DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE and DETAILED SYLLABUS

For

M.TECH

SPECIALIZATION

IN

PRODUCTION ENGINEERING

(Effective from 2016-17)

VEER SURENDRA SAI UNIVESITY OF TECHNOLOGY

BURLA, SAMBALPUR

PIN-768018

VEER SURENDRA SAI UNIVESITY OF TECHNOLOGY,BURLA

COURSE STRUCTURE FOR 2-YEARS M.Tech.DEGREE COURSE in

MECHANICAL ENGINEERING ON PRODUCTION ENGINEERING SPECIALISATION

TO BE EFFECTIVE FROM (2016-17)

PRODUCTION ENGINEERING

Code	1st Year (First Semester)	L-T-P	CR	1st Year (Second Semester)	L-T-P	CR
MME2111	Theory of Plasticity and Metal Forming Process	4-0-0	4	Industrial Engineering	4-0-0	4
MME2112	Advanced casting & Welding	4-0-0	4	Non-Traditional Manufacturing Process	4-0-0	4
MME2113	Theory of Machining and Grinding	4-0-0	4	Computer Aided Design and Manufacturing	4-0-0	4
	Elective-I	4-0-0	4	Elective-III	4-0-0	4
	Elective-II	4-0-0	4	Elective-IV	4-0-0	4
Sessional				Sessional		
MME2181	Manufacturing Engg. Lab.-I	0-0-3	2	Manufacturing Engg. Lab.III	0-0-3	2
MME2182	Manufacturing Engg. Lab.-II	0-0-3	2	Manufacturing Engg. Lab.IV	0-0-3	2
MME2183	Seminar – I	0-0-3	2	Seminar – II	0-0-3	2
MME2184	Comprehensive Viva-Voce - I		2	Comprehensive Viva-Voce – II		2
	Total	**20-0-9**	**28**	**Total**	**20-0-9**	**28**

2nd Year (3rd Semester)		2nd Year (4thSemester)	
Dissertation Interim Evaluation	10	Dissertation Open Defence	5
Comprehensive Viva-Voce	3	Dissertation Evaluation	20
Seminar on Dissertation(100)	2		
Total	**15**	**Total**	**25**

Elective Subjects

Elective-I and Elective-II	Elective-III and Elective-IV
1. Robotics and Felxible Manufacturing 2. Machine Tool Technology 3. Inspection and Quality Assurance 4. Mathematical Methods in Manufacturing	1. Tools and Dies Design 2. Finite Element Method 3. Operation Management 4. Inventory System 5. Human Resource Management

1. **Theory of Plasticity and Metal Forming Process(MME-1111)**:

Course Objectives:

- To study various metal forming processes
- Plastic deformation during forming processes
- Different laws and equations developed for solving metal forming problems

Course Contents:

Module-I

Fundamentals plasticity: True stress-strain curve. Bauschinger effect. Empirical equations to stress-strain curves. Three-dimensional stress and strain invariants and strain. [10]

Module-II

Yield criteria of materials: Tresca and Von-Mises theory, Prandtl Reuss and Levy Mises stress strain relations, work hardening. [8]

Module-III

Equillibrium approach: Concepts of friction in metal forming, Coulumb friction and constant shear friction factor (m). Application of stress equilibrium approach to extrusion, drawing, rolling and forging.[10]

Module-IV

Slip line field theory: Applications to frictionless punch and wedge indentation. Simple solution for frictionless extrusion, drawing. Upper and lower bound theorems: Application to plane strain problems, Simple indentation and extrusion using hodographs. [12]

Text Book(s):

1. Engineering Plasticity – W. Johnson (Von Nostrand)

2. Mechanical Metallurgy – Dieter (Mc Graw Hill)

Reference Book(s)

1. An Introduction to Principles of Metal Working – G.W.Rowe

2. Metal Forming: Processes and Analysis – Avitzur (TMH)

Course Outcomes:

- Recognize the various metal forming techniques
- Apply the theory of plasticity and its application for analyzing various metal formingProcesses
- Describe the advancement in forming technologies

2. **Advanced Casting and Welding (MME-1112)**:

Course Objectives:

- Study of various metal casting and joining processes
- Contr ol of parameters for sound casting and welding
- Ther mal and fluid transfer mechanism during these processes
- Metal lurgical effects of casting and joining

