotiating projects.

Module-2
Planning Projects: Defining the project scope, Project scope checklist, Project priorities, Work Breakdown Structure (WBS), Integrating WBS with organisation, coding the WBS for the information system. Scheduling Projects: Purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt chart.

Module-3

Module-4
Performing Projects: Project supply chain management: - Plan purchasing and acquisitions, plan contracting, contact types, project partnering and collaborations, project supply chain management. Project Progress and Results: Project Balanced Scorecard Approach, Internal project, customer, financial issues, Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure.

Module-5
Network Analysis: Introduction, network construction - rules, Fulkerson’s rule for numbering the events, AON and AOA diagrams; Critical path method (CPM) to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.

Course Outcomes: At the end of the course the student will be able to:
- Understand the selection, prioritization and initiation of individual projects and strategic role of project management.
- Understand the work breakdown structure by integrating it with organization.
- Understand the scheduling and uncertainty in projects.
- Students will be able to understand risk management planning using project quality tools.
- Understand the activities like purchasing, acquisitions, contracting, partnering and collaborations related to performing projects.
- Determine project progress and results through balanced scorecard approach
- Draw the network diagram to calculate the duration of the project and reduce it using crashing

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
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<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<tr>
<td></td>
<td>Title</td>
<td>Author</td>
<td>Publisher</td>
<td>Year</td>
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<tr>
<td>2</td>
<td>Project Management, A systems approach to planning scheduling and controlling</td>
<td>Harold Kerzner</td>
<td>CBS Publication</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Reference Books</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Project Management</td>
<td>Pennington</td>
<td>McGraw Hill</td>
<td></td>
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<td></td>
<td></td>
<td>Lawrence</td>
<td></td>
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<tr>
<td>5</td>
<td>Project Management</td>
<td>A Moder Joseph</td>
<td>New York Van Nostrand, Reinhold</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>and Phillips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Project Management</td>
<td>Bhavesh M. Patal</td>
<td>Vikas Publishing House,</td>
<td></td>
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</tbody>
</table>
# AUTOMOTIVE ENGINEERING

**Course Code**: 18IP752  
**CIE Marks**: 40  
**Teaching Hours/Week (L:T:P)**: (2:2:0)  
**SEE Marks**: 60  
**Credits**: 03  
**Exam Hours**: 03

## Course Learning Objectives:
- The layout and arrangement of principal parts of an automobile
- To learn fuel supply system, cooling and lubrication system in IC engine
- To know the injection system and its advancements
- The working of transmission and brake systems
- To know the automobile emissions and its effects on environment

## Module-1


## Module-2


**COOLING AND LUBRICATION**: Cooling requirements, Types of cooling- Thermo siphon system, Forced circulation water cooling system, Water pump, Radiator, Significance of lubrication, Splash and Forced feed system.

## Module-3

**IGNITION SYSTEM**: Battery Ignition system, Magneto Ignition system, electronic Ignition system. Battery, purpose, Working principle of Lead acid battery, Methods of battery charging, determination of polarity of leads, dry charged battery, battery maintenance. Principle and operation of dynamo.

**SUPERCHARGERS AND TURBOCHARGERS**: Naturally aspirated engines, Forced Induction, Types of superchargers, Turbocharger construction and operation, Intercooler, Turbocharger lag.

## Module-4

**TRANSMISSION SYSTEMS**: Clutch-Purpose and function, Single plate clutch, multiplate clutch gear boxes - manual and automatic, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

**BRAKES**: Purpose and function, Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system.

## Module-5

**AUTOMOTIVE EMISSION CONTROL SYSTEMS**: Different air pollutants, formation of photochemical smog and causes. Automotive emission controls, Controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air aspirator system, Catalytic converter.

**EMISSION STANDARDS**: Euro I, II, III and IV norms, Bharat Stage II, III, IV norms. Motor Vehicle Act

## Course Outcomes:
- To identify the different parts of an automobile and it’s working
- To understand the working of transmission and braking systems
- To comprehend the working of steering and suspension systems
- To learn various types of fuels and injection systems
- To know the cause of automobile emissions, its effects on environment and methods to reduce the emissions.

## Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fluid Power with applications</td>
<td>Anthony Esposito</td>
<td>Pearson edition</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>Oil Hydraulics</td>
<td>Majumdar S.R.</td>
<td>Tata Mc G Raw Hill</td>
<td>2002</td>
</tr>
<tr>
<td>3</td>
<td>Pneumatic systems - Principles and Maintenance</td>
<td>Majumdar S.R.</td>
<td>Tata Mc G Raw Hill</td>
<td>2005</td>
</tr>
<tr>
<td>5</td>
<td>Hydraulics and pneumatics</td>
<td>Andrew Par,</td>
<td>Jaico Publishing House,</td>
<td>2005</td>
</tr>
<tr>
<td>6</td>
<td>Hydraulic Control Systems</td>
<td>Herbert E. Merritt</td>
<td>John Wiley and Sons, Inc</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Introduction to Fluid power</td>
<td>Thomson</td>
<td>PrentcieHall,</td>
<td>2004</td>
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</table>
Course Code: 18IP753  
CIE Marks: 40  
Teaching Hours/Week (L:T:P): (2:2:0)  
SEE Marks: 60  
Credits: 03  
Exam Hours: 03

Course Learning Objectives:

- Course Learning Objectives Missing

Module-1

INTRODUCTION TO ERP: Introduction, Evolution of ERP, What is ERP, Reasons for the growth of the ERP market, The advantages of ERP, Why do ERP Implementations Fail? Why are ERP packages being used now?  
ENTERPRISE – AN OVERVIEW: Introduction, Integrated Management Information, Business modeling, Integrated Data Model

Module-2


Module-3

KANBAN: JIT and Kanban, Product Data Management, Benefits of PDM, Make-to-order, and Make-to Stock, Assemble to order, Engineer to order, Configure-to order.  
ERP MODULES: Introduction, Finance, Plant Maintenance, Quality Management, Materials Management

Module-4

BENEFITS OF ERP: Introduction, Reduction of Lead time, On-time shipment, Reduction in Cycle Time, Improved Resource Utilisation, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Decision – making capability.  

Module-5

VENDOR, CONSULTANTS AND USERS: Introduction, In-house implementation – Pros and Cons, Vendors, Consultants, End-users.  
ERP- Case studies

Course Outcomes:

1. Make use of Enterprise software, and its role in integrating business functions  
2. Analyze the strategic options for ERP identification and adoption.  
3. Design the ERP implementation strategies.  
4. Create reengineered business processes for successful ERP implementation.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.  
- Each full question will be for 20 marks.  
- There will be two full questions (with a maximum of four sub-questions) from each module.  
- Each full question will have sub-question covering all the topics under a module.  
- The students will have to answer five full questions, selecting one full question from each module.

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<tr>
<th>Sl. No</th>
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<th>Name of the Publisher</th>
<th>Edition and Year</th>
</tr>
</thead>
</table>

Reference Books
<p>| 3 | Manufacturing Planning &amp; Controls | Thomas Volloman, et.al. |</p>
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Exercises</th>
</tr>
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<tbody>
<tr>
<td><strong>PART-A</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Regression and Correlation analysis using any of the statistical packages.</td>
</tr>
<tr>
<td>2</td>
<td>Development of simple MIS application programs for use in: (i) Library, (ii) Bank, (iii) Business shop, and (iv) Hospital</td>
</tr>
<tr>
<td><strong>PART-B</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Use of software package to solve Operation Research (LPP) problems.</td>
</tr>
<tr>
<td>2</td>
<td>Plotting Quality Control chart using Software Packages. Plotting appropriate charts and diagrams relevant to various industrial Applications</td>
</tr>
</tbody>
</table>

**Reference Book:** Lab manual prepared by the Department/Institution.

**Suggested Software Packages: For MIS:** Oracle / MS SQL Server (back-end) VB6.0 / Developer2000 (front-end tools)

**Statistical Package** like: SPSS, or Minitab, or SAS, or Systat, or MATLAB, or Statistica, etc.

**OR Packages:** TORA, or LINDO, or KETRON, or ABACUS, etc.

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment each from the questions lot prepared by the examiners from PARTS ‘A’ and ‘B’
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
5. Scheme of Examination: exercises from Parts ‘A’ and ‘B’ = 80 Marks; Viva-voce = 20 Marks.
B. E. INDUSTRIAL AND PRODUCTION ENGINEERING  
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)  
SEMESTER - VII  