Course Contents:

Module-I

Gating system for casting, Elements of a gating system, Sprue, Sprue base well, Gates, Gating System Design, Pouring time, Choke area, Gating Ratios, Ingate design, Slag Trap Systems, Risering Design, Caine's Method, Modulus Method, Naval Research Lab Method, Chills, Feeding aids [10]

Module-II

Solidification of Metals, Freezing of a pure Metal, Nucleation and Growth, Shrinkage, freezing of alloys, Thermal characteristics of the mould, casting defects, gas defects, pouring metal defects, Metallurgical defects [10]

Module-III

Basic Metallurgy of fusion welds, general theory of solidification of metals and alloys, homogeneous and heterogeneous nucleation, Effect of welding speed on grain structure, properties of weld metals, fusion boundary zone, heat affected zone, properties of heat affected zone, Welding stress and distortion, residual stress, causes of residual stress, effect of weld thermal cycle and shrinkage on residual stresses, Reaction stresses, stresses generated by phase transformation, Measurement and calculation of residual stresses in weld metals. [10]

Module-IV

Pre-heat and post weld heat treatment, Methods of Pre-heating, Advantages and limitations of pre-heating, weld defects, classification, arc welding defects and other than arc welding defects, Weld inspection, residual inspection, NDT testing. [10]

Text Books:

1. Manufacturing Technology, Vol.1 P.N.Rao, TATA Mc Graw Hill
2. Welding Engineering and Technology by R.S.Parmar, Khanna Publication

Course Outcomes:

- Discriminate the knowledge of principles, operations and applications of different casting and welding processes.
- Analyze the effects of process parameters on the quality of cast and weld products.
- Select the NDT techniques for the evaluation of cast and weld components.
- Apply the knowledge of welding in Heavy Engineering and nuclear industries.

3. **Theory of Machining and Grinding (MME-1113)**:

Course Objectives:

- Study of various machining processes
- Material removal methods, input parameters during machining
- Theoretical derivation of equations for temperature, strain, force
- Tool wear mechanism, Automation during machining

Course Contents:

Module - I

Basic shapes of machining tools, Wedge action, function of different angles of cutting tools, tool geometry and Nomenclatures-ASA, ORS, NRS systems. Conversion of angles, Geometry of twist dill & slab milling cutter, Mechanism of chip formation, mode of failure under stress, fracture & yielding mechanism, types of chips, factors involved in chip formation, shear plane, effect of cutting variables on chip reduction coefficient, chip formation in drilling and milling [14]

Module – II

Force system in turning, Merchant circle diagram, velocity relationship and Kronenberg relationship. Stress in conventional shear plane. Energy of cutting process, restricted cutting, Force analysis during

oblique cutting. Earnest & Merchant angle relationship, Lee-shafer relationship, Forces in drilling & plane slab milling, Measurement of forces-dynamometer for measuring turning & drilling forces [8]

Module – III

Thermodynamics of chip formation-The shear plane temperature-Interface temperature from dimensional analysis-Experimental determination of chip tool Interface temperature. Coolants-Theory of cutting fluid action at the chip tool interface, Techniques for application of cutting fluids, Tool Wear: Criteria of wear, Machinability and tool life, Flank wear-Taylor's tool life equation, crater wear, causes & mechanism of tool failure [10]

Module - **IV**

Types of Grinding, Shapes and Size of a Grinding Wheel, Various Elements of a Grinding Wheel, Parameters of Grinding Operation, Grinding Fluids, Defects and Remedies in Grinding, Balancing of Grinding Wheel, Grinding of single point cutting tool, Tool materials, Vibration & chater in machining. Economics of metal machining. On-line control in metal machining [8]

Text Books:

1. Metal Cutting Theory and Practice, A. Bhattachary, New Central Book Agency (P) Ltd.
2. Machining and Machine Tools, A. B. Chattopadhyay, Wiley-India Publication.
3. Metal Cutting Principles, M. C. Shaw, Oxford University Press.