CNC AND ROBOTICS LAB  

<table>
<thead>
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<th>Course Code</th>
<th>18IPL77</th>
<th>CIE Marks</th>
<th>40</th>
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<tr>
<td>Teaching Hours/Week (L:T:P)</td>
<td>(0:2:2)</td>
<td>SEE Marks</td>
<td>60</td>
</tr>
<tr>
<td>Credits</td>
<td>02</td>
<td>Exam Hours</td>
<td>03</td>
</tr>
</tbody>
</table>

**Sl. No.** | **Experiments**
--- | ---
**PART - A** |  
1 | Study of functions assigned to Alphabets and Symbols. G and M codes, grouping of codes, Assigned and Unassigned, Model and Non Model codes.  
2 | Writing the program for Contour Milling - 4 exercises  
3 | Writing the program using Canned Cycles, Subroutine Programs for Drilling, Reaming and Thread Cutting - 4 exercises  
4 | Introductive concept of loop in loop program - 2 exercises.

**PART - B** |  
1 | Writing CNC program for Lathe - 2 exercises.  
2 | Exercises on Robots (only demonstration)  
   | Study of a General Configuration of a Robot.  
   | b. Study of Programming methods  
   | c. Study of Overview of Robot languages.

**Conduct of Practical Examination:**
1. All laboratory experiments are to be included for practical examination.  
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.  
3. Students can pick one experiment from the questions lot prepared by the examiners.  
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.  
5. Scheme of Examination: exercises from Parts ‘A’ and ‘B’ = 80 Marks; Viva-voce =20 Marks
Project Work Phase - I: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course Outcomes: At the end of the course the student will be able to:
- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Project Work Phase - I:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase - I, shall be based on the evaluation of project work phase - I Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase - I, shall be based on the evaluation of project work phase - I Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
Course Learning Objectives:  

Module-1  


Module-2  

PLANNING AND MANAGING INVENTORIES IN A SUPPLY CHAIN: Review of inventory concepts., Concepts of Safety Inventory, Concept of Aggregation of Inventory, Concept of product availability.

Module-3  

Module-4  

Module-5  
EMERGING CONCEPTS: Reverse Logistics, Reasons, Activities, Role. RFID Systems; Components, applications, implementation. Lean supply chains, Implementation of Six Sigma in Supply Chains.

Course Outcomes: At the end of the course the student will be able to:
- Recall the elements involved in strategic frame work and analysis of supply chains.
- Demonstrate the elements involved in the design of supply chain networks
- Demonstrate the facilities location for designing the supply chain network
- Evaluate the inventories for supply chains.
- Identify emerging concepts for supply chain networks

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.
<table>
<thead>
<tr>
<th>Textbook/s</th>
<th>Author(s)</th>
<th>Publisher</th>
<th>ISBN</th>
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<tbody>
<tr>
<td>2 Supply Chain and Logistics Management</td>
<td>Upendra Kachuru</td>
<td></td>
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<tr>
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<th>Author(s)</th>
<th>Publisher</th>
<th>ISBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Modelling the Supply Chain</td>
<td>Jeremy F Shapiro, Duxbury</td>
<td>Thomson Learning</td>
<td>0-534-37363. -2002</td>
</tr>
</tbody>
</table>
Course Learning Objectives:

- To know the different types of welding and describe welding and cladding of dissimilar metals.
- To distinguish the weldability of metals.
- To identify the welding design principles and compute welding design parameters.
- To illustrate the symbols used in welding practice and identify the adhesive bonding applications.
- To Identify and use the welding inspection techniques and standards.

Module-1


Welding and Cladding of Dissimilar Materials: Overlaying and surfacing, different methods and applications, thermal-Spray coating or metalizing.

Module-2

Weldability of Metals: like stainless steel, Cast iron, Copper, and Aluminium. Advanced soldering and brazing processes-different types. Welding of plastics- different methods.

Module-3

Welding Design: Basic principles of sound welding design, welding joint design, welding positions, Allowable strength of welds under steady loads, allowable fatigue strength of welds, Design of welds subjected to combined stresses, Numerical examples.

Module-4

Welding Symbols: Need for representing the welds, Basic weld symbols, location of weld, supplementary symbols, dimensions of weld, examples.

Adhesive Bonding: Adhesive materials and properties, non-structural and special adhesives, surface preparation and joint design considerations.

Module-5

Inspection of Welds: ASTM standards for testing weldments, Destructive techniques like Tensile, Bend, Nick break, Impact and Hardness. Non Destructive techniques like ‘X’ rays, Ultrasonic, Magnetic particle, Dye penetrant.

Course Outcomes: At the end of the course the student will be able to:

- Explain the importance of grain size control, methods to avoid distortion and residual stresses; also know the techniques of surfacing and cladding of surfaces.
- Interpret and understand the advantages and limitations of different advanced welding process knowing fully the characteristic features, this
- Identify research topics in the area of welding and related processes.
- Explain the weld ability of engineering materials including plastics and the advanced soldering and brazing processes.
- Design welds subjected to for various loading conditions.
- Explain the symbols used to represent the welds: also be able to explain the methods of adhesive bonding of materials
- Inspect the welds in accordance with ASTM standards employing both destructive and non-destructive methods.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

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<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<tbody>
<tr>
<td>1</td>
<td>Welding Technology</td>
<td>O.P. Khanna</td>
<td>Dhanpat Rai Publication</td>
<td>2008</td>
</tr>
<tr>
<td>2</td>
<td>Welding and welding Technology</td>
<td>Richard Little</td>
<td>Tata McGraw hill</td>
<td>2005</td>
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Reference Books
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<tbody>
<tr>
<td>3</td>
<td>Welding Engineering Handbook</td>
<td>A.W.S.</td>
<td>Ninth Edition</td>
</tr>
<tr>
<td>4</td>
<td>Advanced Welding processes</td>
<td>G. Nikolaev and N. Olshansky</td>
<td>MIR Publications</td>
</tr>
<tr>
<td>5</td>
<td>ASM handbook on welding, brazing and soldering</td>
<td></td>
<td>Vol 6, 2005.</td>
</tr>
</tbody>
</table>
Course Code: 18IP822

Course Learning Objectives:
- To know the importance of location, layouts and material handling
- To know and distinguish between different approaches to layout and draw activity relationship chart
- To compute space requirement and demonstrate skills in area allocation and construct the layout.
- To examine the quantitative approaches to facility planning and identify the different models.
- To know the different computerized techniques and model appropriate design.

Module-1
Plant Location: Factors influencing plant location, theories of plant location, plant layout objectives of plant layout, principles of plant layout, types of plant layout, their merits and demerits, facilities design function: objectives. Simple exercises on layouts.

Introduction to Material Handling: Objectives and principles of material handling, unit load concept, Basic handling equipment types, Common material handling equipments

Module-2
Plant Design: Layout procedure, study of some approaches (Immer, Nadler, Muther, Apple James and Reed’s approach), systematic layout planning, the activity relationship chart, Constructing the activity relationship chart, Activity relationship diagram.

Module-3
Space Determination and Area Allocation: Factors for consideration in space planning, receiving, storage, production, shipping, tool room and tool crib, other auxiliary service actions, establishing total space requirement, area allocation factors to be considered, expansion, flexibility, aisles column, area allocation procedure, the plot plan.

Construction of the Layout: Methods of constructing the layout, evaluation of layout, efficiency indices, presenting layout to management.

Module-4
Quantitative approaches to facilities planning: Deterministic models, single and multi facility models, Conventional layout model: Block stacking, location allocation models, Layout Models: Warehouse layout models, waiting line models, Storage models.

Module-5
Computerized Layout Planning: Computerized relative allocation of facility techniques (CRAFT), Plant layout Evaluation Techniques (PLANET), Computerized Relationship Layout Planning (CORELAP), Comparison of computerized layout techniques.

Course Outcomes: At the end of the course the student will be able to:
- Identify the planning strategies for implementation, evaluation and maintaining the facility.
- Arrive at suitable layout for given situations having understand different approaches.
- Demonstrate the Space determination and area allocation procedure, construction of the layout.
- Analyze the quantitative methods and models to determine for the plant location. Explain the warehouse and waiting line models.
- Demonstrates the ideas on various types of layout and evaluation techniques using computers.

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No. | Title of the Book                     | Name of the Author/s | Name of the Publisher | Edition and Year
---|--------------------------------------|----------------------|-----------------------|-----------------------
1   | Plant layout and material handling   | James M. Apple       | John, Wiley and sons  | 3rd edition, 1991    |
3   | Practical layout                     | Muther Richard       | McGraw Hill           | 1956                 |
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Author(s)</th>
<th>Publisher</th>
<th>Edition/ISBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Plant layout design</td>
<td>James M. Moore, Mac Millon</td>
<td></td>
<td>1962</td>
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<tr>
<td>6</td>
<td>Facilities planning</td>
<td>Tompkins white</td>
<td>wiley India Pvt ltd</td>
<td>3rd edition.</td>
</tr>
<tr>
<td>7</td>
<td>Facility Layout and Location</td>
<td>Richard L Francis</td>
<td>PHI learning Pvt. Ltd</td>
<td>2nd Edition</td>
</tr>
</tbody>
</table>
Course Code: 18IP823
CIE Marks: 40
Teaching Hours/Week (L:T:P): (2:2:0)
SEE Marks: 60
Credits: 3
Exam Hours: 03