Course Outcome:

- Select suitable machining process for suitable materials
- Select optimum parameters for the respective machining process
- Summarizes the merits advantages of high speedmachining process

4. **Robotics and Flexible Manufacturing(Elective) (MME-1114)**:

Course Objectives:

- Automation for industries by various techniques
- Robot design with controlling parts
- Batch production techniques
- Recent development occurred for FMS

Course Contents:

Module-I

Robotics: Historical background, Definitions, Laws of Robotics, Robotic system and robot anatomy, common robot configurations. Coordinate system, work envelop, Elements of robotic system – end effector, actuators, controller, teach pendant, sensors, Specification of robots. Applications, safety measures. [12]

Module-II

Robot Kinematics: Forward and reverse Kinematics of 3-DOF and 4-DOF Robot arms. Homogeneous Transformations, Kinematic Equations using homogeneous transformations. [8]

Module-III

Actuators: Hydraulic actuators, Pneumatic actuators, Electrical actuators. Directional control, servo control, Flow control valves. End effectors: Classification, Drive systems, Magnetic, Mechanical, Vacuum and Adhesive grippers, Force analysis in a gripper. [10]

Module-IV

Sensors: Need for sensing systems, sensory devices, Types of sensors, robot vision system. Robot Languages and Programming: Types of programming, Motion programming, Robot language – VAL systems. Flexible Automation: Technology, FMS, Function of Robot in FMS, Flexible manufacturing cell. [10]

Text Book(s):

1. Robotics Technology and Flexible Automation: S. R. Deb.Tata Mc Graw Hill.

Reference Book(s)

1. Robotics: Lee, Fu, Gonzalez, Mc Graw Hill
2. Industrial Robots: Groover, Mc Graw Hill

Course Outcome:

- Identify the components of a robot
- Program robots for different applications
- Introduce robots in various in various manufacturing techniques
- Define the flexibilities in FMS
- Apply the components of FMS and their integration
- Analyze the issues related to planning for successful implementation of FMS

5. **Machine Tool Technology(Elective) (MME-1115)**:

Course Objectives:

- Study of various machine internal parts
- Dynamics of machining by varying parameters
- Automation of machine parts

Course Contents:

Module-I:

General classification of machine tools, working and auxiliary motions, Hydraulics transmission and its elements, Mechanical transmission and its elements, General requirement of machine tools. [6]

Module-II:

Kinematics of Machine Tools – Stepped and step less drive, Basic considerations in the design of drives, Variable speed range in machine tools, Graphical representation of speed, structure diagram, selection of optimum ray diagram, Design of speed and feed gear boxes, step-less regulation of speed and feed rates. [8]

Module-III:

Machine tool Structures: Design criteria, materials, static and dynamic stiffness, Basic dynamic stiffness, Basic design procedure, design of beds and columns, Model technique in design of machine tool structures. [6]

Module-IV:
Guideways and Power Screws: Classification of guidways, material and Lubrication, design criteria and calculations for guideways, designs of guids under hydrostatic lubrication, Aerostatic slideways, Antifriction guidways, Combination guidways, classification of power screws, Design principles of power screws, Recirculating power screws assemblies, Elimination of backlash. [8]

Module-V:
Machine Tool spindles and its Bearings: Materials of spindles, Effect of machine tool compliance on machining accuracy, Design principles of spindles, Antifriction and sliding bearings. [4]

Module-VI:
Controlling systems in Machine Tools – Classification, Control systems for changing speeds and feeds, Ergonomic considerations applied to design of control members, principles of automatic and adaptive control. [4]

Module-VII:
Vibration in Machine Tools – Forced Vibration, self-excited vibration, stick-slip vibration and its minimization, vibration isolation. [4]

Text Books:

1. Machine Tools Design, N. K. Meheta, TMH.
2. Design of Machine Tools, S. K. Basu, D. K. Pal, OIBH.
3. Principles of Machine Tools, G. C. Sen, Bhattacharya, New Central Book Agency.
4. Metal Cutting Theory and Practice, A. Bhattachary, New Central Book Agency (P) Ltd.
5. Machining and Machine Tools, A. B. Chattopadhyay, Wiley-India Publication.

Course Outcome:
- Identify various parts of machine tools
- Apply various design aspects of spindles and bearings
- Reduce vibration and chatter developing on machine tools

6. **Inspection and Quality Assurance(Elective) (MME-1116)**:

Course Objectives:

- Various types of Inspection methods in industries
- Selection of quality inspection team
- Reliability factor for each component

Course Contents:

Module-I

Inspection: Need for inspection, Precision & Accuracy, Interchangeability, selective assembly, Taylor's Principle of limit gauge design. Use of slip gauge, Use of sine bar, Measurement of surface roughness by Talysurf, Inspection of V-thread by Tool Makers Microscope. Inspection of gear, 2-wire and 3-wire method of measurement, Gear tooth calliper. [8]

Module-II

Reliability: Failure data analysis, hazard models, constant hazard, linearly increasing hazard, system reliability. [10]

Module-III

Quality Assurance – Statistical quality control, frequency distribution, control chart, process control chart for attributes & variables, Acceptance sampling, OC curve, sampling plan, AOQL, AQL, Selection of sampling plan. [12]

Module-IV

Quality circle, Total quality control, Japanese method of quality control, Taguchi method, Kaizen system, Quality system, ISO 9000, Quality documentation, Quality audit. [10]

Text Book(s):

1. Engg. Metrology – R. K. Jain, Khanna Publish
2. Reliability Engg. – L. S. Srinath, East West Press.

Reference Books:

1. Statistical Quality Control – E. C. Grant, Leavenworth Mc.Graw Hill Books Co.
2. Quality Assurance through ISO 9000 – H.D.Gupta, South Asia Pub.
3. Quality Circle in India- S.R.Udpa, TMH

Course Outcome:

- Quality project management
- Customer satisfaction
- Benchmarking

7. **Mathematical Methods in Manufacturing(Elective) (MME-1110)**:

Course Objectives:

- Use of mathematical equations for graphical analysis
- Design of compactable analysis for various manufacturing methods
- Optimization of manufacturing methods by various techniques

Course Contents:

Module-I

Frequency distributions, Central tendency, AM, GM, Weighted mean, mode median, Dispersion, Coefficient of variation, Probability distribution, Bionominal, Poission, Normal distribution. Sampling distribution, types: Random sampling, sample size & standard error, point estimate, interval estimate, Hypothesis testing. Hypothesis Testing of mean with different conditions. Differences in mean, Chi squares as test of independence, as test of goodness fit. [10]

Module-II

Experiments with single factor, Analysis of variance, Fixed effect model Estimation of model parameters, Comparison of individual treatment means, Orthogonal contrasts, Scheffes method of comparing contrasts, Comparing pairs of treatment means, Model adequacy checking, plot of residuals, choice of sample size, OC curves, Method of CI estimation, Fitting response curves, Regression Approach Orthogonal Polynomials. [10]

Module-III

Factorial Designs, Two factor factorial design, statistical analysis of fixed effect model, Estimation, choice of sample size, Random & Mixed model, Fitting response curves and surfaces, General Factorial design. 2k Factorial Design, Single replicate, Addition of center points to the 2^k design Yates Algorithm for 2^k design, 3^k design, Yates of Algorithm for 3^k design. [10]

Module-IV

Response surface methods & designs, Methods of steepest Ascent, Analysis of 2^{nd} order model, Fitting response surface, Evolutionary operation. Taguchi contribution to experimental Design: Quantity engg., Philosophy, Taguchi approach to parameter design. [10]

Text Book(s)

1. Statistics for Management – Richard I. Leviz, PHI

2. Design and Analysis of Experiments – D.C.Montogomery, John Wiley & Sons.

Course Outcome:

- Arrange the application of numerical method for non-linear problems
- Apply numerical methods for manufacturing processes
- Evaluate the numerical results of manufacturing processes

8. **Industrial Engineering (MME-1211)**:

Course Objectives:

- Methods of optimization processes
- Planning, Scheduling, Forecasting methods for industries
- Study of production planning and control by using charts

Course Contents:

Module - I

Linear Programming: Graphical Method, Primal and Dual problem, simplex method, Transportation and assignment problems, Queuing theory-poission's and exponential service time, single server and multi server models [12]

Module – II

Network analysis including PERT & CPM. Productivity: Importance, Productivity ratio, Productivity measurement, Productivity index [6]

Module - III

Forecasting: Methods – moving average, exponential smoothing, Regression analysis, coefficient of co-relation, Delphi, Market survey, Facilities Planning: Site location, facilities layout, work place design, working conditions – noise illumination etc [12]