Course Learning Objectives:
- To understand the concepts of automation in manufacturing systems
- To impart the knowledge of line balancing and assembly systems
- To explore the idea of robotics and understand the computerized manufacturing planning
- To gain the knowledge of automated inspection and shop floor control
- To understand the concepts of additive manufacturing and latest trends in manufacturing

Module-1
Introduction: Production system facilities, Manufacturing support systems, Automation in production systems, Automation principles & strategies
Manufacturing Operations: Manufacturing operations, Product/production relationship, Production concepts and Mathematical models & costs of manufacturing operations. Problems on mathematical models

Module-2
Line Balancing: Methods of line balancing, Numerical problems on largest candidate rule, Kilbridge’s and Wester’s method, and ranked positional weights method, computerized line balancing methods.
Automated Assembly System: Design for automated assembly, types of automated assembly system, Parts feeding devices, Analysis of single and multi station assembly machines.

Module-3
Industrial Robotics: Definition, Robot anatomy, Joints and links, Robot configurations, Robot control systems, Accuracy and repeatability, End effectors, Sensors in robotics. Industrial robot applications: Material handling, Processing, assembly and inspection.

Module-4
Inspection Technologies: Automated inspection, coordinate measuring machines construction, Operation & programming, Software, application & benefits, Flexible inspection system, Inspection probes on machine tools, Machine vision, Optical inspection techniques & Non-contact Non-optical inspection technologies.
Shop Floor Control and Automatic Identification Techniques: Shop floor control, Factory data collection system, Automatic identification methods, Bar code technology, Automatic data collection systems. An Introduction to QR Code Technology

Module-5
Additive Manufacturing Systems: Basic principles of additive manufacturing, Slicing CAD models for AM, Advantages and limitations of AM technologies, Recent trends in manufacturing, Hybrid manufacturing.

Course Outcomes: At the end of the course the student will be able to:
- Explain the basics of production, automation system and manufacturing operations. Solve the simple problems on mathematical model.
- Analyze and solve problems on line balancing
- Explain CAPP and MRP system and analyze the AGVS
- Understand the inspection technologies and shop floor control
- Explain the modern trends in additive manufacturing and automated factory

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year
--- | --- | --- | --- | ---
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<tr>
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<th>Title</th>
<th>Author(s)</th>
<th>Publisher</th>
<th>Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing.</td>
<td>Ian Gibson, David W. Rosen, Brent Stucker</td>
<td></td>
<td>2nd Ed. (2015),</td>
</tr>
<tr>
<td>4</td>
<td>Understanding Additive</td>
<td>Andreas Gebhardt</td>
<td>Hanser Publishers</td>
<td>2011</td>
</tr>
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</table>
Course Code: 18IPP83  
CIE Marks: 40  
SEE Marks: 60  
Credits: 8  
Exam Hours/Batch: 3

Course Learning Objectives:
- To support independent learning and innovative attitude
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course Outcomes: At the end of the course the student will be able to:
- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Project Work Phase - 2:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

Semester End Examination
SEE marks for the project (60 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) as per the University norms by the examiners appointed VTU.
**Course Code**: 18IPS84  
**CIE Marks**: 100  
**Contact Hours/Week**: 02  
**Credits**: 01  
** Exam Hours**: --

### Course Learning Objectives:
The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the Course of Specialization.

- Carryout literature survey, organize the seminar content in a systematic manner.
- Prepare the report with own sentences, avoiding cut and paste act.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the

### Course Outcomes:
At the end of the course the student will be able to:

- Attain, use and develop knowledge in the field of engineering and other disciplines through independent learning and collaborative study.
- Identify, understand and discuss current, real-time issues.
- Improve oral and written communication skills.
- Explore an appreciation of the self in relation to its larger diverse social and academic contexts.
- Apply principles of ethics and respect in interaction with others.

### Evaluation Procedure:
The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior most acting as the Chairman.

**Marks distribution for CIE of the course:**