Module - IV

Motion study – Principles of Motion – economy, Time Study – standard time, Production Planning & Control: Aggregate Planning, Sequencing, Line balancing, Flow control, Dispatching, expendiating Gantt chart. Line of balance, Learning curve. [10]

Text Book(s):

1. Introduction of Operations Research – Hillier & Liberman Holden.

2. Production Systems: Planning & Control: J. L. Giggs, John Wiley & Sons

3. Motion & Time Study: R. M. Barnes, John Wiley & Sons.

Course Outcome:

- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realisticconstraints such as economic, environmental, social, political, ethical, health and safety,manufacturability, and sustainability
- An ability to identify, formulate and solve engineering problems.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- A recognition of the need for, and an ability to engage in life-long learning
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

9. **Non-Traditional Manufacturing Process (MME-1212)**:

Course Objectives:

- Study of various non-traditional machining processes
- Application of these machining methods in various fields
- Use of advance coating technology in various fields

Course Contents:

Module I:

Need for Non-traditional Machining: Classification, process selection-Ultrasonic machining principle, Transducer, Magnetostrictive material, Analysis for Material Removal Rate by Shaw, Effect of process parameters, Application. [8]

Module II:

Abrasive Jet Machining: Principle, Application, Advantages and disadvantages Variables in AJM. Water Jet Machining: Jet Cutting equipment, Principle, advantages, Practical Applications. [6]

Module III:

Electrochemical Machining: Principle. Faraday's Law, Determination Material Removal Rate, evaluation of metal removal rate, Dynamics of ECM process, Tool design, Advantages, Application, Limitation, Electro-chemical grinding, Deburring and Honing. [5]

Module IV:

Electro Discharge Machining: mechanism of material removal, Basic EDM circuitry and principles of operation, Analysis of relaxation circuits, Concepts of critical resistance, Machining accuracy and surface finish. Tool Material, Di-electric fluid, Applications and limitations. [6]

Module V:

Laser Beam Machining: Lasing process and principle, population inversion, Principle of Ruby laser, Nd: YAG Laser and CO_2 Laser, Power control of laser output. Application. Electron Beam Machining: Basic principle, Controlling parameters and focal distance. Application Ion Beam Machining: Principle and Mechanism, Application, Plasma Arc Machining: Generation of Plasma, Equipments, Torch, Classification, Direct and indirect torches and applications, parameters effecting cutting, Advantages. [10]

Module VI:

Principle of Coating Technology: Mechanism, Chemical and Physical vapour deposition, Application, Electroforming, Metal Spraying, Metallic coating, Plasma flame spraying. [5]

Text Books:

1. Non-Conventional Machining, P. K. Mishra, Narosa Publication
2. Manufacturing Science, A. Ghosh, A. K. Mallick, East West Publication
3. Modern Machines Process, P. C. Pandey, H. S. Shan, Tata McGraw Hill

Reference Books:

1. Manufacturing Processes and Systems, P. F. Ostwald, J. Munoz, John Wiley Sons.
2. Materials and Processes in Manufacturing, E. P. DeGarmo, J. T. Black, R. A. Kohser, B. E. Klamecki, Wiley Publication
3. Advanced Machining Processes, H El-Hofy, McGraw Hill Publication
4. Introduction to Manufacturing Processes, J. Schey, McGraw-Hill
5. Micromachining Using Electrochemical Discharge Phenomenon, R. Wuthrich, William Andrew

Course Outcome:

- Select suitable machining process for suitable materials
- Select optimum parameters for the respective machining process
- Summarizes the merits and demerits of the non-traditional manufacturing process

10. **Computer Aided Design and Manufacturing (MME-1213)**:

Course Objectives:

- Developments of software computer interface in design of various elements
- Use of software for manufacturing
- Automation of manufacturing methods

Course Contents:

Module - I

Fundamentals of CAD: The design process, applications of computer for design, creating the Manufacturing, Database, The design workstation, Graphical Terminal, Operator input Devices, Plotters and other devices, the CPU secondary storage [8]

Module - II

Computer graphics Software and Database: Configuration, Graphics Packages, Constructing the Geometry, transformations, Database structure and content, wire frame versus solid modeling [8]

Module - III

CAM – Introduction, Numerical Control and NC Part Programming: NC Coordinate system, NC motion control system, Economics of NC, Manual and Computer Aid Programming, the APT language, NC programming with interactive graphics [12]

Module - IV

Problems with conventional NC, NC technology: CNC, DNC combined DNC/CNC system, Adopter control manufacturing systems, Computer Integrated manufacturing system, Machine Tools and related Equipment, Materials Handling and Storage system, computer system [12]

Text Book(s):

1. Computer Aided design and Manufacture, Grover M.P.Simmers, E.W. Prentice Hall

2. CAD/CAM/CIM P.Radhakrishnan & Subramanyam, Willey Eastern Limited.

3. Automation, Production System and CIM, Goover, Prentice hall

Course Outcomes:
- Define the principles of optimum design
- Apply surface modelling techniques
- Analyze production systems at operation level

11. **Tools and Dies Design(Elective) (MME-1214)**:

Course Objectives:

- Types of tools for heavy machining processes
- Design elements in sheet metal operation
- Use of jigs and fixtures for automation in industries

Course Contents:

Module-I

System approach to production design, Elements of a product manufacturing facility, materials selection, interchangeability & standardization, use of new technology, value engineering and analysis, cost analysis. [5]

Module-II

Design of single-point cutting tools, Tool strength and rigidity calculation, selection of tool angles, chip breakers, carbide, tipped tools, High production cutting tools. Form Tools: Types of form tools, method of determining the profile of circular and flat form of tool, analytical and graphical method. Cutting process in broaching, geometric elements of broach teeth, Design of Internal & external surface broach, calculation of no. of teeth, Rigidity, cutting force, power. [12]

Module-III

Forging Design-Allowances, Forging process, Forging die design, Drop forging Dies and auxiliary tools, Upset forging.

Design for sheet metal works: Press working-shearing action, center of pressure, clearance, cutting force, Die block design, punch design, punch support, stop, pilot, stripper, knockout, blanking & piercing die design, progressive & compound die design, Drawing dies, metal flow, Blank diameter, Drawing force. [13]

Module-IV

Jigs & Fixture design: Locating & clamping, principles of location, clamping, devices, materials for locating & clamping elements, Design principles, Design of Drilling Jig & Milling fixtures. [10]

Text Book(s):

1. Fundamentals of Tool Design: ASTME, PHI

2. Metal Cutting Theory & Cutting Tool Design: Arshinov, MIR Pub.

3. A Text Book of Production Engg.: P.C.Sharma, S.Chand & Co

4. Tool Design: Donaldson, Le Cain, Goold, TMH

5. Fundamentals of Tool Engg. Design: Basu, Mukherjee, Mishra, Oxford & IBH.

Course Outcomes:

- Design of new concepts of manufacturing methods
- Use of various forming methods for making heavy duty products
- Automation of various elements for industries applications
- Methods designed for mass production

12. **Finite Element Method (Elective)(MME-1215)**:

Course Objectives:

- Possess a good understanding of the theoretical basis of the weighted residual Finite Element Method.
- Be able to implement the Galerkin residual weak formulation into the Finite Element Method for the solution of Ordinary and Partial Differential Equations, using mathematical software such as Maple.
- Be able to use the commercial Finite Element package ANSYS to build Finite Element models and solve a selected range of engineering problems.
- Be able to validate a Finite Element model using a range of techniques.
- Be able to communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.
- Be able to discuss the accuracy of the Finite Element solutions.

Course Contents:

Module-I

Structural stiffness and network analysis. Assembly and analysis of a structure, Finite elements of an elastic continuum, Displacement approach, Minimisation of total potential energy, convergence criteria. [8]

Module-II

Generalisation of finite element concepts, Modeless variables: Alternative approaches to finite element formulations, Plane stress and plane strain, Element characteristics, Some practical applications. [12]

Module-III

Axisymmetric stress analysis. Element characteristics. Some illustrativeexamples, Plate Bending Formulations of FEM. [8]

Module-IV

Finite element formulation for large deformation: Masticity and Crop etc., Three Dimensional Analysis: Practical Problems, Computer methods and computer programmes, Data input, stiffness generations. Assembly and solution of equations and output of results. [12]

Text Book(s):

The Finite Element Method in Engineering Science: Zienkiwicz. TMH.

Reference Book(s)

Introduction to Finite Element Method: Abel, Desai, EWP.

Course Outcomes:

- Derivation of various formulations.
- Formulate a corresponding FEM approximation.
- Estimatation of the stability of a given linear PDE and it's FEM approximation.
- Derive a priori and a posteriori error estimates in the energy norm, the L2-norm andlinear functionals of the solution.
- State and use the various theorem for a given variational problem

13. **Operation Management (Elective) (MME-1216)**:

Course Objectives:

- The Operations Management degree program prepares students for graduate school programs such as the MBA or the MIM.
- The Operations Management degree program prepares students for supervisory positions in organizations, including for-profit organizations, non-profit organizations, and government organizations.
- The Operations Management degree program develops skills in problem solving, project management, communication, and managing effectively in team-based work environments, and prepares students for employment within a wide variety of service and product industries.

Course Contents:

Module-I

Introduction: Functional subsystem of an Organisation, Definition of Operation Management, System Concept of Production, Types of Production System, Strategic Management- Corporate Strategies, Generic Competitive Strategies, Functional Strategies, Gross Domestic Product (GDP) and its impact, World Class Manufacturing [10]

Module-II

Line Balancing: Concept of mass Production system, objective of Assembly Line balancing, Rank Positional Weight Method, The COMSOAL Algorithm, Model for Assembly Line Balancing- Integer Programming Model to minimize the number of work Station and model to minimize the balancing Delay, Stochastic Assembly, Line Assembly [10]

Module-III

Maintenance, Planning & Control: Objectives of Maintenance, Types of maintenance, basic reasons for replacement, Replacement problems, Determination of maintenance crew size using Analytical Queuing Model, Total Productive Maintenance: Objectives, Waste elimination, Equipment maintenance Technique, Benefits, Pillers of TPM. [10]

Module-IV

Just in Time Manufacturing, Computer Integrated Manufacturing, Total Quality management, ISO 9000 series, Poke a Yoke, Kaizen, Business Process Re-engineering, Supply chain Management, Lean Manufacturing [10]

Text Book(s):

1. Production and Operation Management, E.E. Adam, R.J. EbertPrentice Hall of India, 2004

2. Production and Operation Management,R. Paneerselvam,Prentice Hall of India, 2005

Course Outcomes:

- Explain the major concepts in the functional areas of accounting, marketing, finance, and management.
- Evaluate the legal, social, and economic environments of business.
- Describe the global environment of business.

- Describe and explain the ethical obligations and responsibilities of business.
- Apply decision-support tools to business decision making.
- Construct and present effective oral and written forms of professional communication.
- Apply knowledge of business concepts and functions in an integrated manner.
- Use specialized knowledge in Operations Management to solve business processes.

14. **Inventory System (Elective) (MME-1217)**:

Course Objectives:

- Study of inventory methods
- Study of various techniques for reducing inventory
- Management of inventory methods
- Concepts used in distribution of materials

Course Contents:

Module-I

Material System, Importance of Inventory in production distribution system. Purchasing – Functions, Procedures – Value Analysis in Purchasing – Vendor Selection, Rating and Development – Buying Seasonal Commodities, Purchasing under Uncertainty, Purchasing capital equipments, Public buying.

Stores Management – Location & layout, Stores System, Storing practice, Quality of incoming material, Stores accounting & stock verifications, absolete & surplus, Scrap disposal. [10]

Module-II

Raw Materials Inventory System: Concept, Function, Inventory cost, Inventory models assuming certainty & risk, Quantity discount. Economical order quantity, Economical manufacturing batch size, Safety stock, Joint ordering policy – Probabilistic Inventory system: (Q,r) and (R,S) policies.

Inventory Management: ABC analysis, VED analysis, Perpetual inventory system. Periodic inventory system, Japanese inventory system. [10]

Module-III

Material Requirement Planning: Bill of material, level coding, Master Production scheduling, Gross requirement determination, Net requirements, Lot size determination techniques (Wasner-werifin, Silver-meal heuristic, part-period Balancing), Offsetting Safety stock in MRP.

Manufacturing Resource Planning: MRP under capacity constraints, Capacity requirement planning, Just-in-time concept: Pull & Push system, Essential conditions of JIT application, practical implementation of JIT through Kanban & other systems. [12]

Module-IV

Physical distribution of Materials: Finished product – Classification, Product features, Branch decisions, packaging decisions, Labelling decisions, product line decision, Distribution channel-nature, Function, Channel behaviour, Physical distribution-warehousing. Transportation, Placing-Products-Retailing. Advertising media selection, sales promotion personal selling. [8]

Course Outcomes:

- Cite the types of inventory, and the need for reorder points, safety stock, and economic order quantities.
- Note the manner in which inventory can be incorporated into a company's competitive strategy, and the situations in which certain strategies should be employed.
- Identify the policies that should be used to control inventory, and the situations in which they should be used.
- State the types of forecasting variations that can be used, how forecasts can be incorrect, and what can be done to mitigate these effects.
- State the types of equipment used in putaway and picking transactions, as well as their advantages and disadvantages.
- Identify the components of the major production management systems, as well as the techniques used to improve the flow of inventory through the production process.

15. **Human Resource Management (Elective) (MME-1218)**:

Course Objectives:

- Apply effective written and oral communication skills to business situations.
- Analyze the global business environment.
- Analyze the local business environment.
- Use critical thinking skills in business situations.
- Apply an ethical understanding and perspective to business situations.

Course Contents:

Module-I

Evolution of management thought, Contribution of Taylor, Fayol & Mayo, Organisation as a system, Approaches to management, Functions, managers. Social responsibility of managers, Japanese management & theory-z. Planning: Types of plans, objectives, Strategies, Policies, Procedures, Rules & programmes. Principles of planning. Decisions making-Development of alternatives, Evaluating, Decision tree. [8]

Module-II

Organising: Organisational structure, Division of work, Formal & Informal organization, Span, Departmentation, Line and Staff authority relationship, Functional authority Delegation of authority, Principles of organizing. Staffing: System approach to staffing, Man power planning matching person with the job-selection methods, selection test, interview, Group discussion, Training need, Inputs. Learning & training, training methods, Evaluation of training, Performance appraisal-methods, Management by objective, Internal mobility, Job evaluation, Merit Rating, Incentives system – Profit sharing, Wage Incentive scheme payment of wages Act. Payment of Bonus Act. [12]

Module-III

Leading: Human factor in managing, Behavioral models, Mc Gregor's Theory-X & Theory-Y, Creativity & Innovation, Leadership – Ingredients of leadership, Leadership traits, Behaviour & Style. Controlling: Basic control process – Elements in organizational behaviour, Human Resources approach, system approach, Motivational patterns, Role play, Status, Model of motivation, Maslow's hierarchy of needs, perception, job satisfaction and performance, Quality of work life, job enrichment,

Core dimension of jobs, Discipline Preventive and corrective discipline, Hot-stove rule, Counselling approach to discipline, Stress-causes & counselling. [10]

Module-IV

Employee participation: Pre-requisites, Benefits, Transaction analysis, Group dynamics, Team work, Meetings, Brain storming, Managing change-resistance to change, implementing change successfully, Trade Union-labour legislation. Collective bargaining, Grievance system, Factory Acts, Safety & Employee welfare. Communication: Importance process, Types, 2 way communication, Formal & informal communication, Barriers in communication. [10]

Text Book(s):

1. Essential of Management: Koontz, O' Donnell. Welhrich, Mc Graw Hill International Edition.
2. Human Behaviour at work: Keith Davis, TMH
3. Personnel Management: Monappa,Salyadain, TMH
4. Personnel/Human Resource Management: De Cenzo, Robbins, PHI

Course Outcomes:

- Synthesize information regarding the effectiveness of recruiting methods and the validity of selection procedures, and make appropriate staffing decisions.
- Design a training program using a useful framework for evaluating training needs, designing a training program, and evaluating training results.
- Properly interpret salary survey data and design a pay structure with appropriate pay grades and pay ranges.
- Evaluate a company's implementation of a performance-based pay system.
- Demonstrate knowledge of employee benefit concepts, plan design, administrative considerations and regulations governing employee benefit practices.
- Align HR systems with the strategic business objectives of a firm.